

October 20, 2016

Dr. Robert Busch, Chief Reactor Supervisor
Nuclear Engineering Department
209 Farris Engineering, MSC 01-1120
University of New Mexico
Albuquerque, NM 87131-0001

SUBJECT: EXAMINATION REPORT NO. 50-252/OL-16-02, UNIVERSITY OF NEW MEXICO

Dear Dr. Busch:

During the week of September 12, 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 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 Ms. Michele DeSouza at (301) 415-0747 or via internet 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-16-02
2. Written examination

cc: w/o enclosures: See next page

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NAME	MDeSouza/JNgyuen for	CRevelle	AMendiola
DATE	09/20/2016	10/11/2016	10/20/2016

OFFICIAL RECORD COPY

cc:

City Manager
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Albuquerque, NM 87101

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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-16-02

FACILITY DOCKET NO.: 50-252

FACILITY LICENSE NO.: R-102

FACILITY: University of New Mexico Reactor

EXAMINATION DATES: September 14, 2015

SUBMITTED BY: /RA/ 09/19/2016
Michele DeSouza, Chief Examiner Date

SUMMARY:

During the week of September 12, 2016 the NRC administered a retake licensing examination to one Reactor Operator (RO) candidate. The candidate passed Category B of the retake examination.

REPORT DETAILS

1. Examiner: Michele DeSouza, Chief Examiner, NRC

2. Results:

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

3. Exit Meeting:
Michele C. DeSouza, Chief Examiner, NRC
Ken Carpenter, UNM Facilities Manager

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

ENCLOSURE 1

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

FACILITY: University of New Mexico

REACTOR TYPE: AGN-201

DATE ADMINISTERED: 09/14/2016

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.

<u>CATEGORY</u>	<u>% OF</u>	<u>CANDIDATE'S</u>	<u>% OF</u>	
<u>VALUE</u>	<u>TOTAL</u>	<u>SCORE</u>	<u>VALUE</u>	<u>CATEGORY</u>
<u>WAIVE</u>	<u>NA</u>	<u>WAIVE</u>	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
<u>20.00</u>	<u>33.3</u>	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
<u>WAIVE</u>	<u>NA</u>	<u>WAIVE</u>	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
<u>20.00</u>		_____	_____	% TOTALS
		<u>FINAL GRADE</u>		

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

Candidate's Signature

ENCLOSURE 2

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 ____ (0.25 each)

B10 a b c d ____

B11 a b c d ____

B12 a b c d ____

B13 a b c d ____

B14 a b c d ____

B15 a b c d ____

B16 a ____ b ____ c ____ d ____ (0.25 each)

B17 a b c d ____

B18 a b c d ____

B19 a b c d ____

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

$$Q = m c_p \Delta T = m \Delta H = U A \Delta T$$

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

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

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

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

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

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

$$CR_1 (1 - K_{\text{eff}_1}) = CR_2 (1 - K_{\text{eff}_2})$$

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

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

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

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

$$M = \frac{1 - K_{\text{eff}_1}}{1 - K_{\text{eff}_2}}$$

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

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

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

$$T_{\frac{1}{2}} = \frac{0.693}{\lambda} \quad \Delta \rho = \frac{K_{\text{eff}_2} - K_{\text{eff}_1}}{K_{\text{eff}_1} K_{\text{eff}_2}}$$

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

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

$$DR_1 d_1^2 = DR_2 d_2^2$$

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

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

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

1 Curie = 3.7 x 10¹⁰ dis/sec

1 kg = 2.21 lb

1 Horsepower = 2.54 x 10³ BTU/hr

1 Mw = 3.41 x 10⁶ BTU/hr

1 BTU = 778 ft-lb

°F = 9/5 °C + 32

1 gal (H₂O) ≈ 8 lb

°C = 5/9 (°F - 32)

c_p = 1.0 BTU/hr/lb/°F

c_p = 1 cal/sec/gm/°C

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.01 [1.0 point]

Which ONE of the following reactor conditions is a violation of UNM Technical Specifications?

- a. Absolute reactivity is $0.55\% \Delta k/k$
- b. Shutdown margin is $\$0.50$
- c. Shield water temperature is 15°C
- d. Excess reactivity is $0.20\% \Delta k/k$

QUESTION B.02 [1.0 point]

In accordance with UNM emergency plan, which ONE of the following is the MAXIMUM exposure and intake limit for life threatening situations, or to deal with situations which are likely to lead to life-threatening situations?

- a. 25 Rem
- b. 30 Rem
- c. 45 Rem
- d. 50 Rem

QUESTION B.03 [1.0 point]

Which ONE of the following surveillances DOES NOT require a maximum annual frequency?

- a. Manual SCRAM
- b. Control rods and drives
- c. Control rod SCRAM
- d. Power level measuring channels calibration

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.04 [1.0 point, 0.25 each]

Match the emergency situation listed in Column A with the classification level listed in Column B. (Answers may be used more than once or not at all)

Column A

- a. Tornado
- b. Civil disturbance to the reactor facility
- c. Nuclear Engineering lab fire extinguished in 5 minutes
- d. Site boundary level of 15MPC

Column B

- 1. Notification of UNM police
- 2. Abnormal levels of radiation
- 3. No Classification

QUESTION B.05 [1.0 point]

Per UNM Technical Specifications, how often is a channel test of the seismic displacement interlock required to be performed?

- a. Daily
- b. Quarterly
- c. Semi-annually
- d. Annually

QUESTION B.06 [1.0 point]

According to the UNM Emergency Plan, "transportation of injured personnel, including those who may be radioactively contaminated" requiring transport to the hospital will be by _____?"

- a. Senior Reactor Operator
- b. Reactor Safety Committee
- c. UNM Police Department
- d. Albuquerque Fire Department

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.07 [1.0 point]

A radioactive source has a current activity of 3 Curies. The activity 30 years ago was 300 Curies. What is the half-life of the radioactive source?

- a. 4.5 years
- b. 10.5 years
- c. 15 years
- d. 20 years

QUESTION B.08 [1.0 point]

How many hours (MINIMUM) are Test and Research Reactors licensed operators required to perform the functions of a licensed operator to resume activities if a licensee has not been actively performing the functions of a reactor operator or senior reactor operator?

- a. 4 hours
- b. 6 hours
- c. 8 hours
- d. 10 hours

QUESTION B.09 [1.0 point, 0.25 each]

Identify each of the following surveillances as a channel check (CHECK), a channel test (TEST), or a channel calibration (CAL). Write the correct answer on your answer sheet next to the space given for each example listed below.

- a. During performance of the daily checklist, you compare the readings of radiation area monitor one and radiation monitor two
- b. During performance of the daily checklist, you press the scram button to verify a scram on the safety system channel
- c. Adjustment of the wide range monitor channel in accordance with recent data collected during a reactor power calibration
- d. You expose a 2 mCi check source to the continuous air monitor detector to verify that its output is operable

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.10 [1.0 point]

UNM Technical Specification basis for the MAXIMUM core temperature limit is to prevent which ONE of the following?

- a. Instrument inaccuracies
- b. Boiling of the shield water
- c. Release of fission products
- d. Breakdown of the graphite reflector

QUESTION B.11 [1.0 point]

Which ONE of the following meets the MINIMUM staffing requirement when the reactor is NOT secured?

- a. 1 RO in the control room, 1 person in NRL, 1 rad safety, and one on call reactor supervisor
- b. 1 SRO in the control room, 1 rad safety, and one on call reactor supervisor
- c. 1 RO in the control room, 1 person in control room, and one on call reactor supervisor
- d. 1 SRO in the control room and one on call reactor supervisor

QUESTION B.12 [1.0 point]

Calculate an individual's total whole body dose given the individual received the following doses: 20 mrad of alpha, 10 mrad of gamma, and 5 mrad of neutron (unknown energy)

- a. 35 mrem
- b. 415 mrem
- c. 435 mrem
- d. 460 mrem

QUESTION B.13 [1.0 point]

A radiation field is 330 mR/hr at 4 feet. What is your dose rate at 2 feet away from the source?

- a. 499 mR/hr
- b. 580 mR/hr
- c. 660 mR/hr
- d. 1320 mR/hr

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.14 [1.0 point]

Which ONE of the following experiments is NOT allowed in accordance with UNM Technical Specifications?

- a. Liquid fissionable materials
- b. Radioactive materials
- c. Explosive materials
- d. Corrosive materials

QUESTION B.15 [1.0 point]

Which ONE of the following locations is the normal Emergency Support Center per the Emergency Plan?

- a. Reactor Control Room
- b. Reactor Shop
- c. Nuclear Engineering Lab, room 60
- d. Reactor Supervisor's Office

QUESTION B.16 [1.0 point, 0.25 each]

Match the appropriate 10CFR part in Column A with the requirements in Column B.

Column A

Column B

- | | |
|------------|---|
| a. 10CFR19 | 1. Technical information including the proposed maximum power level |
| b. 10CFR20 | 2. Individual radiation exposure data |
| c. 10CFR50 | 3. Postings of notices to workers |
| d. 10CFR55 | 4. Medical examination by a physician every two years |

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.17 [1.0 point]

Which ONE of the following would be considered a non-routine operation?

- a. Safety interlock checks
- b. Whenever the console is energized
- c. Calibration of Nuclear Instrumentation
- d. Core excess reactivity and the worth of the coarse and fine control rods are measured

QUESTION B.18 [1.0 point, 0.33 each]

Match the following limitations in Column A with its specification in Column B (Assume natural convection; Answers may be used more than once or not at all)

Column A

- a. Safety Limit
- b. Limiting Safety System Setting
- c. Limiting Condition for Operation

Column B

- 1. Maximum shutdown margin \$1.00
- 2. Maximum core temperature 200°C
- 3. Maximum high power of 6W

QUESTION B.19 [1.0 point]

A 2.5 curie source emits a 1.332MeV gamma and a 1.173MeV gamma 100% of the time. The source will be placed in the reactor storage room. How far from the source should a high radiation area sign be posted?

- a. Not required
- b. 10 feet
- c. 15 feet
- d. 20 feet

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B. 20 [1.0 point]

Which ONE of the following radiation levels at the console requires the operator to order an evacuation?

- a. 25
- b. 50
- c. 75
- d. 100

(***** End of Category B *****)

(*****End of Examination*****)

Category B: Normal/Emergency Operating Procedures and Radiological Controls

B.1

Answer: c
Reference: UNM Technical Specifications 2.2 and 3.2

B.2

Answer: a
Reference: 10CFR20.1206 and UNM Emergency Plan 7.3.3

B.3

Answer: a
Reference: UNM Technical Specifications 4.1 and 4.2

B.4

Answer: a(1),b(1),c(3),d(2)
Reference: UNM Emergency Plan

B.5

Answer: d
Reference: UNM Technical Specifications 4.2

B.6

Answer: d
Reference: UNM Emergency Plan 8.3.2

B.7

Answer: a
Reference: $T A = A_0 \cdot e^{-\lambda t}$
 $3\text{Ci} = 300\text{Ci} \cdot e^{-\lambda(t)}$ Note: $\lambda = -\ln 2 / t^{1/2}$
 $\ln(3/300) = -\ln 2 / X \text{ yr} \cdot (30 \text{ years}) \rightarrow -4.605 / -1.021 \rightarrow$
solve for t: 4.51 years

B.8

Answer: b
Reference: 10CFR55.53(f)(2)

B.9

Answer: a (check), b (test), c (cal), d (test)
Reference: UNM Technical Specifications 1, definitions

B.10

Answer: c
Reference: UNM Technical Specifications 2.1

B.11

Answer: a
Reference: UNM Technical Specifications 6.1.3

B.12

Answer: d
Reference: $20\text{mrad Alpha} \times 20 = 400\text{mrem}$, $10\text{mrad Gamma} \times 1 = 10\text{mrem}$, $5\text{mrad neutron} \times 10 = 50\text{mrem} \rightarrow 400\text{mrem} + 10\text{mrem} + 50\text{mrem} = 460\text{mrem}$

Category B: Normal/Emergency Operating Procedures and Radiological Controls

B.13

Answer: d

Reference: $I_1 D_1^2 = I_2 D_2^2 \rightarrow 330 \text{ mR/hr} @ (4 \text{ ft})^2 = I_2 @ (2 \text{ ft})^2 \rightarrow 1320 \text{ mR/hr}$

B.14

Answer: c

Reference: UNM Technical Specifications 3.3

B.15

Answer: c

Reference: UNM Emergency Plan 8.1

B.16

Answer: a (3), b(2), c(1), d(4)

Reference: 10CFR19.11, 10CFR20.1501(2)(i), 10CFR50.34(1)(ii)(A), 10CFR55.21

B.17

Answer: b

Reference: UNM Reactor Operation and Training Manual III, Operating Procedures

B.18

Answer: a(2), b(3), c(1)

Reference: UNM Technical Specifications 2.1, 2.2, and 3.1

B.19

Answer: d

Reference: $I = 6 C E n = \text{R/hr} @ \text{ft.} \rightarrow 6 \times 25 \text{ Ci} \times [(1.332 \text{ Mev} \times 100\%) + (1.173 \times 100\%)] = 375.75 \text{ R/hr} @ (1 \text{ ft})^2 = 0.1 \text{ R/hr} @ D^2 = \sqrt{376 \text{ R/hr}} = 19.4 \text{ ft.}$

B.20

Answer: d

Reference: UNM Emergency Plan 7.3.2