

September 13, 2016

Dr. Jeffrey Geuther, Manager
KSU Nuclear Reactor Facility
Department of Mechanical and Nuclear Engineering
112 Ward Hall
Kansas State University
Manhattan, KS 66506-5204

SUBJECT: EXAMINATION REPORT NO.: 50-188/OL-16-03, KANSAS STATE UNIVERSITY

Dear Dr. Geuther:

During the week of September 1, 2016, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Kansas State University 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 you and 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 enclosure 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 Mrs. Paulette Torres at (301) 415-5656 or via e-mail Paulette.Torres@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. 50-188

Enclosures: 1. Examination Report No. 50-188/OL-16-03
2. Written Examination

cc: w/o enclosure: See next page

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DISTRIBUTION w/ encl.

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ADAMS Accession No. ML16257A444

NRR-074

OFFICE	NRR/DPR/PROB	NRR/DIRS/IOLB/OLA	NRR/DPR/PROB/BC
NAME	PTorres	CRevelle	AMendiola
DATE	9/07/2016	9/13/2016	9/13/2016

OFFICIAL RECORD COPY

Kansas State University
cc:

Docket NO: 50-188

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

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 09/01/2016

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 one (1) hour 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>20.00</u>	<u>100.0</u>	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
<u>20.00</u>		_____	_____	% TOTALS
		FINAL GRADE		

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

Candidate's Signature

B. Normal/Emergency Procedures and Radiological Controls

ANSWER SHEET

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 ____

B14 a b c d ____

B15 a b c d ____

B16 a b c d ____

B17 a b c d ____

B18 a b c d ____

B19 a b c d ____

B20 a b c d ____

(***** END OF SECTION 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

$$Q = mc_p \Delta T = m \Delta H = UA \Delta T$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 Curie = 3.7 x 10¹⁰ dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54 x 10³ BTU/hr

1 Mw = 3.41 x 10⁶ BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal (H₂O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_p = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C



KANSAS STATE UNIVERSITY

Operator Licensing Examination

Week of September 1, 2016

QUESTION B.01 [1.0 point]

Per definition in the Emergency Plan, Dose Commitment is _____.

- a. A term denoting the quantity of radiation or energy absorbed.
- b. A quantity that expresses all radiation on a common scale for determining the biological effect.
- c. The radiation dose equivalent received by an exposed individual or a specific organ cited over a lifetime from a single event.
- d. The dose equivalent that is projected to be received by individuals in a population group from a contaminating event if no protective actions were taken.

QUESTION B.02 [1.0 point]

Which ONE of the following SHALL NOT exceed the equivalent of 25 milligrams of TNT without prior USNRC approval?

- a. Fueled experiment.
- b. Material corrosive to the reactor.
- c. Explosive solid material with a National Fire Protection Association Reactivity index of 1.
- d. Explosive liquid material with a National Fire Protection Association Reactivity index of 2.

QUESTION B.03 [1.0 point]

The Emergency Plan allows the Emergency Team Worker to have a Whole Body radiation exposure limit of _____ Rem for the protection of valuable property and _____ Rem for life saving.

- a. 5 and 50
- b. 10 and 25
- c. 25 and 50
- d. 25 and 100

QUESTION B.04 [1.0 point]

Where is the Emergency Assembly Area #2 located?

- a. Lobby of Ward Hall
- b. Basement of Ward Hall (Room 007)
- c. Control Room (Room 109)
- d. Reractor Bay (Room 110)

QUESTION B.05 [1.0 point]

A radioactive sample which initially was reading 50 R/hr has decayed over 8 hours to 25 R/hr. What will the sample read in another 4 hours?

- a. 12.5 R/hr
- b. 17.7 R/hr
- c. 18.8 R/hr
- d. 22.9 R/hr

QUESTION B.06 [1.0 point]

The dose rate from a mixed beta-gamma point source is 100 mrem/hour at a distance of 1 foot, and is 0.1 mrem/hour at a distance of 20 feet. What percentage of the source consists of beta radiation?

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

QUESTION B.07 [1.0 point]

In order to ensure the health and safety of the public, in an emergency, 10 CFR 50 allows the operator to deviate from Technical Specifications. What is the minimum level of authorization needed to deviate from Technical Specifications?

- a. USNRC
- b. Reactor Supervisor
- c. Licensed Reactor Operator
- d. Licensed Senior Reactor Operator

QUESTION B.08 [1.0 point]

_____ are those not connected by a mechanical, chemical, or electrical link to another experiment.

- a. Movable experiments
- b. Nonsecured experiments
- c. Independent experiments
- d. Secured experiments with movable parts

QUESTION B.09 [1.0 point]

Based on 10 CFR 55, which ONE of the following is the MINIMUM requirement that must be met to retain an active Reactor Operator license? Must perform license duties:

- a. A minimum of 8 hours per month.
- b. At least 40 hours per calendar year.
- c. A minimum of 4 hours per calendar quarter.
- d. A minimum of 5 eight-hour shifts per calendar quarter.

QUESTION B.10 [1.0 point]

The releases of Argon-41 from the reactor bay exhaust plenum to an unrestricted environment shall not exceed:

- a. 30 Ci per year
- b. 2000 DAC hours
- c. 10 mrem per year
- d. 50 mrem per 24 hour period

QUESTION B.11 [1.0 point]

A fuel element that is laterally bent greater than 1/8 in. may give indication of a:

- a. Fission product release from the reactor.
- b. Activation of argon in air from the reactor.
- c. Disassociation of water and nitrogen-16 production.
- d. Activation of aluminum from reactor and primary piping materials.

QUESTION B.12 [1.0 point]

Which ONE of the following is identified as a Limiting Condition of Operation (LCO)?

- a. Stainless steel clad, high-hydride fuel element temperature shall not exceed 1150°C.
- b. Power level shall not exceed 1,250 kW (th) in steady state mode of operation.
- c. The standard fuel elements shall be visually inspected for corrosion and mechanical damage, and measured for length and bend.
- d. Water temperature at the exit of the reactor pool shall not exceed 130°C with flow through the primary cleanup.

QUESTION B.13 [1.0 point]

The unit of dose equivalent is the _____.

- a. Rad
- b. Rem
- c. Gray
- d. Becquerel

QUESTION B.14 [1.0 point]

Which ONE of the following is the correct line of succession to designate the Emergency Director?

- a. Reactor Manager, Reactor Supervisor, Senior Reactor Operators, Reactor Safeguards Committee.
- b. Reactor Supervisor, Reactor Manager, Reactor Safeguards Committee, Senior Reactor Operators.
- c. Reactor Safeguards Committee, Reactor Supervisor, Reactor Manager, Senior Reactor Operators.
- d. Reactor Supervisor, Reactor Manager, Senior Reactor Operators, Reactor Safeguards Committee.

QUESTION B.15 [1.0 point]

The KSU ALARA Goal (annual) established to the fetus during pregnancy is:

- a. < 500 mrem annual TEDE
- b. < 50 mrem DOSE EQUIVALENT
- c. < 5 rem annual DOSE EQUIVALENT
- d. < 1.5 rem annual DOSE EQUIVALENT

QUESTION B.16 [1.0 point]

Which ONE of the following IS NOT an exit condition for the IRIS experimental procedure?

- a. The reactor is secured.
- b. Sample lead wires are stored in the fully withdrawn position.
- c. Sample mass must be verified by reactor staff after irradiation.
- d. All samples and sample capsules have been removed from the IRIS.

QUESTION B.17 [1.0 point]

Which ONE of the following procedures has a PRECAUTIONS AND LIMITS condition of having a REACTIVITY BALANCE completed prior performing the procedure?

- a. Annual Power Level Calibration Procedure
- b. Control Rod Drop Time Measurement Procedure
- c. Removal of Fuel from the Reactor Tank Procedure
- d. Reactor Start-Up with Period SCRAM Bypassed Procedure

QUESTION B.18 [1.0 point]

Per KSU Reactor Training Manual, film badges containing both gamma and neutron sensitive film will be issue to, and worn by:

- a. Authorized personnel as needed, when working around the beam ports.
- b. All visitors at the reactor.
- c. All licensed reactor operators at the reactor.
- d. All staff personnel and students who regularly work at the reactor.

QUESTION B.19 [1.0 point]

The principal radionuclide typically discharged to sewerage from the K-State reactor to sanitary sewerage is:

- a. H-3
- b. C-14
- c. Co-58
- d. Sr-90

QUESTION B.20 [1.0 point]

The automatic flux control system uses the period signal from the _____ to limit rod movements when the reactor period is short.

- a. PA-1000 Preamplifier
- b. NLW-1000 Wide Range Power Level
- c. NMP-1000 Multi Range Linear Power
- d. NPP-1000 Percent Power and Pulsing

***** End of Section B *****
***** End of the Exam *****

B.01

Answer: c
REF: Emergency Plan & Emergency Plan Procedures, Section 2.1, pg. 10

B.02

Answer: d
REF: TS 5.4.3 (9), pg. TS-41

B.03

Answer: b
REF: Emergency Plan & Emergency Plan Procedures, Table 9.1, pg. 34

B.04

Answer: b
REF: Emergency Plan & Emergency Plan Procedures, Figure 1.6, pg. 7 and Section 6.3, pg. 26

B.05

Answer: b
REF: $A = A_0e^{-(\lambda t)}$
 $25 = 50 e^{-(\lambda \times 8 \times 3600)}$
 $\lambda = 2.4 \times 10^4 \text{ sec}$
 $A = 25e^{(-2.4 \times 10^4 \times 4 \times 3600)}$
 $A = 17.7 \text{ R/hr}$

B.06

Answer: c
REF: 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%.

B.07

Answer: d
REF: 10 CFR 50.54(y)

B.08

Answer: c
REF: TS 1, pg. 6

B.09

Answer: c
REF: 10 CFR 55.53(e)

B.10

Answer: a
REF: TS 3.5.3(2), pg. 20

B.11

Answer: a
REF: TS 3.7.3(2) and 3.7.5, pg.24

B.12

Answer: d
REF: TS 3.8.3 (1), pg. 25

B.13

Answer: b
REF: Emergency Plan & Emergency Plan Procedures, Section 2.1, pg. 11

B.14

Answer: a
REF: Emergency Plan & Emergency Plan Procedures, Section 3.2, pg. 13

B.15

Answer: b
REF: Radiation Protection Program, Section 6, pg. 15 of 19

B.16

Answer: c
REF: Experiment 51 – Sample Irradiation in the Intra-Reflector Irradiation System (IRIS), Exit Conditions, pg. 2 of 2

B.17

Answer: c
REF: Procedure No. 27 - c. Removal of Fuel from the Reactor Tank Procedure, Precautions And Limits, pg. 1 of 5

B.18

Answer: d
REF: KSU Reactor Training Manual, Operations Manual, Section 8.4, pg. 30 of 212

B.19

Answer: a
REF: Procedure No. 24 – Sump Water Discharge System, Precautions and Limits, pg. 2 of 7

B.20

Answer: b
REF: Procedure No. 23 - Automatic Flux Control System, Discussion, pg. 1 of 3