December 19, 2013

Dr. Warren D. Reece, Director
Texas A&M University System
Nuclear Science Center
1095 Nuclear Science Road
MS 3575
College Station, TX 77843-3575

SUBJECT: EXAMINATION REPORT NO. 50-128/OL-14-01, TEXAS A&M UNIVERSITY

Dear Dr. Reece:

During the week of November 18, 2013, 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 Phillip T. Young at (301) 415-4094 or via electronic mail Phillip.Young@nrc.gov.

Sincerely,

/RA/

Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Examination Report No. 50-128/OL-14-01
2. Written examination

cc w/o enclosures: See next page

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SUBJECT: EXAMINATION REPORT NO. 50-128/OL-14-01, TEXAS A&M UNIVERSITY

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ADAMS ACCESSION No.: ML13347B069 **NRR-079**

OFFICE	NRR/DPR/PROB	NRR/DPR/PROB	NRR/DPR/PROB	NRR/DPR/PROB
NAME	PYoung	MMorlang	CRevelle	GBowman
DATE	12/17/2013	12/17/2013	12/18/2013	12/19/2013

OFFICIAL RECORD COPY

cc:

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

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

REPORT NO.: 50-128/OL-14-01

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: TEXAS A&M UNIVERSITY

EXAMINATION DATES: November 18 - 21, 2013

SUBMITTED BY: **/RA/** 12/18/2013
Philip T. Young, Chief Examiner Date

SUMMARY:

During the week of November 18, 2013, the NRC administered the operator licensing examinations to four (4) reactor operator candidates, one (1) senior reactor operator instant candidate, and one (1) senior reactor operator upgrade candidate.

REPORT DETAILS

1. Examiners: Philip T. Young, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	0/4	1/0	1/4
Operating Tests	3/1	2/0	6/1
Overall	0/4	2/0	2/4

3. Exit Meeting: Philip T. Young, Chief Examiner
Jerry Newhouse, Assistant Director, Texas A&M University TRIGA
Greg Stasny, Manager of Reactor Operations, Texas A&M University TRIGA

The examiner thanked the facility for their support during the examination and their comments. The examiner expressed concern over the number of written exam failures.

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

FACILITY: TEXAS A&M UNIVERSITY

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 11/18/2013

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
20.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
60.00		_____	____%	TOTALS
			FINAL GRADE	

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

_____
Candidate's Signature

Enclosure 2

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

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

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

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

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

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

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

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

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

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

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

EQUATION SHEET

$$\dot{Q} = \dot{m}\, c_{\ddot{p}}\, \Delta T = \dot{m}\, \Delta H = UA\, \Delta T$$

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

$$SUR = 26.06\left[\frac{\lambda_{eff}\,\rho}{\beta - \rho}\right] \qquad SCR = \frac{S}{-\rho} \approx \frac{S}{1 - K_{eff}} \qquad CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$

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

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}} \qquad M = \frac{1}{1 - K_{eff}} = \frac{CR_1}{CR_2}$$

$$P = P_0\, 10^{SUR(t)} \qquad P = P_0\, e^{\frac{t}{T}} \qquad P = \frac{\beta(1-\rho)}{\beta - \rho} P_0$$

$$SDM = \frac{(1 - K_{eff})}{K_{eff}} \qquad T = \frac{\ell^*}{\rho - \overline{\beta}} \qquad T = \frac{\ell^*}{\rho} + \left[\frac{\overline{\beta} - \rho}{\lambda_{eff}\,\rho}\right]$$

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1}\, x\, K_{eff_2}} \qquad T_{‰} = \frac{0.693}{\lambda} \qquad \rho = \frac{(K_{eff} - 1)}{K_{eff}}$$

$$DR = DR_0\, e^{-\lambda t} \qquad DR = \frac{6CiE(n)}{R^2} \qquad DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

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 x 10^{10} dis/sec
1 Horsepower = 2.54 x 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 x 10^6 BTU/hr
°F = 9/5 °C + 32
°C = 5/9 (°F - 32)
c_p = 1 cal/sec/gm/°C

Question A.001 [1 point] (1.0)
A reactor is subcritical with a K_{eff} of 0.955. A positive reactivity of $5.00 is inserted into the core (β = 0.007 delta k/k). At this point, the reactor is:

a. supercritical.
b. exactly critical.
c. prompt critical.
d. subcritical.

Answer: A.01 d.
Reference: Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, pg. 282.
$5.00 = 0.035 delta k/k. Reactor is initially subcritical by 0.045 delta k/k.

Question A.002 [1 point] (2.0)
For the same constant reactor period, which ONE of the following transients requires the LONGEST time to occur? A power increase of:

a. 5% of rated power - going from 1% to 6% of rated power.
b. 10% of rated power - going from 10% to 20% 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.02 a.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-4. Largest value of $P/P_o = e^{t/\tau}$.

Question A.003 [1 point] (3.0)
You enter the control room and observe that the neutron instrumentation indicates a steady neutron level with no rods in motion. Which ONE condition below CANNOT be true?

a. The reactor is critical.
b. The reactor is subcritical.
c. The reactor is supercritical.
d. The neutron source is in the core.

Answer: A.03 c.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-21.

Question A.004 [1 point] (4.0)
Approximately how many fissions occur each second in order to produce 1 MW of thermal power?

a. $3x10^{16}$
b. $1x10^{10}$
c. $7x10^{4}$
d. $5x10^{22}$

Answer: A.04 a.
Reference: Standard NRC question

$$1\,MW = 1E6\,{}^{J}\!/_{s} * \frac{1\,eV}{1.602E-19\,J} * \frac{1}{200E6\,{}^{eV}\!/_{fission}} = 3.12E16\,{}^{fission}\!/_{\sec}$$

Question A.005 [1 point] (5.0)
The speed of the prompt drop occurring just after a large amount of negative reactivity is suddenly inserted into the core is directly related to what factor?

a. Delayed neutron lifetime.
b. Prompt neutron lifetime.
c. Effective delayed neutron fraction.
d. Effective prompt neutron fraction.

Answer: A.05 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, 1988, page 4-21.

Question A.006 [1 point] (6.0)
The _____ of the six factor formula will _____ due to the insertion of control rods in the NSCR core.

a. reproduction factor; increases
b. resonance escape probability; decreases
c. fast non-leakage probability; increases
d. thermal utilization factor; decreases

Answer: A.06 d.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, 1988, page 3-17.

Question A.007 [1 point] (7.0)
During a fuel loading of the NSCR core, as the reactor approaches criticality, the value of 1/M:

a. increases toward unity.
b. decreases toward unity.
c. increases toward infinity.
d. decreases toward zero.

Answer: A.07 d.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, 1988, page 5-16.

Question A.008 [1 point, 0.25 each] (8.0)
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.08 a. = 2; b. = 4; c. = 1; d. = 3
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §§ 3.2.2, p. 3-7

Question A.009 [1 point] (9.0)
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.09 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §§

Question A.010 [1 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.10 .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 point] (11.0)
Core excess reactivity changes with…
a. Fuel burnup
b. Neutron Level
c. Control Rod Height
d. Reactor Power Level

Answer: A.11 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 6.2 p. 6-1 — 6-4.

Question A.012 [1 point] (12.0)
Which one of the following is the MAJOR source of energy released during fission?
a. Kinetic energy of the fission neutrons.
b. Kinetic energy of the fission fragments.
c. Decay of the fission fragments.
d. Prompt gamma rays.

Answer: A.12 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 3.2.1, p. 3-4.

Question A.013 [1 point] (13.0)
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.13 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 3.3.2, p. 3-18

Question A.014 [1 point] (14.0)
Which one of the following factors has the LEAST effect on K_{eff}?

a. Xenon and samarium fission products.
b. Increase in moderator temperature.
c. Increase in fuel temperature.
d. Fuel burn-up.

Answer: A.14 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 3.3.2, p. 3-18.

Question A.015 [1 point] (15.0)
Which ONE of the following atoms will cause a neutron to lose the most energy in an elastic collision?

a. $Carbon^{12}$
b. $Uranium^{238}$
c. $Hydrogen^{2}$
d. $Hydrogen^{1}$

Answer: A.15 d.
Reference: Lamarsh, J.R., Introduction to Nuclear Engineering, 1983. § App II Table II.2, p. 643.

Question A.016 [1 point] (16.0)
The reactor is required to pulse from low power levels (less than one KW) to prevent exceeding the:

a. fuel element temperature limit
b. maximum power level limit
c. reactivity insertion limits
d. pool temperature limit

Answer: A.16 a.
Reference: TAMU Technical Specification 3.2.2 Basis

Question A.017 [1 point] (17.0)
The peak power produced in a fuel element during pulsing operations is greater in FLIP fuel than it is in Standard fuel because:

a. the U^{235} loading is greater in FLIP fuel.
b. the absolute temperature rise is smaller.
c. the burnable poison is the main factor limiting the power peak.
d. the neutron mean free path is longer allowing more time for moderation.

Answer: A.17 a.
Reference: SAR, III.C.2

Question A.018 [1 point] (18.0)
A reactor startup is in progress. Each control rod withdrawal is inserting exactly EQUAL amounts of reactivity. Select the EXPECTED neutron population and count rate response as "Keff" approaches 1.0.

The change in neutron population per reactivity insertion is:
a. SMALLER, and it takes LESS time to reach a new equilibrium count rate
b. LARGER, and it takes LESS time to reach a new equilibrium count rate.
c. SMALLER, and it takes MORE time to reach a new equilibrium count rate.
d. LARGER, and it takes MORE time to reach a new equilibrium count rate.

Answer: A.18 d.
Reference: Reactor Training Manual - Introduction To Nuclear Physics

Question A.019 [1 point] (19.0)
The amount of radioactivity in any material can be determined by:

a. Measuring the dose coming from it using an accurate radiation detector.
b. Taking the results of a. above and multiplying by (4 x pi) to account for geometry.
c. Measuring the total number of radioactive emissions given off over time.
d. First figure out c. above, then multiply the results by the correct quality factor.

Answer: A.19 c.
Reference: Glasstone, 1958, CHAP 5, LAMARSH, 1983, CHP2.8

Question A.20 [1 point] (20.0)
An experienced reactor operator understands that:

a. The more neutrons multiply during startup the lower the rods are at critical.
b. There is no fixed relationship between neutron level and criticality.
c. Neutron multiplication during startup is just neutrons getting lost at a slower rate.
d. Without the Sb-Be source the reactor would not go critical.

Answer: A.20 b.
Reference: Glasstone, 1958, CHAP 14

Question B.001 [1.0 point] {1.0}
The Design Basis Accident for the TA&M reactor is:

a. an accidental pulse at full power.
b. a loss of coolant accident (reactor pool is accidentally drained of water).
c. the loss of integrity of one fuel element cladding and the simultaneous loss of pool water.
d. the accidental insertion of an experiment with a positive reactivity worth of $1.00 while the reactor is critical.

Answer: B.01 c.
Reference: SAR Chapter 13.5.1

Question B.002 [1.0 point] {2.0}
Which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. Steady state power level of 1.3 megawatts for purposes of testing.
b. A non-secured experiment worth $1.50.
c. A fuel element is known to be damaged, but has been moved to the edge of the core.
d. The Continuous Air Radiation Monitor and the Exhaust Gas Radiation Monitor are inoperable due to maintenance and have been replaced with gamma sensitive instruments with alarms.

Answer: B.02 a.
Reference: TA&M Technical Specifications, Section 3.1.1.

Question B.003 [1.0 point] {3.0}
Limiting Safety System Settings used to prevent exceeding a Safety Limit:

a. must actuate automatically before the limit is exceeded.
b. can be exceeded during transients.
c. can be changed by the Reactor Safety Board.
d. apply only in the steady state mode of operation.

Answer: B.03 a.
Reference: TA&M Technical Specifications, Section 2.2.

Question B.004 [1.0 point] {4.0}
The reactor was pulsed but the reactor was switched back to the steady state mode before the reactor operator logged the NVT and the pulse temperature values. The reactor operator should:

a. repeat the pulse.

b. look in the log book for a previous pulse of the same reactivity and use the NVT and pulse temperature values for that pulse.

c. shut down the reactor and record a statement in the Operations Log to document the event.

d. record the pulse temperature from the fuel element temperature recorder and correlate that value to the pulse power.

Answer: B.04 d.
Reference: SOP Pulsing Operation.

Question B.005 [1.0 point] {5.0}
An automatic scram signal which is NOT required by the Technical Specifications when operating in the steady state mode is:

a. short period.
b. high fuel temperature.
c. high power level.
d. loss of detector high voltage.

Answer: B.05 a.
Reference: TA&M Technical Specifications, Table 1.

Question B.006 [1.0 point] {6.0}
A startup checklist has been completed and a startup performed. The reactor is then shutdown (scheduled.) During the shutdown, the bridge is moved. When the reactor is again started up on the same day:

a. another complete checklist is required.
b. the scram circuits must be checked.
c. only section A of the checklist is required.
d. only section D of the checklist is required.

Answer: B.06 b.
Reference: SOP II-C.5, Reactor Startup.

Question B.007 [1.0 point] {7.0}
In accordance with 10CFR55, a licensed operator must:

a. pass a comprehensive requalification written examination and an annual operating test during a 24-month period.

b. complete a minimum of six hours of shift functions each month.

c. have a medical examination during the six-year term of the license.

d. notify the NRC within 30 days following an arrest.

Answer: B.07 a.
Reference: TA&M Requalification Program.

Question B.008 [1.0 point] {8.0}
Information regarding the assembly and location of each fuel bundle is found in the:
a. fuel log.
b. operations log.
c. supervisor log.
d. reactor data log.

Answer: B.08 a.
Reference: SOP Operations Records.

Question B.009 [1.0 point] {9.0}
A "Red Tag" can only be initiated by:
a. the SRO on duty.
b. any SRO.
c. any NSC staff member.
d. the Manager of Reactor Operations.

Answer: B.09 c.
Reference: SOP Red Tag Procedures.

Question B.010 [1.0 point] {10.0}
A reactor parameter which is protected by a Safety Limit is:

a. reactor power.
b. fuel element temperature.
c. fuel cladding temperature.
d. pool water level.

Answer: B.10 b.
Reference: Technical Specifications, Section 2.1.

Question B.011 [1.0 point] {11.0}
Which ONE of the following Emergency classifications is NOT used at the Texas A&M TRIGA reactor?

a. Operational Event
b. Notification of Unusual Event
c. Alert
d. General Emergency

Answer: B.11 d.
Reference: SOP IX § A Emergency Classification Guide, pp. 1 & 2

Question B.012 [1.0 point] {12.0}
Work is to be performed near a source of radiation emitting a field of 2 Mev gamma measuring 500 Mrem/hr. Considering linear attenuation coefficients of 1.15 $in.^{-1}$ and 0.575$in.^{-1}$, respectively, estimate the thickness of lead and steel (separately) in inches to reduce the radiation level to 5 Mrem/hr.
{(tenth thickness for lead is 2 inches) & (tenth thickness for steel is 4 inches)}

	lead	steel
a.	2 inches	4 inches
b.	4 inches	8 inches
c.	2 inches	10 inches
d.	4 inches	20 inches

Answer: B.12 b.
Reference: $D = D_o e^{-\mu x}$ □ $\ln D/D_o = -\mu x$ □ $x = -4.605/-\mu$ -or-
2 tenth thickness required
tenth thickness for lead is 2 inches
tenth thickness for steel is 4 inches

Question B.013 [1.0 point] {13.0}
Which ONE of the following areas is defined as " ... any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source...

a. Radiation Area
b. Restricted Area
c. High Radiation Area
d. Airborne Radioactivity Area

Answer: B.13 c.
Reference: 10CFR20, Part 20.1003

Question B.014 [1.0 point] {14.0}
Shortly after an evacuation of the reactor building, an NSC management representative arrives at the facility. Which ONE of the statements below describes a situation that warrants his/her assumption of the Emergency Director responsibilities?

a. The management representative immediately assumes the responsibilities of the Emergency Director in all cases.

b. The management representative assumes the responsibilities of the Emergency Director when the health and safety of the public are in jeopardy.

c. The management representative assumes the responsibilities of the Emergency Director only in cases where the SRO requests to be relieved.

d. The management representative assumes the responsibilities of the Emergency Director at the point where interaction with outside support organizations becomes necessary.

Answer: B.014 b.
Reference: SOP IX-B, Sect. j

Question B.015 [1.0 point, 0.25 each] {15.0}
Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

Answer: B.015 a. = 20; b. = 1; c. = 1; d. = 10
Reference: 10CFR20.100x

Question B.016 [1.0 point] {16.0}
An accessible area within the facility has general radiation levels of 325 mrem/hour. What would be the EXPECTED posting for this area?

a. "Caution, Very High Radiation Area"
b. "Danger, Airborne Radioactivity Area"
c. "Danger, High Radiation Area"
d. "Caution, Radiation Area"

Answer: B.16 c.
Reference: Reactor Training Manual - 10CFR20

Question B.017 [1.0 point, 0.25 each] {17.0}
Match type of radiation (1 thru 4) with the proper penetrating power (a thru d)

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.17 a. = 4; b. = 2; c. = 1; d. = 3
Reference: Reactor Training Manual - Health Physics

Question B.018 [1.0 point] {18.0}
Which ONE of the following is the MAXIMUM amount of explosive materials allowed in the building per Technical Specification 3.6.2?

a. 25 milligrams
b. 5 grams
c. 5 pounds
d. 25 pounds

Answer: B.18 c.
Reference: Technical Specification 3.6.2

Question B.019 [1.0 point] {19.0}
"The area within the operations boundary for the NSCR (defined as the reactor confinement building)."
Which one of the following terms matches the above definition?

a. Emergency Support Center (ESC)
b. Emergency Planning Zone (EPZ)
c. Site Boundary
d. Controlled Access Area (CAA)

Answer: B.19 b.
Reference: Emergency Preparedness Plan Section 6.0

Question B.020 [1.0 point] {20.0}
Which ONE of the statements below describes the reason the lab receivers in the pneumatic system are kept closed except when loading or unloading a sample?

a. Prolonged opening will introduce air into the system and result in high levels of radioactive Ar^{41}.
b. They remain closed to prevent any CO2 leakage past the isolation valve from entering the labs.
c. They remain closed for neutron shielding purposes during reactor core operation.
d. Prolonged opening will cause pool leakage into the transport hoses due to the pressure differential.

Answer: B.20 a.
Reference: SOP IV-C.2, Pneumatic System Operation.

Question C.001 [1.0 point, 0.333 each] (1.0)
Match the detector type in column B with the proper reactor channel in column A.

a. Log Power Channel	1. Fission Chamber
b. Linear Power Measuring Channel	2. BF_3 Counter
c. Safety Power Measuring Channel	3. Compensated Ion Chamber
	4. Uncompensated Ion ChamberAnswer:

C.01 a. = 1; b. = 3; c. = 4
Reference: TAMU Reactor Instrumentation and Control Lecture

Question C.002 [1.0 point] (2.0)
Which ONE of the following fuel element temperatures is NOT selected using the fuel element temperature selector switch?

a. Instrumented Fuel Element Temperature
b. Pool Temperature
c. Irradiation Cell Temperature
d. Instrumented Fuel Peak Temperature

Answer: C.02 d.
Reference: SAR, 7.2.3.7 Fuel Temperature Channel Figure 7.4

Question C.003 [1.0 point] (3.0)
Why is Erbium added to TRIGA-FLIP fuel?

a. to improve the overall heat transfer coefficient, which is necessary due to higher temperatures generated when pulsing FLIP fuel.

b. to act as both a burnable poison, (allowing more fuel to be added), and as a resonance absorber, (enhancing prompt negative temperature coefficient).

c. to act as a burnable poison only (allowing more fuel to be added).

d. to act as a resonance absorber only, (enhancing prompt negative temperature coefficient).

Answer: C.03 b.
Reference: SAR, 1.8 Facility Modifications and History

Question C.004 [1.0 point] (4.0)
The reactor is in the "PULSE" mode when the TR fire button is depressed. As a result, the solenoid valve is:

a. energized, admitting air to the cylinder.
b. de-energized, admitting air to the cylinder.
c. de-energized, removing air from the cylinder.
d. energized, removing air from the cylinder.

Answer: C.04 a.
Reference: SAR, 7.3.1.1 Transient Rod Control

Question C.005 [1.0 point] (5.0)
For a control rod, the "CARR UP" light is OFF, the "CARR DOWN" light is OFF, and the "ENGAGED" light is ON. This indicates that:

a. the rod and drive are in contact, and are both full in.
b. the rod and drive are in contact, and are both full out.
c. the rod and drive are in contact, and are somewhere between full in and full out.
d. the rod and drive are not in contact, and the rod and drive are somewhere between full in and full out.

Answer: C.05 c.
Reference: SAR, 7.3.1 Shim Safety Rod Control

Question C.006 [1.0 point] (6.0)
In the event of a building ventilation isolation, the emergency exhaust system can be operated in a manual mode from the:

a. Supervisor's Console in the control room.
b. Air Handling Control Panel in the reception room.
c. Emergency Operating Panel in the central mechanical chase.
d. Radiation Release Monitoring Panel in the Health Physicist's Office.

Answer: C.06 b.
Reference: SAR, 6.2.1 Confinement pg. 6.2

Question C.007 [1.0 point] (7.0)
Looking at three element fuel bundles from above:

a. Individual element identification numbers are visible.
b. The bundle identification number should be visible.
c. You should see the locking bolt oriented North.
d. The bundle doesn't have any shims.

Answer: C.07 d.
Reference: SOP II H.1 and 2.

Question C.008 [1.0 point] (8.0)
Which ONE of the following statements correctly describes system response for a pool level drop to less than 90%?

a. Two float switches actuate. Each stopping the pool water recirculation pump and energizing an alarm at the University Communications Room.

b. Two float switches actuate. One stopping the pool water recirculation pump and one energizing an alarm at the University Communications Room.

c. One float switch actuates. This switch both stops the pool water recirculation pump and energizes an alarm at the University Communications Room.

d. One float switch actuates. This switch energizes an alarm at the University Communications Room. The pool water recirculation pump continues to operate.

Answer: C.08 c.
Reference: SAR, 6.2.3 Emergency Core Cooling System pg. 6.3 and SOP-III-O-2

Question C.009 [1.0 point] (9.0)
Which one of the following choices correctly describes the capability of the emergency pool fill system, in case of a loss of beam port integrity?

a. Approximately 1200 GPM
b. Approximately 800 GPM.
c. Approximately 400 GPM.
d. Approximately 200 GPM.

Answer: C.09 c.
Reference: SAR, 6.2.3 Emergency Core Cooling System pg. 6.3

Question C.010 [1.0 point] (10.0)
The emergency exhaust air filter system, installed between the exhaust fan and the exhaust stack, consists of:

a. TWO activated carbon filter banks, and ONE particulate filter bank.
b. TWO activated carbon filter banks, and TWO particulate filter banks.
c. ONE activated carbon filter bank, and TWO particulate filter banks.
d. ONE activated carbon filter bank, and ONE particulate filter bank.

Answer: C.10 c.
Reference: SAR, 6.2.1 Confinement pg. 6.2

Question C.011 [1.0 point] (11.0)
The reactor is being operated at 100 kw in the "Servo" mode of control. The compensating voltage to the Linear Power measuring channel suddenly begins to trend down due to a malfunction. Select the statement that describes reactor response with no operator action.

a. The regulating rod would move in, causing power to decrease
b. The regulating rod would move out, causing power to increase
c. All scram capable rods would insert
d. The regulating rod would shift back to manual due to a lower indicated reactor power.

Answer: C.11 a.
Reference: SOP III-C

Question C.012 [1.0 point] (12.0)
Which one of the following choices is correct regarding the minimum equipment required to achieve confinement of the reactor building? Assume no maintenance is in progress.

a. Central exhaust fan available.
b. Central exhaust fan and the Radiation Monitoring Channels in operation.
c. The ventilation system and the Radiation Monitoring Channels in operation.
d. Central exhaust fan in operation and the ventilation system controls in the reception room available.

Answer: C.12 d.
Reference: TS 3.3.2.

Question C.013 [1.0 point] (13.0)
Which ONE of the following alarms requires the air handlers to be shut down as part of immediate action?

a. stack particulate monitor
b. stack gas monitor
c. building particulate monitor
d. building gas monitor

Answer: C.13 a.
Reference: SOP VII-A4.c.2

Question C.014 [1.0 point] (14.0)
Assuming the reactor is shutdown and all systems in a normal line-up, which one of the following pressures at the primary pump would indicate a full reactor pool?

a. 47 psig
b. 42 psig
c. 33 psig
d. 15 psig

Answer: C.14 d.
Reference: SOP IX-E-1 p. 2

Question C.015 [1.0 point] (15.0)
Control rods have fueled followers in order to:

a. decrease the core excess reactivity.
b. enhance their control characteristics.
c. gain excess reactivity and extend core life.
d. increase the effectiveness for reactor pulsing.

Answer: C.15 c.
Reference: SAR, 14.5.3 Control Rods

Question C.016 [1.0 point] (16.0)
Which ONE of the following is the method you should use (as the console operator) to sound the evacuation alarm if the solenoid valve which supplies air to the horn was inadvertently left shut in the reception room?

a. Open a "bypass" valve located in the control room.
b. Use the normal switch on the control panel which should still work.
c. Open a "bypass" valve located just inside the door leading out of containment.
d. Override the solenoid signal via a switch located in the back of the reactor console.

Answer: C.16 a.
Reference: SOP III-R, Evacuation Horn System Surveillance.

Question C.017 [1.0 point] (17.0)
On a decreasing pool level you are directed to line makeup to the pool via the demineralizer system at 100 gpm. SOP V-A cautions you not to exceed 70 gpm through the demineralizer. At the higher (100 gpm) rate you run the risk of:

a. blowing the filter upstream of the demineralizer into the demineralizer.
b. blowing resin out of the demineralizer into the pool.
c. creating channels through the demineralizer.
d. over pressuring the demineralizer.

Answer: C.17 c.
Reference: SOP V-A, Demineralizer System.

Question C.018 [1.0 point, 0.25 each] (18.0)
Match the nuclear instrumentation channel in Column B that satisfies the control function in Column A. Items in column B may be used once, more than once or not at all.

Column A	Column B
a. Energizes interlock that prevents start-ups when less than 2 cps.	1. Log power channel
b. Energizes interlock that prevents pulsing operations when greater than 1 kw.	2. Linear power channel
c. Inputs reactor scram signal when power is greater than 125%.	3. Safety channel(s)
d. Inputs reactor scram signal in the event of a reactor period of 3 seconds or less.	

Answer: C.18 a. =1; b. =1; c. =3; d. =1
Reference: TAMU Reactor Instrumentation and Control Lecture

Question C.019 [1.0 point] (19.0)
What do the thermocouples in each of the instrumented fuel elements measure?

a. The temperature of the fuel reflector end pieces.
b. The temperature of the fuel's surface.
c. The temperature of the fuel cladding.
d. The temperature of the fuel's interior.

Answer: C.19 d.
Reference: TAMU Reactor Instrumentation and Control Lecture

Question C.020 [1.0 point] (20.0)
What ONE of the following can cause the control rod jammed interlock?

a. Control rod drive going down and control rod going down at a slower rate.
b. Control rod drive going up and control rod going up at a slower rate.
c. Control rod drive going down and control rod not going down.
d. Control rod drive going up and control rod not going up.

Answer: C.20 c.
Reference: SAR, 7.3.1 Shim Safety Rod Control

***** END OF EXAMINATION *****