October 17, 2008

Dr. Warren D. Reece, Director
Texas A&M University System
Nuclear Science Center
Texas Engineering Experiment Station
F. E. Box 89, M/S 3575
College Station, Texas 77843

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-128/OL-08-01, TEXAS A&M UNIVERSITY

Dear Dr. Reece:

During the week of August 18, 2008, the NRC administered an operator licensing examination at your Nuclear Science Center 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 pty@nrc.gov.

Sincerely,

/RA MVoth for/

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

Docket No. 50-128

Enclosures: 1. Initial Examination Report No. 50-128/OL-08-01
2. Written examination with facility comments incorporated

cc without enclosures: See next page

October 17, 2008

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SUBJECT: INITIAL EXAMINATION REPORT NO. 50-128/OL-08-01, TEXAS A&M UNIVERSITY

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DISTRIBUTION w/ encls.:
PUBLIC PRTB r/f RidsNRRDPRPRTA
RidsNRRDPRPRTB Facility File (CHart) O-13 D-07

ADAMS ACCESSION #: ML082690287 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung		CHart		MVoth for JEads	
DATE	10/03/08		10/10/08		10/17/2008	

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-08-01

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: TEXAS A&M UNIVERSITY

EXAMINATION DATES: August 18 – 20, 2008

SUBMITTED BY: _____ _____
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of August 18, 2008, the NRC administered operator licensing examinations to two Reactor Operator applicants and one Senior Operator Upgrade applicant. All applicants passed all portions of the operating test and written 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	1/0	3/0
Overall	2/0	1/0	3/0

3. Exit Meeting:
   Phillip T. Young, Examiner, NRC
   Jim Remlinger, Associate Director, NSC Reactor
   Jerry Newhouse, Reactor Supervisor, NSC Reactor

   The examiner thanked the facility for their work and cooperation during the examination.

ENCLOSURE 1

US NRC License Operator Examination

Texas A & M University

Operator Written Examination
with Answer Key

August 18, 2008

ENCLOSURE 2

FACILITY COMMENTS:

QUESTION B.006
The given answer to question B.006 is "c, Keeping the reactor below 300 watts for pulsing." However, SOP II-C-4-d states, "The power level will be maintained below 1000 watts. Normally, the reactor is taken to a steady state power level of 300 watts for pulsing. Hence, diffuser pump is not required." The would mean that choice "b, The diffuser pump is not required during pulse operations" is the true correct answer.

NRC RESPONSE
Facility comment accepted. Answer key changed to show “b.” as the correct answer.

QUESTION B.020
I think that depending on how one reads the question two answers could be correct. If one starts off the question assuming the mentioned 1/4" lead sheet is already in place, and so the exposure rate starts at 50%, then the answer is "b, 6." But, if one does not assume the mentioned 1/4" lead sheet is in place, and so the exposure rate starts at 100%, then the answer is "c, 7."

NRC RESPONSE
Facility comment accepted. Answer key changed to show both answer “b.” and answer “c.” as accepted. The question will be modified to state the answer is to include all lead sheets.

Question A.001 [1.0 point] (1.0)
Which ONE of the following explains the response of a ***SUBCRITICAL*** reactor to equal insertions of positive reactivity as the reactor approaches criticality?

a. Each insertion causes a SMALLER increase in the neutron flux resulting in a LONGER time to stabilize.

b. Each insertion causes a LARGER increase in the neutron flux resulting in a LONGER time to stabilize.

c. Each insertion causes a SMALLER increase in the neutron flux resulting in a SHORTER time to stabilize.

d. Each insertion causes a LARGER increase in the neutron flux resulting in a SHORTER time to stabilize.

Answer: A.001 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

Question A.002 [1.0 point] (2.0)
K_{eff} for the reactor is 0.85. If you place an experiment worth +17.6% into the core, what will the new K_{eff} be?

a. 0.995

b. 0.9995

c. 1.005

d. 1.05

Answer: A.002 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §
SDM = $(1-k_{eff})/k_{eff}$ = (1-0.85)/0.85 = 0.15/0.85 = 0.1765, or a reactivity worth (ρ) of -0.1765. Adding + 0.176 reactivity will result in a SDM of 0.1765 - 0.1760 = 0.0005. K_{eff} = 1/(1+SDM) = 1/(1 + 0.0005) = 0.9995

Question A.003 [1.0 point] (3.0)
Which of the following does NOT affect the Effective Multiplication Factor (Keff)?

a. The moderator-to-fuel ratio.

b. The physical dimensions of the core.

c. The strength of installed neutron sources.

d. The current time in core life.

Answer: A.003 c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.4, p. 3-21.

Question A.004 [1.0 point] (4.0)
The term *PROMPT JUMP* refers to …

a. the 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.004 a.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 4.7, p. 4-21

Question: A.005 [1.0 point] (5.0)
Inelastic Scattering is the process whereby a neutron collides with a nucleus and:

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

Answer: A.005 b.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 2-28.

Question: A.006 [1.0 point] (6.0)
A reactor is critical at full rated power, with reactivity = zero. A control rod is inserted and the power decreases to a lower steady-state value. The reactivity of the reactor at the lower power level is zero because:

a. the positive reactivity due to the fuel temperature decrease balances the negative reactivity due to the control rod insertion.
b. the negative reactivity due to the fuel temperature decrease equals the negative reactivity due to the control rod insertion.
c. the positive reactivity due to the fuel temperature increase balances the negative reactivity due to the control rod insertion.
d. the negative reactivity due to the fuel temperature increase equals the negative reactivity due to the control rod insertion.

Answer: A.006 a.
Reference: Since the fuel temperature must drop, positive reactivity is added.

Question: A.007 [1.0 point] (7.0)
An experiment to be placed in the central thimble has been wrapped in cadmium. Which one of the following types of radiation will be most effectively blocked by the cadmium wrapping?

a. Thermal neutrons

b. Fast neutrons

c. Gamma rays

d. X-rays

Answer: A.007 a.
Reference: Glasstone, S. and Sesonske, 1991, § 10.34, pp. 639.

Question: A.008 [1.0 point] (8.0)
The Inhour Equation relates reactivity insertion, ρ, to reactor period, T. Reactivity insertion A is +0.001 Δk/k, and reactivity insertion B is -0.001 Δk/k. The absolute value of the period will be:

a. smaller for A.

b. smaller for B.

c. larger for A.

d. the same for A and B.

Answer: A.008 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, pg. 285.

Question: A.009 [1.0 point] (9.0)
Which ONE of the reactions below is an example of a photoneutron source?

a. $_{92}U^{238} \rightarrow {}_{35}Br^{87} + {}_{57}La^{148} + 3n + \gamma$

b. $_{51}Sb^{123} + n \rightarrow {}_{51}Sb^{124} + \gamma$

c. $_{1}H^{2} + \gamma \rightarrow {}_{1}H^{1} + n$

d. $_{4}Be^{9} + \alpha \rightarrow {}_{6}C^{12} + n$

Answer: A.009 c.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-3.

Question: A.010 [1.0 point] (10.0)
With the reactor critical at 10 KW a rod is pulled to insert a positive reactivity of 0.00126 ΔK/K. Which one of the following will be the stable reactor period as a result of this reactivity insertion?

a. 10 seconds
b. 50 seconds
c. 60 seconds
d. 70 seconds

Answer: A.010 b.
Reference: $\tau = (\beta-\rho)/\lambda_{eff}\rho = \frac{.0075 - .00126}{(.1)(.00126)} = 49.5$ seconds

Question: A.011 [1.0 point] (11.0)
An initial count rate of 100 is doubled five times during a startup. Assuming an initial Keff of 0.950, which one of the following is the new Keff?

a. 0.957
b. 0.979
c. 0.985
d. 0.998

Answer: A.011 d.
Reference: CR1 (1-Keff1) = CR2 (1 - Keff2) or M1 (1-Keff1) = M2 (1 - Keff2)
CR2/CR1 = 32 → CR1 (1-Keff1)/CR2 = 1 - Keff2) → 100 (1-0.950)/3200 = 1 - Keff2
Keff2 = 1 - .0015625 = .998

Question: A.012 [1.0 point] (12.0)
Consider two identical critical reactors, with the exception that one has a beta of 0.0072 and the other has a beta of 0.0060. Each reactor is operating at 10 watts. Which one of the following compares the response of the reactors to a +0.1% delta k/k reactivity insertion?

a. The resulting period will be shorter for the reactor with the 0.0072 beta fraction
b. The resulting period will be shorter for the reactor with the 0.0060 beta fraction
c. The resulting power level will be higher for the reactor with the 0.0072 beta fraction
d. The resulting power level will be higher for the reactor with the 0.0060 beta fraction

Answer: A.012 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, §§ 3.2.2 — 3.2.3

Question: A.013 [1.0 point] (13.0)
The reactor is critical and increasing in power. Power has increased from 20 watts to 80 watts in 60 seconds. How long will it take at this rate for power to increase from 0.080 KW to 160 KW?

a. 0.5 minute
b. 2.5 minutes
c. 5.5 minutes
d. 10.5 minutes

Answer: A.013 c.
Reference: $P = Poe^{t/T} \rightarrow 80 = 20e^{60\ sec/T} \rightarrow T = 43.28$ sec 1.6×10^5 watts = 80et/43.28 t = 329 sec = 5.5 minutes

Question: A.014 [1.0 point] (14.0)
As a reactor continues to operate over a period of months, for a constant power level, the average neutron flux:

a. decreases, due to the increase in fission product poisons.
b. decreases, because fuel is being depleted.
c. increases, in order to compensate for fuel depletion.
d. remains the same.

Answer: A.014 c.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-50.

Question: A.015 [1.0 point] (15.0)
Which one of the following is the PRIMARY reason that delayed neutrons are so effective at controlling reactor power?

a. Delayed neutrons make up a very large fraction of the fission neutrons in the core.
b. Delayed neutrons have a much longer mean lifetime than prompt neutrons.
c. Delayed neutrons are born at lower energies than prompt neutrons.
d. Delayed neutrons are born at thermal energies.

Answer: A.015 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, §§ 3.2.2 — 3.2.3

Question: A.016 [1.0 point] (16.0)
The following data was obtained during a reactor fuel load.

No. of Elements	Detector A (cps)
0	20
8	28
16	30
24	32
32	42
40	80

Which one of the following represents the number of fuel elements predicted to reach criticality?

a. 48
b. 52
c. 56
d. 60

Answer: A.016 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.5, pp. 5-18 — 5-25.

Question: A.017 [1.0 point] (17.0)
Following 8 hours at 1 MW, the reactor operator reduces reactor power to 50%. Rod control is placed in manual mode and all rod motion is stopped. Which one of the following describes the response of reactor power, without any further operator actions, and the PRIMARY reason for its response?

a. Power increases due to the burnout of xenon.
b. Power increases due to the burnout of samarium.
c. Power decreases due to the buildup of xenon.
d. Power decreases due to the buildup of samarium.

Answer: A.017 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §§ 8.1 —8.4, pp. 8-3 — 8-14.

Question: A.018 [1.0 point] (18.0)
Which one of the following is a correct statement concerning the factors affecting control rod worth?

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

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

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

d. As Rx power increases rod worth increases.

Answer: A.018 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 7.2 & 7.3, pp. 7-1 — 7-10.

Question: A.019 [1.0 point] (19.0)
Pool temperature increases by 20 ºF. Given αTmoderator = -0.0005 ΔK/K/ºF and an average regulating rod worth of 0.004 ΔK/K/inch. By how much and in what direction did the regulating rod move to compensate for the temperature change?

a. 0.25 inches in

b. 0.25 inches out

c. 2.5 inches in

d. 2.5 inches out

Answer: A.019 d.
Reference: +20ºF × -0.0005 ΔK/K/ºF = - 0.01 ΔK/K.
To compensate the rod must add +0.01 ΔK/K. +0.01ΔK/K ÷ +0.004 ΔK/K/inch = +2.5 inches

Question: A.020 [1.0 point] (20.0)
Which ONE of the following statements describes the subcritical reactor response as Keff approaches unity?

a. A LARGER change in neutron level results from a given change in Keff and a SHORTER period of time is required to reach the equilibrium neutron level for a given change in Keff.

b. A LARGER change in neutron level results from a given change in Keff and a LONGER period of time is required to reach the equilibrium neutron level for a given change in Keff.

c. A SMALLER change in neutron level results from a given change in Keff and a SHORTER period of time is required to reach the equilibrium neutron level for a given change in Keff.

d. A SMALLER change in neutron level results from a given change in Keff and a LONGER period of time is required to reach the equilibrium neutron level for a given change in Keff.

Answer: A.020 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, Chapt. 5, pp. 5-1 — 5-28.

Question B.001 [1.0 point] (1.0)
Which ONE of the following is true about gamma radiation when compared to alpha and beta radiation?

a. For the same curie content, greatest hazard when taken internally
b. Greatest whole body concern
c. Highest ionization potential
d. Least penetrating

Answer: B.001 b.
Reference: Standard NRC Question

Question B.002 [1.0 point] (2.0)
Which one of the following statements define the Technical Specifications term "Channel Test?"

a. The adjustment of a channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures.

b. The combination of sensors, electronic circuits and output devices connected to measure and display the value of a parameter.

c. The qualitative verification of acceptable performance by observation of channel behavior.

d. The introduction of a signal into a channel for verification of the operability of the channel.

Answer: B.002 d.
Reference: Technical Specifications Section 1.0, Page 1

Question B.003 [1.0 point] (3.0)
An experiment with a reactivity worth of $0.25 is to be removed from the core. Prior to performing this operation:

a. reactor power must be less than 600 kW.
b. the reactor must be subcritical by at least $0.25.
c. the reactor must be subcritical.
d. the reactor must be shutdown.

Answer: B.003 a.
Reference: SOP II-D.6

Question B.004 [1.0 point] (4.0)
Which one of the following is a duty of the Reactor Operator (RO) during an emergency which requires a facility evacuation?

a. Verify all persons are accounted for.
b. Verify all doors to the reactor building are closed.
c. Shutdown building air handling and exhaust systems.
d. Verify that rope barriers are in place in the reception room.

Answer: B.004 c.
Reference: SOP IX-B

Question B.005 [1.0 point] (5.0)
An individual receives 100 mRem of Beta (ß), 25 mRem of gamma (γ), and 5 mRem of neutron radiation. What is his/her total dose?

a. 275 mRem
b. 205 mRem
c. 175 mRem
d. 130 mRem

Answer: B.005 d.
Reference: 10 CFR 20.4 A rem is a rem is a rem

Question B.006 [1.0 point] (6.0)
Major differences between steady state and pulsing include:

a. Limiting the peak fuel temperature to 830 ºF during pulsing.
b. The diffuser pump is not required during pulse operations.
c. Keeping the reactor below 300 watts for pulsing.
d. Setting the bridge ARM higher for pulsing.

Answer: B.006 b. ~~c.~~ Answer changed per facility comment.
Reference: SOP II, REACTOR OPERATIONS, C.4 and E.1.

Question B.007 [1.0 point] (7.0)
Which one of the following does NOT require NRC approval for changes?

a. Facility License
b. Emergency Plan
c. Requalification plan
d. Emergency Implementation Procedures

Answer: B.007 d.
Reference: 10 CFR 50.54 (q); 10 CFR 50.59; 10 CFR 55.59

Question B.008 [1.0 point] (8.0)
The three fuel handling tools at the NSCR TRIGA are:

a. Made to release their load by raising the manipulator or plunger upwards.
b. Designed to manipulate fuel bundles either by hand or overhead crane.
c. Stored on the tool rack located at the northeast corner of the main pool.
d. Fitted with a locking ball-detent latching mechanisms.

Answer: B.008 a.
Reference: SOP II, REACTOR OPERATIONS, H.3.

Question B.009 [1.0 point] (9.0)
The dose rate from a mixed beta-gamma source is 100 mrem/hour at a distance of one (1) foot, and is 0.1 mrem/hour at a distance of twenty (20) feet. What percentage of the source consists of beta radiation?

a. 20%.
b. 40%.
c. 60%.
d. 80%.

Answer: B.009 c.
Reference: At twenty feet, the dose rate consists only of gamma radiation. The gamma dose rate at one foot is: $DR_1 d_1^2 = DR_2 d_2^2$; $(DR_1)(1) = (0.1)(400)$; $DR_1 = 40$ mrem/hour.
The beta dose rate at one foot is 60 mrem/hour = 60%.

Question B.010 [1.0 point] (10.0)
While performing a power calibration the difference between the indicated power and the measured power is 10%. Which one of the below statements is correct for this condition?

a. Position the detector to match indicated and measured power.

b. A difference this great is suspect and may be an indication of "shadowing effect".

c. The adjustments will be verified by a follow-up calorimetric prior to taking the reactor to greater than 400 kW indicated power.

d. Adjustments to the power instrumentation cannot be performed under any circumstances, if the difference is greater than 5%.

Answer: B.010 c.
Reference: SOP II-J.2.b

Question B.011 [1.0 point] (11.0)
Which ONE of the following checks must be performed following a SCHEDULED shutdown during which the bridge was moved?

a. A complete pre-startup check is required.

b. All limit switches for the control rods must be verified for proper operation.

c. Control rods must be driven through their full range of travel with no abnormalities or jamming.

d. All scrammable rods must be raised to 10% positions, then manually scrammed, checking all indicators for proper operation.

Answer: B.011 d.
Reference: SOP II.C.5

Question: B.012 [1.0 point] (12.0)
During a pre-startup checkout in preparation for pulsing operations, the operator sets the Wide Range Monitor Module to 600 W and attempts to fire the transient rod. He hears the transient rod pneumatic system fire. Which one of the following statements describes the status of the pre-startup check?

a. The pre-startup checkouts requirements are satisfied if the transient rod position indication confirms that the rod did, in fact, withdraw. Both audible indication and position feedback indicating withdrawal are required to satisfy the checkouts requirements.

b. The pre-startup checkouts requirements are satisfied. Audible indication of the pneumatic system operation is sufficient to verify operability of the system since actual rod motion is not yet permitted.

c. The pre-startup checkouts requirements are NOT satisfied. The power level should be set higher than the interlock level. A procedural error has been made.

d. The pre-startup checkouts requirements are NOT satisfied. The pneumatic system should not have fired. A system malfunction has occurred.

Answer: B.012 c.
Reference: SOP II-C.2.b; NSC form 532, Sect. D

Question: B.013 [1.0 point] (13.0)
"The temperature in a LEU fuel element shall not exceed 2100 ºF (1150 ºC) under any conditions of operation." This is an example of a:

a. safety limit.
b. limiting safety system setting.
c. limiting condition for operation.
d. surveillance requirement.

Answer: B.013 a.
Reference: TA&M Technical Specifications, Section 2.1.

Question B.014 [1.0 point] (14.0)
Which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. Shutdown margin = 20 cents.
b. A vacant lattice position on the periphery of the core assembly.
c. Steady state power level of 1.4 megawatts for purposes of testing and calibration.
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.014 b.
Reference: TA&M Technical Specifications, Section 3.1.4.

Question B.015 [1.0 point] (15.0)
Argon-41 is produced by neutron absorption of argon-40. Argon-41 decays by:

a. a 1.3 Mev gamma with a half-life of 1.8 hours.
b. a 6.1 Mev gamma with a half-life of 7 seconds.
c. neutron emission with a half-life of 1.8 hours.
d. a 1.3 Mev beta with a half-life of 7 seconds.

Answer: B.015 a.
Reference: Chart of the Nuclides

Question B.016 [1.0 point] (16.0)
In accordance with the Emergency Classification Guide, all alarms from the Facility Air Monitor System are classified as Operational Events with the exception of:

a. Stack Particulate Monitor.
b. Building Gas Monitor.
c. Fission Gas Monitor.
d. Stack Gas Monitor.

Answer: B.016 c.
Reference: Emergency Classification Guide, pg. 2.

Question B.017 [1.0 point] (17.0)
The SRO on duty has directed you to "secure the reactor." This is done by:

a. fully inserting all control rods and placing the rod control switches to NEUTRAL.

b. scramming the reactor.

c. removing all experiments.

d. removing the reactor key from the control console.

Answer: B.017 d.
Reference: SOP Reactor Shutdown.

Question B.018 [1.0 point] (18.0)
Limiting Safety System Settings:

a. are limits on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

b. are combinations of sensors, interconnecting cables or lines, amplifiers, and output devices which are connected for the purpose of measuring the value of a variable.

c. are the lowest functional capability or performance levels of equipment required for safe operation of the facility.

d. are settings for automatic protective devices related to those variables having significant safety functions.

Answer: B.018 d.
Reference: TA&M Technical Specifications, Section 1.13.

Question B.019 [1.0 point] (19.0)
Operation of the reactor in the steady state mode means that:

a. reactor power is constant.

b. the mode switch is in the steady state position.

c. the mode switch is in the steady state position with power at 1 MW.

d. reactor power is constant, with power controlled by the servo system.

Answer: B.019 b.
Reference: TA&M Technical Specifications, Section 1.41.

Question B.020 [1.0 point] (19.0)
You are standing ten (10) feet from a point source of radiation. When a ¼ inch sheet of lead is placed between you and the source, your exposure rate is halved. How many total sheets of lead are required to reduce your exposure rate to 1% of its original value?

a. 2
b. 6
c. 7
d. 10

Answer: B.020 b. or c. Additional answer choice (b.) added per facility comment.
Reference: Each sheet of lead reduces the exposure rate by half. First sheet - 50%; second sheet - 25%; third sheet - 12.5%, etc.

Question C.001 [2.0 points, 0.5 each] (2.0)
Identify whether each of the Reactor Safety Channels must be effective in the Steady State (SS) mode, the Pulse mode (PULSE), or both modes (BOTH)

a. Fuel Element Temperature
b. HI Power Level
c. Shim Safeties & Reg Rod Position
d. Pool Level

Answer: C.001 a. = BOTH; b. = SS; c. = PULSE; d. = BOTH
Reference: SAR Table V on page 100. Draft SAR, Table 7-1: Minimum Reactor Safety Channels

Question C.002 [1.0 point] (3.0)
When the stack particulate activity alarm sounds, which ONE of the following occurs?

a. The reactor scrams.
b. The evacuation alarm sounds.
c. The air handling system shuts down.
d. There are no automatic actions.

Answer: C.002 c.
Reference: SAR, page 119; Draft SAR, 7.7.2 Facility Air Monitors (pg 7-21)

Question C.003 [1.0 point] (4.0)
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.003 c.
Reference: SAR pg. 10.
Draft SAR, 1.8 Facility Modifications and History (pg 18)

Question C.004 [1.0 point] (5.0)
A three-way solenoid valve controls the air supplied to the pneumatic cylinder of the transient rod. De-energizing the solenoid causes the valve to shift to:

a. open, admitting air to the cylinder.
b. close, admitting air to the cylinder.
c. open, removing air from the cylinder.
d. close, removing air from the cylinder.

Answer: C.004 d.
Reference: SAR, page 38; Draft SAR, 7.3.1.1 Transient Rod Control (pg 7-13)

Question C.005 [1.0 point] (6.0)
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.005 a.
Reference: SOP III-R, Evacuation Horn System Surveillance.

Question C.006 [1.0 point] (7.0)
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.006 c.
Reference: SOP V-A, Demineralizer System.

Question C.007 [2.0 points, 0.5 each] (9.0)
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 al.

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.007 a. =1; b. =1; c. =3; d. =1
Reference: SAR pg. 91-93. Draft SAR, 7.2.3.1 Log Power Channel & 7.2.3.5 Safety Power Channels

Question C.008 [1.0 point] (10.0)
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.008 d.
Reference: SAR, page 4-5; Draft SAR, 4.2.1 Reactor Fuel (pg 4-7)

Question C.009 [1.0 point] (11.0)
Which ONE of the following is provided by the wide range linear detector?

a. An indication of reactor period in steady state mode.
b. An indication of reactor power from shutdown to operating levels.
c. A signal for the reactor to SCRAM if the maximum pulse power level is exceeded.
d. A signal for the reactor to SCRAM if the maximum steady state power level is exceeded.

Answer: C.009 b.
Reference: SAR, page 7-2; Draft SAR, 7.2.3.3 Wide Range Linear Channel (pg 7-3)

Question C.010 [1.0 point] (12.0)
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.010 c.
Reference: SAR, page 7-12; Draft SAR, 7.3 Reactor Control System

Question C.011 [1.0 point] (13.0)
Which ONE of the following statements is NOT TRUE regarding the Servo Flux Control system?

a. Pressing the Gang-Up/Gang-Down switch will turn off the servo unit.
b. The regulating rod moves in response to the linear channel signal.
c. The regulating rod moves in response to the log power channel signal.
d. If power level drifts +/- 5% of the setpoint the servo unit will turn off.

Answer: C.010 c.
Reference: SOP Steady State Operation

Question C.012 [1.0 point] (14.0)
What is the purpose of the exhaust duct in the lower irradiation cell?

a. To minimize buildup of water if a leak develops in the irradiation window.
b. To minimize radiation exposure due to production of Ar-41.
c. To minimize radiation exposure due to production of N-16.
d. To reduce humidity for experiment efficiency.

Answer: C.012 b.
Reference: SAR, page 10-7; SOP IV-E-1; Draft SAR, 10.1.4 Irradiation Cell (pg 145)

Question C.013 [1.0 point] (15.0)
What type of detector is used to measure the amount of radiation exposure at the top of the pool due to N-16?

a. Gamma scintillator.
b. Geiger-Mueller tube.
c. Ionization chamber.
d. Proportional counter.

Answer: C.013 b.
Reference: SOP VII-B-7

Question C.014 [1.0 point] (16.0)
What prevents a fuel followed control rod from falling out of the core should it become detached from its mounting?

a. Bottom of pool is within 2 inches of grid plate.
b. Notch in control rod pole connected to reactor frame.
c. Safety plate assembly beneath the reactor grid plate.
d. Tapered section above absorber prevents passage through reactor frame.

Answer: C.014 c.
Reference: SAR, page 4-8; Draft SAR, 4.2.5 Core Support Structure (pg 4-13)

Question C.015 [1.0 point] (17.0)
What prevents liquid radioactive waste from spilling uncontrollably into the environment if one of the liquid waste effluent tanks exceeds its capacity?

a. Drain on the concrete pad leading to a sanitary sewer.
b. Electrical heater in tank accelerates evaporation.
c. Connection to other waste effluent tanks.
d. Pressure sealed caps.

Answer: C.015 c.
Reference: NRC Inspection Report No. 50-128/2003-201

Question C.016 [1.0 point] (18.0)
Which ONE of the following actions will cause the operating reactor to automatically SCRAM?

a. Opening the thermal column shield door with the reactor positioned at the centerline of BP 1 & 4.
b. Opening one of the beam port lead seal doors when the reactor is in the stall core position.
c. Opening the cave door to BP4 when the reactor is against the radiography reflector.
d. Opening the irradiation cell door when the reactor is in the pool core position.

Answer: C.016 c.
Reference: SAR, page 10-7; SOP IV-F-3; Draft SAR, 10.1.5 Neutron Radiography Cave (pg 146)

Question C.017 [1.0 point] (19.0)
For the Shim Safety Control Rod drives, which ONE of the following statements is correct?

a. An IN signal for one shim rod overrides an IN signal for the gang of shim rods.
b. An OUT signal for one shim rod overrides an IN signal for the gang of shim rods.
c. An IN signal for one shim rod overrides an OUT signal for the gang of shim rods.
d. An OUT signal for one shim rod overrides an OUT signal for the gang of shim rods.

Answer: C.017 c.
Reference: SAR, page 7-9; Draft SAR 7.3.1 Shim-Safety Rod Control (pg 7-9)

Question C.018 [1.0 point] (20.0)
Why is the pneumatic system vented to the main exhaust stack?

a. Prevent exposure to Ar-41 due to buildup of air in the line.
b. Prevent exposure to N-16 due to buildup of water in the line.
c. Prevent exposure to CO_2, which is an asphyxiation hazard.
d. Prevent exposure to fission product gases due to a fuel cladding breach.

Answer: C.018 a.
Reference: SOP IV-C-2; Precautions