March 24, 2016

Dr. Robert Busch, Chief Reactor Supervisor
Department of Nuclear Engineering,
MSC01-1120
University of New Mexico
1901 Redondo Dr. NE
Albuquerque, NM 87131-0001

SUBJECT: EXAMINATION REPORT NO. 50-252/OL-16-01, UNIVERSITY OF NEW MEXICO

Dear Dr. Busch:

During the week of February 16, 2016, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your University of New Mexico reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with you and Ken Carpenter, Facilities Manager, 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 Ms. Michele DeSouza at (301) 415-1169 or via e-mail, Michele.DeSouza@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-252

Enclosures: 1. Examination Report No. 50-252/OL-16-01
2. Written examination

cc: w/o enclosures: See next page

Dr. Robert Busch, Chief Reactor Supervisor
Department of Nuclear Engineering,
MSC01-1120
University of New Mexico
1901 Redondo Dr. NE
Albuquerque, NM 87131-0001

March 24, 2016

SUBJECT: EXAMINATION REPORT NO. 50-252/OL-16-01, UNIVERSITY OF NEW MEXICO

Dear Dr. Busch:

During the week of February 16, 2016, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your University of New Mexico reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with you and Ken Carpenter, Facilities Manager, 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 Ms. Michele DeSouza at (301) 415-1169 or via e-mail, Michele.DeSouza@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-252

Enclosures: 1. Examination Report No. 50-252/OL-16-01
2. Written examination

cc: w/o enclosures: See next page

DISTRIBUTION w/ encls.:
PUBLIC RidsNrrDprPrta RidsNrrDprPrtb

ADAMS ACCESSION No.: ML16073A006 **TEMPLATE #:NRR-079**

OFFICE	NRR/DPR/PROB/CE		NRR/DPR/PROB/OLA		NRR/DPR/PROB/BC	
NAME	MDeSouza		CRevelle		AMendiola	
DATE	03/14/2016		03/14/2016		03/24 /2016	

OFFICIAL RECORD COPY

cc:

City Manager
City of Albuquerque
City Hall
Albuquerque, NM 87101

Dr. Anil Prinja, Chair
Nuclear Engineering Department
209 Farris Engineering, MSC 01-1120
1 University of New Mexico
Albuquerque, NM 87131-0001

Salmen Locksen, Radiation Safety Officer
1 University of New Mexico
MCS08 4560
Albuquerque, NM 87131

Chief, Radiation Control Bureau
Field Operations Division
Environment Department
Harold S. Runnels Bldg.
1190 St. Francis Drive, Rm S2100
Santa Fe, NM 87505-4173

Deputy Secretary, Office of the Secretary
New Mexico State Environment Department
1190 St. Francis Drive, Suite 4050N
Santa Fe, NM 87502-6110

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.: 50-252/OL-16-01

FACILITY DOCKET NO.: 50-252

FACILITY LICENSE NO.: R-102

FACILITY: University of New Mexico Reactor

EXAMINATION DATES: February 16-17, 2015

SUBMITTED BY: **/RA/** **02/22/2016**
Michele DeSouza, Chief Examiner Date

SUMMARY:
During the week of February 16, 2016, the NRC administered operator licensing examinations to two Reactor Operator (RO) candidates. One Reactor Operator candidate passed all applicable portions of the examination and one Reactor Operator candidate failed category B of the written but passed all other applicable portions of the examination.

REPORT DETAILS

1. Examiner: Michele DeSouza, Chief Examiner, NRC

2. Results:

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

3. Exit Meeting:
Michele C. DeSouza, Chief Examiner, NRC
Robert Busch, Ph.D., Chief Reactor Supervisor
Ken Carpenter, Facilities Manager

Upon completion of the examinations, the NRC Chief Examiner met with facility staff representatives to discuss the results. At the conclusion of the meeting, the NRC Chief examiner thanked the facility for their support in the administration of the examinations.

ENCLOSURE 1

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

FACILITY: University of New Mexico

REACTOR TYPE: AGN-201

DATE ADMINISTERED: 02/17/2016

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the Answer sheet provided. Attach all Answer sheets to the examination. Point values are indicated in parentheses for each question. A 70% in each category is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	33.3	_____	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
15.00	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
16.00	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
51.00		_____ FINAL GRADE	_____ %	TOTALS

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

_____
Candidate's Signature

ENCLOSURE 2

Category A – Reactor Theory, Thermodynamics, & Facility Operating Characteristics

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your Answer, write your selection in the blank.

A01 a ___ b ___ c ___ d ___ (0.25 each)

A02 a b c d ___

A03 a b c d ___

A04 a b c d ___

A05 a b c d ___

A06 a b c d ___

A07 a b c d ___

A08 a b c d ___

A09 a b c d ___

A10 a b c d ___

A11 a b c d ___

A12 a b c d ___

A13 a b c d ___

A14 a b c d ___

A15 a b c d ___

A16 a b c d ___

A17 a b c d ___

A18 a b c d ___

A19 a b c d ___

(***** END OF CATEGORY A *****)

Category B – Normal/Emergency Operating Procedures and Radiological Controls

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your Answer, write your selection in the blank.

B01 a b c d ___

B02 a b c d ___

B03 a b c d ___

B04 a b c d ___

B05 a b c d ___

B06 a b c d ___

B07 a b c d ___

B08 a b c d ___

B09 a b c d ___

B10 a b c d ___

B11 a b c d ___

B12 a b c d ___

B13 a ____ b ____ c ____ d ____ (0.25 each)

B14 a b c d ___

B15 a b c d ___

(***** END OF CATEGORY B *****)

Category C – Facility and Radiation Monitoring Systems

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your Answer, write your selection in the blank.

C01 a b c d ___

C02 a b c d ___

C03 a b c d ___

C04 a b c d ___

C05 a ___ b ___ c ___ d ___

e ___ f ___ g ___ h ___ (0.25 each)

C06 a b c d ___

C07 a b c d ___

C08 a b c d ___

C09 a b c d ___

C10 a b c d ___

C11 a b c d ___

C12 a b c d ___

C13 a ___ b ___ c ___ d ___ (0.5 each)

C14 a b c d ___

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

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

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

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

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

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

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

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

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

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

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

EQUATION SHEET

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

$$P_{\max} = \frac{(\beta - \rho)^2}{(2\alpha\lambda)}$$

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

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

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

$$\lambda^* = 1 \times 10^{-4} \text{ sec}$$

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

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

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

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

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

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

$$M = \frac{1 - K_{eff_1}}{1 - K_{eff\,2}}$$

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

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

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

$$T_{\frac{1}{2}} = \frac{0.693}{\lambda} \qquad \Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{K_{eff_1} K_{eff_2}}$$

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

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

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

$$DR = \frac{6 Ci \, E(n)}{R^2}$$

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

DR – Rem, Ci – curies, E – Mev, R – feet

1 Curie = 3.7 x 10^{10} dis/sec **1 kg = 2.21 lb**

1 Horsepower = 2.54 x 10^3 BTU/hr **1 Mw = 3.41 x 10^6 BTU/hr**

1 BTU = 778 ft-lb **°F = 9/5 °C + 32**

1 gal (H_2O) ≈ 8 lb **°C = 5/9 (°F - 32)**

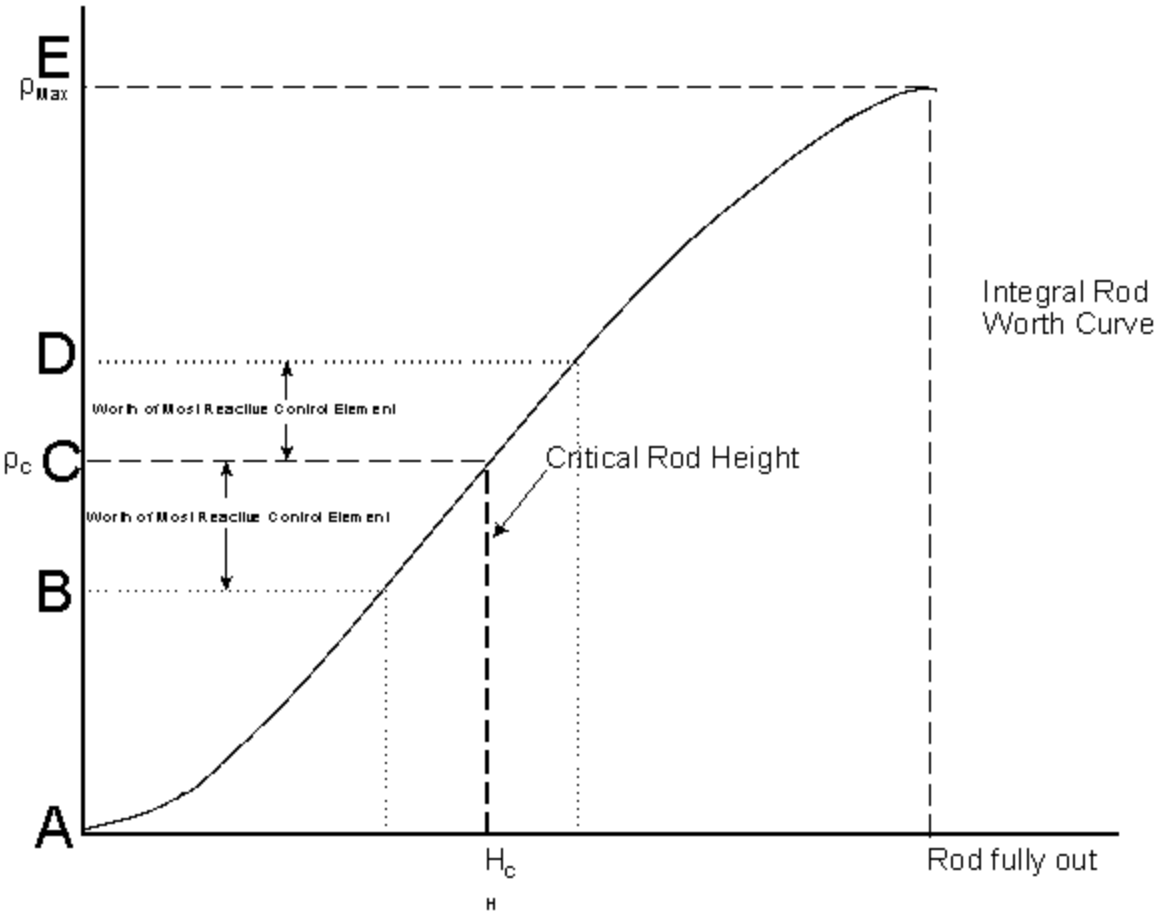
c_P = 1.0 BTU/hr/lb/°F **c_p = 1 cal/sec/gm/°C**

Question A.001 (1.00 point, 0.25 points each) {1.0}
Using the drawing of the Core Rod Position provided, identify each of the following reactivity worths.

a. Total Rod Worth
b. Actual Shutdown Margin
c. Technical Specification Shutdown Margin Limit
d. Excess Reactivity

1. B - A
2. C - A
3. C - B
4. D - C
5. E - C
6. E - D
7. E - A

Answer: A.01 a. = 7; b. = 2; c. = 1; d. = 5
Reference: Standard NRC Question



Question A.002 (1.00 point) {2.0}

Which ONE of the following neutrons would result in the highest probability of fission for ^{235}U?

a. Thermal neutron (0.025 eV)

b. Epi-Thermal neutron (1 eV)

c. Prompt neutron (0.7 MeV)

d. Fast neutron (2 MeV)

Answer: A.02 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 78.

Question A.003 (1.00 point) {3.0}

A critical reactor is operating at a steady-state power level of 1.00 W. Reactor power is increased to a new steady-state power level of 1.05 W. Neglecting any temperature effects, what reactivity insertion is required to accomplish this?

a. 0.05 delta k/k.

b. 5.0% delta k/k.

c. 1.05% delta k/k.

d. Indeterminate, since any amount of positive reactivity could be used.

Answer: A.03 d.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 329.

Question A.004 (1.00 point) {4.0}

During a reactor startup, you insert Coarse Rod #1 in 5 equal steps of 8 cm. The reactor is still subcritical after the fifth step. Which one of the following statements best describes reactor behavior during these 5 rod insertions.

a. Each insertion added the same amount of reactivity.

b. For equal reactivity insertions, reactor power will increase the same amount.

c. The time for reactor power to stabilize after the fifth insertion is longer than the time after the first.

d. If you were to decrease the time between rod insertions, final critical rod height would decrease.

Answer: A.04 c.
Reference: Lamarsh does not cover reactor characteristics for approach to critical.

Question A.005 (1.00 point) {5.0}

You perform two startups with exactly the same core characteristics. During the first startup you proceed straight to criticality. During the second startup you receive a phone call after starting to insert rods, but before reaching criticality. How will this increase in time before reaching criticality affect reactor critical conditions? For the second startup

a. rod height will be the same, reactor power will be the same.

b. rod height will be the same, reactor power will be higher.

c. rod height will be higher, reactor power will be higher.

d. rod height will be lower, reactor power will be lower.

Answer: A.05 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 5.3

Question A.006 (1.00 point) {6.0}

If K_{eff} equals 1.0, what is the minimum amount of reactivity that must be added to the core to make the reactor prompt critical?

a. 10% ΔK/K

b. 75% ΔK/K

c. 10 ΔK/K

d. 75 ΔK/K

Answer A.06 b.
Reference: Lamarsh, Introduction to Nuclear Engineering, Addison-Wesley Publishing, Reading, Massachusetts, 1983, § 7.1, pp. 286 — 287.

Question A.007 (1.00 point) {7.0}

While the reactor is shutdown you place an experiment into the glory hole to determine its worth. The reactor is shutdown by 2% ΔK/K. Before insertion of the experiment, Channel #1 reads 70 cps. After insertion of the experiment, Channel #1 reads 35 cps. What is the worth of the experiment?

a. -2.1% ΔK/K

b. -1.05% ΔK/K

c. -0.21% ΔK/K

d. -0.105% ΔK/K

Answer: A.07 a.
Reference: $SDM = (1 - K_{eff})/K_{eff}$ $K_{eff} = 1/(1 + SDM)$
Given $SDM = 0.2$ $K_{eff} = 1/(1 + 0.2) = 1/1.02$
Initial $K_{eff} = .9804$ $CR_1/CR_2 = (1 - K_{eff1})/(1 - K_{eff2})$
Rearranging: $K_{eff2} = 1 - (1 - K_{eff1}) \times CR_2/CR_1$

K_{eff2} = 1 - [(1 - 0.9804) × 35/70] = 1 - 0.0196 × 2 = 1 - 0.0392 = 0.9608
$\Delta\rho = (K_{eff2} - K_{eff1})/K_{eff2}$ K_{eff2} = (0.9804 - 0.9608)/(0.9804 × 0.9608) = 0.0196/0.94197
$\Delta\rho$ = 0.02081

Question A.008 (1.00 point) {8.0}
Which of the following is the largest effect on the reactivity worth of a control rod?

a. Overall reactor power.

b. Drop time of the control rod.

c. Axial and radial flux shape.

d. Delayed neutron fraction value.

Answer: A.08 c.
Reference: Lamarsh, Nuclear Reactor Theory

Question A.009 (1.00 point) {9.0}
The reactor is initially shut down with count rate at 8 counts per second (cps) and K_{eff} = 0.975. Control rods are inserted, changing K_{eff} to 0.995. Select the stable count rate you would expect.

a. 15 cps

b. 25 cps

c. 40 cps

d. 90 cps

Answer: A.09 c.
Reference: Basic Reactor Theory

Question A.010 (1.00 point) {10.0}
Which one of the following is the correct reason that delayed neutrons allow human control of the reactor?

a. Fewer prompt neutrons are produced than delayed neutrons.

b. Delayed neutrons increase the mean neutron lifetime.

c. Delayed neutrons take longer to thermalize than prompt neutrons.

d. Delayed neutrons are born at higher energies than prompt neutrons.

Answer: A.10 b.
Reference: Standard NRC Question

Question A.011 (1.00 point) {11.0}
Which ONE of the following elements will produce the greatest energy loss per collision?

a. Plutonium

b. Graphite

c. Hydrogen

d. Uranium 238

Answer: A.11 c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, Chapter 3, Section 3.66, Table 3.3, p 134.

Question A.012 (1.00 point) {12.0}
Which ONE of the following causes reactor period to stabilize shortly after a reactor scram from full power? Assume normal system/component operation and no maintenance activity.

a. Xenon removal by decay at a constant rate.

b. Longest lived delayed neutron precursor.

c. Decay of compensating voltage at low power levels.

d. Power level dropping below the minimum detectable level.

Answer: A.12 b.
Reference: Lamarsh, Nuclear Reactor Theory

Question A.013 (1.00 point) {13.0}
What is β?

a. The fraction of all fission neutrons that are born as delayed neutrons.

b. The fractional change in neutron population per generation.

c. The fraction of all delayed neutrons that reach thermal energy.

d. The time required for the reactor to change by power by a factor of e.

Answer: A.13 a.
Reference: DOE Fundamentals *Nuclear Physics and Reactor Theory*, Vol 2, Mod 4

Question A.014 (1.00 point) {14.0}
A reactor with Keff = 0.8 contributes 1000 neutrons in the first generation. When progressing from the FIRST generation to the SECOND generation, how many **TOTAL** neutrons are there after the SECOND generation?

a. 1250

b. 1600

c. 1800

d. 2000

Answer: A.14 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.3, p. 5.6
2nd generation=n + K*n=1000+800=1800 neutrons

Question A.015 (1.00 point) {15.0}

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation defines the:

a. fast fission factor.

b. neutron non-leakage factor.

c. neutron reproduction factor.

d. effective multiplication factor.

Answer: A.15 d.
Reference: Burn, R., Introduction to Nuclear Operation, 1982, Sec 3.3

Question A.016 (1.00 point) {16.0}

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 - increasing from 1% to 6% of rated power.

b. 10% of rated power - increasing from 10% to 20% of rated power.

c. 15% of rated power - increasing from 20% to 35% of rated power.

d. 20% of rated power - increasing from 40% to 60% of rated power.

Answer: A.16 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, page 4-4.
P/P_o is largest for answer A, therefore requires the longest time.

Question A.017 (1.00 point) {17.0}

Starting with a critical reactor at low power, a control rod is inserted 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. withdrawn deeper than position X.

b. withdrawn, but not as far as position X.

c. withdrawn back to position X.

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

Answer: A.17 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations.

Question A.018 [1.0 point] {18.0}

The probability of neutron interaction per cm of travel in a material is defined as:

a. a neutron flux.

b. a mean free path.

c. a microscopic cross section.

d. a macroscopic cross section.

Answer: A.18 d.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Section 2.5.2, page 2-44.

Question A.019 [1.0 point] {19.0}
Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. Lowering moderator temperature if the moderator temperature coefficient is negative.

b. Inserting an experiment adding positive reactivity.

c. Depletion of a burnable poison.

d. Depletion of uranium fuel.

Answer: A.19 d.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.3, p. 6-4.

END OF CATEGORY A

Question B.001 [1.0 point] {1.0}
The Emergency Planning Zone (EPZ) has been evacuated. Which ONE of the following staff positions is responsible (by title) for authorizing reentry?

a. The Senior Reactor Operator
b. The Chief Reactor Supervisor
c. The Director of Emergency Operations
d. The Radiation Safety Officer

Answer: B.01 c.
Reference: Emergency Plan 8/31/2015, 3.2.2, pg. 5

Question B.002 [1.0 point] {2.0}
Temporary procedures which do NOT change the intent of the original procedure or involve an unreviewed safety question may be approved as a MINIMUM by the:

a. Reactor Operator.
b. Senior Reactor Operator.
c. Chief Reactor Supervisor.
d. Reactor Administrator.

Answer: B.02 c.
Reference: Technical Specifications, 6.6 Procedures, pg. 28

Question B.003 [1.0 point] {3.0}
A radiation survey of an area reveals a general radiation reading of 1 mRem/hr. However, a small section of pipe (point source) reads 10 mRem/hr at one (1) meter. Which ONE of the following is the posting requirement for the area, in accordance with 10 CFR Part 20?

a. “CAUTION - RADIATION AREA”
b. “CAUTION - HIGH RADIATION AREA”
c. “CAUTION - RADIOACTIVE MATERIAL”
d. “CAUTION - AIRBORNE RADIOACTIVITY AREA”

Answer: B.03 b.
Reference: 10 CFR 20.1003, For a point source, 10 mrem/hr at 100 cm (1 meter) = 111.1 mrem/hr at 30 cm.

Question B.004 [1.0 point] {4.0}

During Annual Reactor Maintenance, select from the following the most correct answer to the statement "when **shall** a senior reactor operator must be **present**?"

a. Calibration of Nuclear Instrumentation

b. Safety Interlocks Check

c. Core excess reactivity and the worth of the coarse and fine control rods are measured

d. Whenever the console is energized

Answer: B.04 d.
Reference: Reactor Operation and Training Manual – Section IV Maintenance and Inspections

Question B.005 [1.0 point] {5.0}

Which of the following would be considered a non-routine operation except approved experiments?

a. Reactivity is inserted other than by moving the control rod or the neutron source

b. Monthly inspections

c. Routine operation following maintenance

d. Operator training

Answer: B.05 a.
Reference: Reactor Operation and Training Manual – III Operating Procedures

Question B.006 [1.0 point] {6.0}

A channel test of the seismic displacement interlock is required by Technical Specifications to be performed:

a. daily

b. quarterly

c. semiannually

d. annually

Answer: B.06 d.
Reference: Technical Specifications, 4.2.h, pg. 14

Question B.007 [1.0 point] {7.0}

To prevent damage to the reactor or excessive release of radioactive materials in the event of an experiment failure, experiments containing corrosive materials shall:

a. be doubly encapsulated.

b. be limited to less than 10 grams.

c. not be inserted into the reactor or stored at the facility.

d. have a TEDE of less than 500 mrem over two hours from the beginning of the release.

Answer: B.07 a.
Reference: Technical Specifications, 3.3.b Limitations on Experiments, pg. 11

Question B.008 [1.0 point] {8.0}

What type of radiation detector is used for surveying contaminated areas?

a. Ionization chamber

b. Proportional counter

c. Geiger-Mueller tube

d. Scintillation detector

Answer: B.08 c.
Reference: General Radiation Protection Practice.

Question B.009 [1.0 point] {9.0}

During a survey you read 100 mrem/hr with the window open and 40 mRem/hr with the window closed. Which ONE of the following is the dose rate due to GAMMA radiation?

a. 140 mRem/Hr

b. 100 mRem/Hr

c. 60 mRem/Hr

d. 40 mRem/Hr

Answer: B.09 d.
Reference: Dose (γ) = Dose with window closed

Question B.010 [1.0 point] {10.0}
The Technical Specification basis for the MAXIMUM core temperature limit is to prevent:

a. breakdown of the graphite reflector.

b. instrument inaccuracies.

c. release of fission products.

d. boiling of the shield water.

Answer: B.10 c.
Reference Technical Specifications, 2.1 Basis, pg. 5

Question B.011 [1.0 point] {11.0}
In accordance with the UNM AGN emergency plan, which ONE of the following instances would NOT require immediate notification of the UNM police?

a. Bomb threat directed toward the reactor

b. Tornado warning on campus

c. Civil disturbance directed toward the reactor

d. Fire in the Nuclear Engineering Laboratory building lasting more than 10 minutes

Answer: B.11 b.
Reference: Emergency Plan, Section 5.0

Question B.012 [1.0 point] {12.0}
In the event of any emergency, if the radiation levels at the console are greater than_____ mR/hr, the operator shall order an evacuation.

a. 10.

b. 50.

c. 75.

d. 100.

Answer: B.12 d.
Reference: Emergency Plan 8/31/2015 - 7.3.2 Evacuation Procedure, pg. 11

Question B.013 [1.0 point, 0.25 each] {13.0}
Match the operator license requirements in Column A with the proper time period from column B.

Column A	Column B
a. License Renewal	1 year
b. Medical Examination	2 years

c. Requalification Written Exam 4 years

d. Requalification Operating Test 6 years

Answer: B.13 a. = 6; b. = 2; c. = 2; d. = 1
Reference: 10 CFR 55.21, 10 CFR 55.55, 10 CFR 55.59,

Question B.014 [1.0 point] {14.0}
The dose rate from a mixed beta-gamma point 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. At one (1) foot what percentage of the source consists of beta radiation?

a. 20%

b. 40%

c. 60%

d. 80%

Answer: B.14 c
Reference: 10CFR20. At 20 feet, there is no beta radiation. Gamma at 20 feet = 0.1 mrem/hour, gamma at 1 foot = 40 mrem/hour. Therefore beta at 1 foot = 60 mrem/hour = 60%.

Question B.015 [1.0 point] {15.0}
Which ONE of the following defines a CHANNEL CHECK?

a. Connection of output devices for the purpose of measuring the response to a process variable.

b. Adjustment such that the output responds within standards of accuracy and range to known inputs.

c. Introduction of a signal into a channel to verify it is operable.

d. A qualitative verification of acceptable performance by observation of channel behavior.

Answer: B.15 d.
Reference: Technical Specification 1.1.3, pg. 1

END OF CATEGORY B

Question C.001 [1.0 point] {1.0}
The Low Power Interlock is controlled by power level indication from:

a. Channel 1.

b. Channel 2.

c. Channel 3.

d. Auxiliary Channel.

Answer: C.01 b.
Reference: Safety Analysis Report, dated February 2007, Part II, Section C Reactor Control, 3 Fine Rod, pg. 9

Question C.002 [1.0 point] {2.0}
Which one of the following materials will have a positive effect on reactivity when inserted into the Glory Hole?

a. Borated Polyethylene

b. Polyethylene

c. Natural Uranium

d. Gold

Answer: C.02 b.
Reference: NRC Examination Question Bank

Question C.003 [1.0 point] {3.0}
Which power channel detector high voltage is automatically removed when a pre-selected

power level is reached:

a. Channel 1.

b. Channel 2.

c. Channel 3.

d. Auxiliary Channel.

Answer: C.03 a.
Reference: UNM - Start-up Procedure

Question C.004 [1.0 point] {4.0}

Which ONE of the following statements describes the design/operation of the control rod drive assemblies?

a. The fine control rod does not have a dashpot since it does not scram.

b. The dashpots consist of a foam cushion to reduce rod impact following a scram.

c. The course control rod dashpot uses magnetic force to slow the rod down before impact on a scram.

d. Dashpots are only associated with the safety rods since these rods have been raised against spring tension to assist in driving these rods down on a scram.

Answer: C.04 a.
Reference: SAR Figure 1 - Control Rod Drive Motor and Assembly

Question C.005 [2.0 point, 0.25 each] {6.0}

In the attached Figure 1 diagram, match the identified items with the correct numbered locations on the diagram:

a. Ionization Channel 2

b. Lead

c. Reactor Tank

d. Ionization Channel 3

e. Core

f. Core Tank

g. Fission Chamber

h. Glory Hole

Answer: C.05 a. = 8; b. = 4; c. = 2; d. = 9; e. = 6; f. = 3; g. = 10; h. = 12
Reference: Safety Analysis Report, dated February 2007, Figure 2 - Top View of Reactor and Instrumentation

Question C.006 [1.0 point] {7.0}

The shield tank is designed to provide shielding from:

a. the glory hole area.

b. high energy β radiation.

c. high energy γ radiation.

d. fast neutron radiation.

Answer: C.06 d.
Reference: TS. 5.1.d, pg. 18

Question C.007 [1.0 point] {8.0}

The shield tank water temperature interlock prevents reactor operation:

a. during periods of high thermal stress.

b. in the event of a high temperature condition.

c. during a condition that will produce excess radiation levels.

d. from a reactivity addition due to a temperature decrease.

Answer: C.07 d.
Reference: Technical Specification, 3.2 Basis

Question C.008 [1.0 point] {9.0}

The shield tank water level trip will occur if water level drops below:

a. 18 cm

b. 14 cm

c. 10 cm

d. 8 cm

Answer: C.08 a.
Reference: Technical Specification, 3.2.g, pg. 9

Question C.009 [1.0 point] {10.0}

The reactor Access Ports pass through the steel tank:

a. up to the graphite.

b. then the lead shield, and the graphite reflector.

c. then the lead shield, the graphite reflector, repeats in reverse, and then back out.

d. then the lead shield, the graphite reflector, the core, repeats in reverse, and then back out.

Answer: C.09 b.
Reference: Reactor Operation and Training Manual**,** Jan. 2013, page 8

Question C.010 [1.0 point] {11.0}

Which ONE of the following does **NOT** automatically cause rod magnet current deactivation?

a. Shield water level >18cm below highest manhole opening.

b. Shield tank temperature <18^{o}C.

c. Radiation level.

d. Earthquake Switch.

Answer: C.010 c.
Reference: Reactor Operation and Training Manual**,** Jan. 2013,

Question C.011 [1.0 point] {12.0}

Which ONE control rod listed below will NOT instantaneously eject from the core in the event of a SCRAM?

a. Fine.

b. Coarse.

c. Safety 1.

d. Safety 2.

Answer: C.11 a.
Reference: Reactor Operation and Training Manual, Jan. 2013, Section 5

Question C.012 [1.0 point] {13.0}

What material is typically placed in the glory hole to ensure the reactor stays in a sub-critical mode when no one is present?

a. Boron.

b. Beryllium.

c. Cadmium.

d. Polyethylene.

Answer: C.12 c.
Reference: Reactor Operation and Training Manual, Jan. 2013

Question C.013 [2.0 points, 0.5 each] {15.0}

Identify each of the following values as either a Safety Limit (SL), a Limited Safety Setting (LSSS) or a Limiting Condition for Operation (LCO).

a. the maximum core temperature shall not exceed 200ºC during operation _____.

b. polystyrene core thermal fuse melts when heated to a temperature of about 120ºC_____.

c. excess reactivity shall not exceed 0.65% delta k/k _____.

d. shall not exceed 0.065% delta k/k per second _____.

Answer: B.13 a. = SL; b. = LSSS; c. = LCO; d. = LCO
Reference: Technical Specification

Question C.014 [1.0 point] {16.0}

An aluminum baffle plate separates the fuel disks in the upper section of the core from the fuel disks in the lower section of the core. Of the total of _____ fuel disks, ___ are in the upper section and _____ are in the lower section.

a. 7; 4; 3
b. 7; 3; 4
c. 9; 6; 3
d. 9; 5; 4

Answer: C.14 c.
Reference: SAR, Figure 4 - Fuel Disc Loading, pg. 5

END OF CATEGORY C

END OF WRITTEN EXAMINATION