December 15, 2011

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: EXAMINATION REPORT NO. 50-128/OL-12-01, TEXAS A&M UNIVERSITY (TRIGA)

Dear Dr. Reece:

During the week of November 14, 2011, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Texas A&M University TRIGA 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 at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10, Section 2.390 of the Code of Federal Regulations, 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 Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Mr. John T. Nguyen at (301) 415-4007 or via internet e-mail John.Nguyen@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-128

Enclosures: 1. Examination Report No. 50-128/OL-12-01
2. Written Exam with facility comments incorporated

cc: Jerry E. Newhouse
cc: w/o enclosures: See next page

December 15, 2011

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 77843-3575

SUBJECT: EXAMINATION REPORT NO. 50-128/OL-12-01, TEXAS A&M UNIVERSITY (TRIGA)

Dear Dr. Reece:

During the week of November 14, 2011, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Texas A&M University TRIGA 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 at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10, Section 2.390 of the Code of Federal Regulations, 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 Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Mr. John T. Nguyen at (301) 415-4007 or via internet e-mail John.Nguyen@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-128

Enclosures: 1. Examination Results Report No. 50-128/OL-12-01
2. Written Exam with facility comments incorporated
cc: Jerry E. Newhouse
cc: w/o enclosures: See next page

DISTRIBUTION w/ encls:
PUBLIC PROB r/f RidsNrrDprProb RidsNrrDprPrlb Facility File (CRevelle)

ADAMS Accession No: ML113360340

OFFICE	PROB:CE		IOLB:LA	E	PROB:BC
NAME	JNguyen		CRevelle		JEads
DATE	11/30/2011		12/15 /2011		12/15 /2011

OFFICIAL RECORD COPY

cc:

Mayor, City of College Station
P.O. Box Drawer 9960
College Station, TX 77840-3575

Governor's Budget and
Planning Office
P.O. Box 13561
Austin, TX 78711

Texas A&M University System
ATTN: Jim Remlinger, Associate Director
Nuclear Science Center
Texas Engineering Experiment Station
F. E. Box 89, M/S 3575
College Station, Texas 77843

Radiation Program Officer
Bureau of Radiation Control
Dept. Of State Health Services
Division for Regulatory Services
1100 West 49th Street, MC 2828
Austin, TX 78756-3189

Susan M. Jablonski
Technical Advisor
Office of Permitting, Remediation & Registration
Texas Commission on Environmental Quality
P.O. Box 13087, MS 122
Austin, TX 78711-3087

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-12-01

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: Texas A&M University TRIGA Reactor

EXAMINATION DATES: November 14 – November 16, 2011

SUBMITTED BY: _____**/RA/**_____ _11/30/2011__
John T. Nguyen, Chief Examiner Date

SUMMARY:

During the week of November 14, 2011, the NRC administered operator licensing examinations to one Reactor Operator license candidate and three Senior Reactor Operator Upgrade license candidates. All license candidates passed all applicable portions of the examinations.

REPORT DETAILS

1. Examiners: John T. Nguyen, Chief Examiner, NRC

2. Results:

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

3. Exit Meeting:
John T. Nguyen, Chief Examiner, NRC
Warren D. Reece, Director, Texas A&M University TRIGA Reactor
Jerry Newhouse, Reactor Supervisor, Texas A&M University TRIGA Reactor

At the conclusion of the site visit, the examiner met with representatives of the facility staff to discuss the results of the examinations. The examiner thanked the facility for their support of the examination.

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

FACILITY: Texas A&M University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 11/14/2011

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
20.00	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60.00		_____ FINAL GRADE	_____ %	TOTALS

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

_____
Candidate's Signature

ENCLOSURE 2

A. RX THEORY, THERMO & FAC OP CHARS

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 ___

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 ___

A20 a b c d ___

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

B. NORMAL/EMERG PROCEDURES & RAD CON

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 ___

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 CATEGORY B *****)

C. PLANT AND RAD 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 ___

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 ___

C14 a b c d ___

C15 a b c d ___

C16 a b c d ___

C17 a b c d ___

C18 a b c d ___

C19 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

$\dot{Q} = \dot{m}\, c_p\, \Delta T$

$\dot{Q} = \dot{m}\, \Delta h$

$\dot{Q} = UA\, \Delta T$

$$SUR = \frac{26.06\ (\lambda_{eff}\rho)}{(\beta - \rho)}$$

$SUR = 26.06/\tau$

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

$P = P_0\ e^{(t/\tau)}$

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

$\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$

$\rho = (Keff-1)/Keff$

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.007$

$DR_1D_1^2 = DR_2D_2^2$

$Cp\ (H20) = 0.146\ \frac{kw}{gpm \cdot {}^\circ F}$

$\lambda_{eff} = 0.1/sec$

$SCR = S/(1-Keff)$

$CR_1\ (1-Keff)_1 = CR_2\ (1-Keff)_2$

$$M = \frac{(1-Keff)_0}{(1-Keff)_1}$$

$M = 1/(1-Keff) = CR_1/CR_0$

$SDM = (1-Keff)/Keff$

$I = I_o\ e^{-ux}$

$\ell^* = 1 \times 10^{-4}$ seconds

$\bar{\tau} = \ell^*/(\rho-\beta)$

$R = 6\ C\ E\ n$

$$T_{1/2} = \frac{0.693}{\lambda}$$

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

$P = S / (1 - Keff)$

---

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

$^\circ F = 9/5\,^\circ C + 32$

931 Mev = 1 amu

$^\circ C = 5/9\ (^\circ F - 32)$

TEXAS A&M UNIVERSITY TRIGA REACTOR

Operator Licensing Examination

November 14, 2011

ENCLOSURE 2

FACILITY COMMENT Question B.19
We suggest answers “a” and “c” both be accepted. This is because the regulating rod worth is one of the terms subtracted from the total rod worth when calculating the shutdown margin, so it is not part of the margin.

NRC RESPONSE
Facility comment accepted. Answer key changed to either “a” or “c”, both answers will be accepted as correct.

QUESTION A.01 [1.0 points]
Which ONE of the following factors in the “six factor” formula is the MOST affected by the CONTROL RODS?

a. Fast fission factor

b. Reproduction factor

c. Thermal utilization factor

d. Resonance escape probability

QUESTION A.02 [1.0 point]
Which ONE of the following conditions will **DECREASE** a shutdown margin of reactor?

a. Fuel depletion

b. Insertion of a positive reactivity worth experiment

c. Insertion of a negative reactivity worth experiment

d. increase moderator temperature (Assume negative temperature coefficient)

QUESTION A.03 [1.0 point]
Which ONE of the following isotopes has the **HIGHEST** thermal neutron cross section?

a. Cd-112

b. Sm-149

c. Xe-135

d. U-238

QUESTION A.04 [1.0 point]
The injection of a sample results in a 50 millisecond period. If the scram setpoint is **1200 KILOWATTS** and the scram delay time is 0.1 seconds, which ONE of the following is the peak power of the reactor at shutdown?

a. 1270 kW

b. 4370 kW

c. 8870 kW

d. 12200 kW

QUESTION A.05 [1.0 point]
Given a source strength of 200 neutrons per second (N/sec) and a multiplication factor of 0.9, which ONE of the following is the expected stable neutron count rate?

a. 900 N/sec

b. 1000 N/sec

c. 2000 N/sec

d. 2500 N/sec

QUESTION A.06 [1.0 point]
The neutron microscopic cross-section for absorption σ_a generally:

a. increases as neutron energy increases

b. decreases as target nucleus mass increases

c. increases as target nucleus mass increases

d. decreases as neutron energy increases

QUESTION A.07 [1.0 point]
Which ONE of the following is an example of alpha decay?

a. $_{35}Br^{87} \rightarrow {}_{33}As^{83}$

b. $_{35}Br^{87} \rightarrow {}_{35}Br^{86}$

c. $_{35}Br^{87} \rightarrow {}_{34}Se^{86}$

d. $_{35}Br^{87} \rightarrow {}_{36}Kr^{87}$

QUESTION A.08 [1.0 point]
The time period in which the MAXIMUM amount of Xe 135 will be present in the core is approximately 8 hours after:

a. a start up to 100%power

b. a scram from 100% power

c. a power increase from 0% to 50%

d. a power decrease from 100% to 50%

QUESTION A.09 [1.0 point]
A reactor fuel consisting of U-235 and U-238 only, is 20% enriched. This means that:

a. 20% of the volume of the fuel consists of U-235

b. 20% of the weight of the fuel consists of U-235

c. 20% of the total number of atoms in the fuel consists of U-235

d. the ratio of the number of U-235 atoms to the number of U-238 atoms is 0.20 (20%)

QUESTION A.10 [1.0 point]
Delayed neutrons are produced by:

a. decay of N-16

b. Pair Production process

c. decay of fission fragments

d. directly from the fission process

QUESTION A.11 [1.0 point]
In a subcritical reactor, Keff is increased from 0.861 to 0.946. Which ONE of the following is the amount of reactivity added to the core?

a. 0.054 delta-K/K

b. 0.104 delta-K/K

c. 0.125 delta-K/K

d. 0.161 delta-K/K

QUESTION A.12 [1.0 point]
Which ONE of the following statements correctly describes thermal neutrons?

a. A neutron that experiences a linear decrease in energy as the temperature of the moderator increases.

b. A neutron at resonant epithermal energy levels that causes fissions to occur in U-238.

c. A neutron that experiences an increase in energy levels after collisions with larger atoms of the moderator.

d. A neutron that experiences no net change in energy after several collisions with atoms of the moderator.

QUESTION A.13 [1.0 point]
Which ONE of the following statements best describes on how moderator temperature affects the core operating characteristics?

a. Increase in moderator temperature will increase the neutron multiplication factor due to the resonance escape probability increase.

b. Increase in moderator temperature will increase the neutron multiplication factor due to the fast non leakage probability decrease.

c. Increase in moderator temperature will decrease the neutron multiplication factor due to the reproduction factor increase.

d. Increase in moderator temperature will decrease the neutron multiplication factor due to the resonance escape probability decrease.

QUESTION A.14 [1.0 point]
Delayed neutrons comprise approximately what percent of all neutrons produced in the reactor?

a. 0.65%

b. 1.3%

c. 6.5%

d. 20%

QUESTION A.15 [1.0 point]
The reactor is CRITICAL at the following core reactivity data (not at NSCR):

Control Rod	Total Worth (%ΔK/K)	Worth Removed (%ΔK/K)
Safety Rod 1	2.70	1.68
Transient Rod	3.20	2.60
Safety Rod 2	2.60	1.52
Regulating Rod (scrammable)	0.40	0.40

The **TECHNICAL SPECIFICATION LIMIT** for Shutdown Margin for this core is:

a. 2.70 %ΔK/K

b. 3.00 %ΔK/K

c. 5.70 %ΔK/K

d. 6.20 %ΔK/K

QUESTION A.16 [1.0 point]
The reactor is on a **CONSTANT** positive period. Which ONE of the following power changes will take the **LONGEST TIME** to complete?

a. 5%, from 95% to 100%

b. 10%, from 80% to 90%

c. 15%, from 15% to 30%

d. 20%, from 60% to 80%

QUESTION A.17 [1.0 point]
An example of a **FISSILE ISOTOPE** which occurs **NATURALLY** is:

a. Pu-239

b. U-238

c. U-235

d. Th-232

QUESTION A.18 [1.0 point]
Which ONE of the following statements is the definition of **REACTIVITY**?

a. A measure of the core's excess.

b. Equal to 1.00 ΔK/K when the reactor is critical.

c. The factional change in neutron population between generations.

d. The number of neutrons produced by fission in a generation over the number of neutrons produced by fission in the previous generation.

QUESTION A.19 [1.0 point]
A reactor with K_{eff} = 0.5 contributes 1000 neutrons in the first generation. Changing from the first generation to the SECOND generation, how many neutrons are there in the second generation?

a. 1250

b. 1500

c. 1750

d. 2000

QUESTION A.20 [1.0 point]
Which ONE of the following describes the term **PROMPT DROP**?

a. A reactor is subcritical at negative 80 second period.

b. A reactor has attained criticality on prompt neutrons alone.

c. The instantaneous change in power level due to inserting a control rod.

d. The instantaneous change in power level due to withdrawing a control rod.

********** End of Section A **********

QUESTION B.01 [1.0 point]
According to emergency classification guide, the pool leakage which indicated abnormal loss at a rate exceeding makeup capacity is defined as:

a. Operational Event

b. Notification of Unusual Event

c. Alert

d. Site Area Emergency

QUESTION B.02 [1.0 point]
What is the **HALF LIFE** of the isotope contained in a sample which produces the following count rates?

Time (Minutes)	Counts per Minute (cpm)
Initial count	900
30	740
60	615
90	512
180	294

a. 551 minutes

b. 312 minutes

c. 111 minutes

d. 88 minutes

QUESTION B.03 [1.0 point]
Which ONE of following types of radiation is the **HIGHEST** Quality Factor specified in 10 CFR 20?

a. alpha

b. beta

c. gamma

d. neutron (unknown energy)

QUESTION B.04 [1.0 point]
A sheet of two-inch lead reduces the gamma exposure in a beam of radiation from 800 mR/hr to 400 mR/hr. If you add additional 2 sheets (total of six inches of lead) what will be the new radiation level? (Assume all reading is the same distance from the source.)

a. 50 mR/hr

b. 100 mR/hr

c. 175 mR/hr

d. 200 mR/hr

QUESTION B.05 [1.0 point]
Your Reactor Operator license expires after _____ years.

a. 2

b. 4

c. 6

d. 8

QUESTION B.06 [1.0 point]
A reactor operator sees a tag marked **98-23-2.** It means:

a. the tag was issued on February 23 rd, 1998

b. the tag was the 23 rd tag of the 2 nd tag group, in 1998

c. the tag was the 1998 th tag of the 23 rd tag group, in 2002

d. the tag was the 2 nd tag of the 23 rd tag group, in 1998

QUESTION B.07 [1.0 point]
Which ONE of the following types of experiments shall NOT be irradiated at the NSC REACTOR?

a. 20 mg of Explosive materials

b. The single experiment has a reactivity worth of $2.50

c. The unsecured experiment has a reactivity worth of $0.75

d. The experiment contains iodine isotopes 131 through 135 has a total inventory of 5 Ci

QUESTION B.08 [1.0 point]
A system or component is defined as "OPERABLE" by Technical Specifications if:

a. a channel check has been performed

b. a functional test has been performed

c. it has no outstanding testing requirements

d. it is capable of performing its intended function

QUESTION B.09 [1.0 point]
“The reactivity to be inserted for pulse operation shall not exceed that amount which will produce a peak fuel temperature of 1526 °F (830 ° C)”. This is an example of:

a. a Safety Limit (SL)

b. a Limiting Safety System Setting (LSSS)

c. Limiting Conditions for Operation (LCO)

d. a Pulse Operational Core (POC)

QUESTION B.10 [1.0 point]
A visitor requires a _____and is issued a _____badge.

a. general employee training; green

b. radiation worker training; blue

c. limited access Training; orange

d. constant escort; yellow

QUESTION B.11 [1.0 point]
Which ONE of the following requires NRC approval for changes?

a. Facility License

b Requalification Operator Licensing Examination

c SOP- Section II, Procedure M, Response to Alarms

d SOP- Section II, Procedure K, Control Rod Calibration

QUESTION B.12 [1.0 point, 0.25 each]
Column A below lists four activities in which a senior operator might participate. Column B lists four categories of procedures in which the activities are described. Match the procedure in Column B to the activity in Column A. Each procedure can be used once, more than once, or not at all.

Column A	Column B
a. Fuel Manipulation	1. Administrative Policy
b. Control Rod Inspection	2. Reactor Operations
c. Calibration of Emergency Dosimeters	3. Maintenance and Surveillance
d. Reactor Safety Board	4. Health Physics Procedure

QUESTION B.13 [1.0 point]
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

QUESTION B.14 [1.0 point]
The SRO on duty has directed you to "secure the reactor." This is done by:

a. scramming the reactor

b. removing all experiments

c. removing the reactor key from the control console

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

QUESTION **B.15** [1.0 point]
Per SOP II-C, Reactor Startup, the MINIMUM staff required during the INITIAL STARTUP of the day is:

a. 1 SRO in the facility + 1 RO in the control room + 1 Reactor Supervisor in the facility

b. 1 SRO in the control room + 1 RO in the control room + 1 duty HP in the facility

c. 1 SRO in the facility + 1 RO in the control room + 1 Reactor Supervisor in the facility

d. 1 SRO in the control room + 1 RO in the facility + 1 duty HP in the facility

QUESTION **B.16** [1.0 point]
In accordance with the Emergency Classification Guide, which ONE of the following alarms in the facility air monitor system is classified as Notification of Unusual Event?

a. Alarm on Channel #1

b. Alarm on Channel #2

c. Alarm on Channel #3

d. Alarm on Channel #4

QUESTION B.17 [1.0 point]
Which ONE of the following is the large contributor to N-16 production?

a. Neutron interaction with the hydrogen in the reactor pool water

b. Gamma interaction with the oxygen in the reactor pool water

c. Beta interaction with the Nitrogen in the reactor pool water

d. Neutron interaction with the oxygen in the reactor pool water

QUESTION B.18 [1.0 point]
A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. However, there is a small section of pipe which reads 20 mrem/hr at one (1) meter. Assuming that the pipe is a point source, which ONE of the following defines the posting requirements for the area in accordance with 10CFR Part 20?

a. Radiation Area

b. High Radiation Area

c. Controlled Access Area

d. Grave Danger, Very High Radiation Area

QUESTION B.19 [1.0 point] Answer key changed to “a” or “c” as the correct answers per facility comment

Which ONE of the following is NOT part of the calculated Shutdown Margin?

a. regulating rod worth (assume not scrammable)

b. most reactive rod worth

c. transient rod pulse stop worth

d. highest non-secured experiment worth

QUESTION B.20 [1.0 point]
Which ONE of the following is the 10CFR20 definition for “Annual Limit on Intake (ALI)”?

a. The concentration of a radionuclide in air which, if inhaled by an adult worker for a year, would result in a total effective dose equivalent of 100 millirem

b. Projected dose commitment values to individuals, that warrant protective action following a release of radioactive material

c. The effluent concentration of a radionuclide in air which, if inhaled continuously over a year, would result in a total effective dose equivalent of 50 millirem for noble gases

d. 10CFR20 derived limit, based on a Committed Effective Dose Equivalent of 5 Rems whole body or 50 Rems to any individual organ, for the amount of radioactive material inhaled or ingested in a year by an adult worker

********** End of Section B **********

QUESTION C.01 [1.0 point]
Which ONE of the following best describes the thermocouples in each of the instrumented fuel elements (IFE)?

a. There are consisted of two chromel-alumel thermocouples embedded at the midpoint and one inch above vertical center in the IFE.

b. There are consisted of three chromel-alumel thermocouples embedded at the midpoint, one inch above, and below vertical center in the IFE.

c. There are consisted of two Resistance Temperature Detectors (RTDs) embedded at the midpoint and one inch below vertical center in the IFE.

d. There are consisted of three platinum-rhodium thermocouples embedded at the midpoint, one inch above, and below vertical center in the IFE.

QUESTION C.02 [1.0 point]
On a long-term basis, more than 95% of the facility's Ar-41 is produced in the:

a. beam ports

b. reactor pool

c. irradiation cell

d. reactor building atmosphere

QUESTION C.03 [1.0 point]
The MAXIMUM setting for the preset timer in the pulse mode is:

a. 100 msec

b. 1 sec

c. 3 sec

d. 15 sec

QUESTION C.04 [1.0 point]
Which ONE of the following will cause the operating reactor to automatically SCRAM?

a. Fuel temperature = 500 °C

b. Reactor period = 5 sec

c. High voltage to safety channel = 110 V

d. Fire a pulse at 2 kW steady state power

QUESTION C.05 [1.0 point]
For an emergency fill of the pool using the demineralizer system, what is the reason why the flow rate of 70 gpm should not be exceeded, as specified in SOP V-A?

a. Cause channeling through the demineralizer resin column

b. Blow out the demineralizer resin into the pool

c. Destroy the recirculation pump control switch

d. Destroy the conductivity probe in the demineralizer

QUESTION C.06 [1.0 point]
The 3-Second-Period-Scram signal comes from:

a. Pulse Channel

b. Log Power Channel

c. Wide Range Linear Channel

d. Safety Power Channel

QUESTION C.07 [2.0 points, 0.5 each]
Match the input signals listed in column A with their display on reactor control room listed in column B. (Items in column B may be used more than once or not at all). Assume that the reactor is in operation.

Column A	Column B
a. Cell door open	1. Alarm only
b. Servo Fault	2. Alarm and rod withdraw prohibit
c. 125% Safety Power Channel	3. Alarm and scram
d. Withdrawal of safety rod if its rod height is fully out	4. Alarm and rod run-in

QUESTION C.08 [1.0 point]
Which ONE of the following can cause the Transient control rod interlock when a steady state mode is selected?

a. SHIM rod drive DOWN and SHIM control rod DOWN

b. Carriage DOWN and supply air energized

c. SHIM rod drive UP and SHIM control rod DOWN

d. Carriage UP and supply air energized

QUESTION C.09 [1.0 point]
Which ONE of the following controls the AMOUNT OF REACTIVITY that is inserted by the transient rod during pulse operations?

a. The preset pulse timer setting that vents the pneumatic piston

b. The steady state power of the reactor prior to firing the pulse

c. The pressure of the air applied to the pneumatic piston

d. The position of the cylinder

QUESTION C.10 [1.0 point]
For calibration of the control rod, the operator determines the rod reactivity by measuring the rate of decrease in power level by scram of the calibrated rod from the desired height. This technique is called:

a. Rod Drop Method

b. Positive Period Method

c. Thermal Power Calibration Method

d. Positive Period-Differential Worth Method

QUESTION C.11 [1.0 point]
Which ONE of the following best describes on how the Uncompensated Ion Chamber (UIC) and Compensated Ion Chamber (CIC) operate?

a. The CIC has two chambers, both can sense gamma rays but only one is coated with boron-10 for (n,α) reaction; whereas the UIC has only one chamber coated with boron-10 for (n,α) reaction.

b. The CIC has two chambers, one is coated with U-235 for fission reaction and the other is coated with boron-10 for (n,α) reaction; whereas the UIC has only one chamber coated with U-235 for fission reaction.

c. The CIC has only one chamber coated with boron-10 for (n,α) reaction; whereas the UIC has two chambers, one is coated with U-235 for fission reaction and the other is coated with boron-10 for (n,α) reaction.

d. The CIC has only one chamber coated with U-235 for fission reaction, whereas the UIC has two chambers, both can sense gamma rays but only one is coated with boron-10 for (n,α) reaction.

QUESTION C.12 [1.0 point]
During reactor operation, a leak develops in the SECONDARY to PRIMARY heat exchanger. Which ONE of the following conditions correctly indicates a leak in the heat exchanger?

a. Pool water conductivity will increase and Pool level will increase

b. Pool water conductivity will decrease and Pool level will decrease

c. Pool water conductivity will increase and Pool level will decrease

d. Pool water conductivity will decrease and Pool level will increase

QUESTION C.13 [1.0 point]
The current configuration of TAMU TRIGA-LEU fuel elements is:

a. 30/20 (30 percent uranium by weight and 20 percent enriched)

b. 70/20 (70 percent enriched uranium and 20 percent by weight)

c. 30/20 (30 percent enriched and 20 percent uranium by weight)

d. 20/70 (20 percent enriched uranium and 70 percent by weight)

QUESTION C.14 [1.0 point]
Which ONE of the following would indicate a clog in the demineralizer tank?

a. High radiation level at pool surface

b. High flow rate through demineralizer

c. High temperature in demineralizer

d. High pressure upstream of demineralizer

QUESTION C.15 [1.0 point]
Which ONE of the following air monitor channels is designated as the Stack Particulate Monitor?

a. Facility Air Monitor Channel # 1

b. Facility Air Monitor Channel # 2

c. Facility Air Monitor Channel # 3

d. Facility Air Monitor Channel # 4

QUESTION C.16 [1.0 point]
Which ONE of the following statements is NOT TRUE regarding the Servo Flux Control system?

a. The regulating rod control is automatically shift back to manual if the level drifts out of ±.5% range

b. The regulating rod moves in response to the signal from the Linear Power Channel

c. The regulating rod moves in response to the signal from the Log Power Channel

d. Alarm if the REG rod is inserted less than 20% fully withdrawn

QUESTION C.17 [1.0 point]
The Pulse Drawer in the Pulse Mode provides the indications of:

a. Percent Power and 2 cps Interlock

b. Peak Power and 1 KW Interlock

c. Peak Power and Reactor period

d. Peak Power and Energy

QUESTION C.18 [1.0 point]
Which ONE of the following is the Safety Limit (LS) for the NSCR?

a. The cladding temperature must not exceed 1150 °C

b. The cladding temperature must not exceed 525 °C

c. The thermal power shall not exceed 1.3 MW

d. The pulse power shall not exceed $2.0

QUESTION C.19 [1.0 point]
Which ONE of the following Beam Ports will use for neutron radiography?

a. Beam Port # 1

b. Beam Port # 2

c. Beam Port # 3

d. Beam Port # 4

********** End of Section C **********
********** End of the Exam **********

A.01
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.2.2, page 3-18.

A.02
Answer: b
Reference: Adding a positive reactivity in the reactor core will decrease the shutdownmargin.

A.03
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Table2.5, page 2-59.

A.04
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982,
$P = P_0 e^{t/\tau}$, P = 1200 kilowatts × $e^{0.1/0.05}$ = 1200 × e^2 = 8866.9 kilowatts

A.05
Answer: c
Reference: CR = S/(1-K) → CR = 200/(1 - .9) = 2000

A.06
Answer: d
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982

A.07
Answer a
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume 1, Module 1

A.08
Answer b
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 8.4, page 8-9

A.09
Answer b
Reference: Standard NRC Question

A.10
Answer: c
Reference: Burn, R., *Introduction of Nuclear Reactor Operations*, © 1982, Sec 3.2.1

A.11
Answer: b
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.3, page 3-21.
At k=0.861; ρ = ΔKeff/Keff or ρ = Keff-1/Keff = -0.139/0.861 =-0.161. At k=0.946, ρ =-0.054/0.946 ρ = -0.0571. The difference between ρ is the answer ,i.e. -0.0571-(-0.161)=0.104

A.12
Answer: d
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Sec 2.5.3, page 2-45.

A.13
Answer: d
Reference: Burn, R., *Introduction of Nuclear Reactor Operations*, © 1982, Sec 3.3.1

A.14
Answer: a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume 2

A.15
Answer: b
Reference: Tech Spec SDM = ∑total rod worth removed at critical – most reactivity control rod worth= 6.2%dk/k -3.2 %dk/k = 3.0 %dk/k

A.16
Answer: c
Reference: Time is related to ratio of final power to initial power. 2:1 is the largest ratio.

A.17
Answer: c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* 1988 Section 3.2 page 3-2

A.18
Answer c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.3, page 3-20.

A.19
Answer: b
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.3, p. 5.6
2-nd generation=n + K*n=1000+500=1500 neutrons

A.20
Answer: c
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Page 4-21.

B.01
Answer: c
Reference: Emergency Plan, Section 4, Emergency Classification System Table-I.

B.02
Answer: c.
Reference: $A = A_o e^{-\lambda t}$
$294 = 900e^{-180\lambda}$, $180\lambda = -\ln 0.327$, $\lambda = 0.00623\ min^{-1}$
$t_{1/2} = 0.693 / \lambda$, $= 0.693 / 0.00623\ min^{-1}$, $= 111$ minutes

By guessing, a count rate at 60 min is 615 cpm and a count rate at 180 min is 294 cpm (from 615 cps to 294 cps, we can consider that the source has been reduced by half) so an approximate half life is (180 min-60 min=120 min) which is closed to answer key of 111 min.

B.03
Answer: a
Reference: 10CFR20.1004

B.04
Answer: b
Reference: 2 inches equal a half-thickness. Adding 4 inches (in total of six inches) results in a total of three half-thicknesses. $(800) \times (½)^3 = 800*0.125 = 100$ mR/hr

B.05
Answer: c.
Reference: 10CFR55.55(a)

B.06
Answer: d
Reference: System Tag Procedure

B.07
Answer: b
Reference: TS 3.6

B.08
Answer: d
Reference: TA&M Technical Specifications, Section 1.17

B.09
Answer: c
Reference: TA&M Technical Specifications, Section 3.1

B.10
Answer: d
Reference: SOP NSC Access Control.

B.11
Answer: a
Reference: 10 CFR 50.54

B.12
Answer: a,2 b,3 c,4 d,1
Reference: TM&A SOP Index

B.13
Answer: a
Reference: Chart of the Nuclides

B.14
Answer: c
Reference: SOP Reactor Shutdown.

B.15
Answer: b
Reference: SOP C, Section II

B16
Answer: b
Reference: Emergency Classification Guide, pg. 2.

B.17
Answer: d
Reference: Chart of Nuclide

B.18
Answer: b
Reference: 20 mrem/hr at 1 meter (100 cm.) = 222.2mrem/hr at 30 cm.
20 mrem/hr*(100cm) ^{2} /(30 cm) ^{2} = 222.2 mrem/hr at 30 cm

B.19
Answer: a or c. Answer key changed to “a” or “c” as the correct answers per facility comment

Reference: Tech Spec, 3.1.3; SOP III-M

B.20
Answer: d.
Reference: 10CFR20.1003 Definitions

C.01
Answer: b
Reference: SAR 7.2.3.7, page 111

C.02
Answer: b
Reference: SAR 11.1.1, page 142

C.03
Answer: d
Reference: SAR 7.2.3.8, page 111

C.04
Answer: c
Reference: SAR 7.2.3.6, page 110

C.05
Answer: a
Reference: SOP V-A

C.06
Answer: b
Reference: SAR 7.2.3.1, page 108

C.07
Answer: a(3) b(1) c(3) d(2)
Reference: TS 3.3 and SAR 7.0, Instrumentation and Control

C.08
Answer: d
Reference: SAR, 7.3 Reactor Control Systems

C.09
Answer: d
Reference: SOP II E, Pulsing Operation.

C.10
Answer: a
Reference: SOP II, Procedure K

C.11
Answer: a
Reference: NRC Standard Question

C.12
Answer: c
Reference: SAR 5.1 and figure 5-4.

C.13
Answer: a
Reference: SAR 1.3, page 1-2

C.14
Answer: d
Reference: Standard NRC question

C.15
Answer: a
Reference: SAR 7.7.2

C.16
Answer c
Reference: SAR 7.1 Summary Description, Figure 7-1 and SOP III-C

C.17
Answer d
Reference: SAR 7.2.3.2

C.18
Answer: a
Reference: TS 2.1

C.19
Answer: d
Reference: SAR 10.1.5