December 20, 2001

Dr. Carl Beard
Nuclear Engineering Teaching Laboratory
10100 Burnett Road
University of Texas at Austin
Austin, TX 78758

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-602/OL-02-01

Dear Dr. Beard:

During the week of November 12, 2001, the NRC administered initial examinations to an employee of your facility who had applied for a license to operate your University of Texas Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's 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 document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/indesx.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 Patrick Isaac at (301)415-1019 or via Internet E-mail at pxi@nrc.gov.

Sincerely,

/RA/

Eugene V. Imbro, Acting Chief
Operational Experience and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-602

Enclosures: 1. Initial Examination Report No. 50-602/OL-02-01
2. Examination and answer key (RO)

cc w/encls:
Please see next page

cc:

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

Bureau of Radiation Control
State of Texas
1100 West 49th Street
Austin, TX 78756

Mr. Roger Mulder
Office of the Governor
P.O. Box 12428
Austin, TX 78711

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Facility File (EBarnhill O6-D17)		PIsaac		

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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-602/OL-02-01

FACILITY DOCKET NO.: 50-602

FACILITY LICENSE NO.: R-129

FACILITY: University of Texas

EXAMINATION DATES: November 15, 2001

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: ***/RA/***
11/27/2001

Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of November 12, 2001, NRC administered Operator Licensing Examinations to one Reactor Operator (RO) candidate. The candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick Isaac, Chief Examiner

2. Results:

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

3. Exit Meeting

An exit meeting was conducted on November 15, 2001, between the Chief Examiner and Mr. Michael Krause, University of Texas, Acting Associate Director, to discuss the preliminary results of the examinations. There were no generic concerns raised by the examiner.

ENCLOSURE 1

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

FACILITY: University of Texas

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2001/11/15

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.

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

019 a b c d ___

020 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.

001 a b c d ___

002 a ___ b ___ c ___ d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a _____ b _____ c _____ d _____

010 a _____ b _____ c _____ d _____

011 a _____ b _____ c _____ d _____

012 a _____ b _____ c _____ d _____

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 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.

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a _____ b _____ c _____ d _____ e _____

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 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.

QUESTION: 001 (1.00)
Which ONE of the following is the major source of energy released due to thermal fission of a U235 atom?

a. Kinetic energy of the fission neutrons.

b. Prompt gamma rays.

c. Fission product decay.

d. Kinetic energy of the fission fragments.

QUESTION: 002 (1.00)
A core contains fuel with 20% U235 and 80% U238. From the following data, what is the probability that fission will occur when the fuel absorbs a thermal neutron?

Isotope	σf	σc
U235	582 barns	99 barns
U238	0 barns	3 barns

a. 0.833

b. 0.840

c. 0.851

d. 0.855

QUESTION: 003 (1.00)
Which factor in the six-factor formula is represented by the ratio:

$$\frac{\text{number of neutrons that reach thermal energy}}{\text{number of neutrons that start to slow down}}$$

a. fast non-leakage probability

b. resonance escape probability

c. reproduction factor

d. thermal utilization factor

QUESTION: 004 (1.00)
Which ONE of the following is the description of a thermal neutron?

a. A neutron possessing thermal rather than kinetic energy.

b. The primary source of thermal energy increase in the reactor coolant during reactor operation.

c. A neutron that has been produced in a significant time (on the order of seconds) after its initiating fission took place.

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

QUESTION: 005 (1.00)
A reactor is subcritical with a Keff of 0.955. A positive reactivity of 3.5% delta k/k is inserted into the core. At this point, the reactor is:

a. supercritical.

b. exactly critical.

c. prompt critical.

d. subcritical.

QUESTION: 006 (1.00)
Which ONE of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.

b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.

c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay of fission products.

d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

QUESTION: 007 (1.00)
The fuel temperature coefficient of reactivity is -1.25x10-4 delta k/k/deg.C. When a control rod with an average rod worth of 0.1 % delta k/k/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, the fuel temperature has:

a. increased by 80 degrees C.

b. decreased by 80 degrees C.

c. increased by 8 degrees C.

d. decreased by 8 degrees C.

QUESTION: 008 (1.00)
Which ONE of the reactions below is an example of a photoneutron source?

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

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

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

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

QUESTION: 009 (1.00)
The major contributor to the production of Xenon-135 in a reactor operating at full power is:

a. directly from the fission of Uranium-235.

b. directly from the fission of Uranium-238.

c. from the radioactive decay of Promethium.

d. from the radioactive decay of Iodine.

QUESTION: 010 (1.00)
The effective neutron multiplication factor, Keff, is defined as:

a. production/(absorption + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. absorption/(production + leakage)

QUESTION: 011 (1.00)
For the same constant reactor period, which ONE of the following transients requires the SHORTEST time to occur? A power increase of:

a. 5% of rated power - going from 1% to 6% of rated power.

b. 15% of rated power - going from 10% to 25% of rated power.

c. 30% of rated power - going from 20% to 50% of rated power.

d. 50% of rated power - going from 50% to 100% of rated power.

QUESTION: 012 (1.00)
Which ONE of the following is the principal source of energy (heat generation) in the reactor 15 minutes following a reactor shutdown from extended operation at full power?

a. Production of delayed neutrons.

b. Subcritical multiplication of neutrons.

c. Spontaneous fission of U-238.

d. Decay of fission products.

QUESTION: 013 (1.00)
Which ONE of the following describes the characteristics of a good moderator?

a. High scattering cross-section and low absorption cross-section.

b. Low scattering cross-section and high absorption cross-section.

c. Low scattering cross-section and low absorption cross-section.

d. High scattering cross-section and high absorption cross-section.

QUESTION: 014 (1.00)
During the minutes following a reactor scram, reactor power decreases on a negative 80 second period, corresponding to the half-life of the longest-lived delayed neutron precursors, which is approximately:

a. 20 seconds.

b. 40 seconds.

c. 55 seconds

d. 80 seconds.

QUESTION: 015 (1.00)
During fuel loading, which ONE of the following will have NO effect on the shape of the 1/M plot?

a. The order of fuel placement.

b. The source strength.

c. The location of the source in the core.

d. The location of the detector (or detectors) in the core.

QUESTION: 016 (1.00)
Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. An experiment which adds positive reactivity.

b. Depletion of burnable poison added to the uranium fuel.

c. Depletion of uranium fuel.

d. Decreasing fuel temperature.

QUESTION: 017 (1.00)
The reactor is to be pulsed. The projected pulse will add TWICE as much reactivity as the last pulse performed. In relation to the last pulse, for the projected pulse:

a. peak power will be four times larger and the energy released will be four times larger.

b. peak power will be two times larger and the energy released will be four times larger.

c. peak power will be four times larger and the energy released will be two times larger.

d. peak power will be two times larger and the energy released will be two times larger.

QUESTION: 018 (1.00)
Which ONE of the following parameter changes will require control rod INSERTION to maintain constant power level following the change?

a. Pool water temperature increase.

b. Insertion of a void into the core.

c. Removal of an experiment containing cadmium.

d. Buildup of samarium in the core.

QUESTION: 019 (1.00)
The equations which describe the operation of the installed neutron source at the UT reactor are:

a. Am-241 -> alpha + Np-237
Be-9 + alpha -> C-12 + neutron

b. Am-241 -> alpha + Np-237
B-10 + alpha -> N-13 + neutron

c. Am-241 -> beta + Cm-241
Be-9 + beta -> Li-8 + neutron

d. Am-241 -> beta + Cm-241
B-10 + beta -> Be-9 + neutron

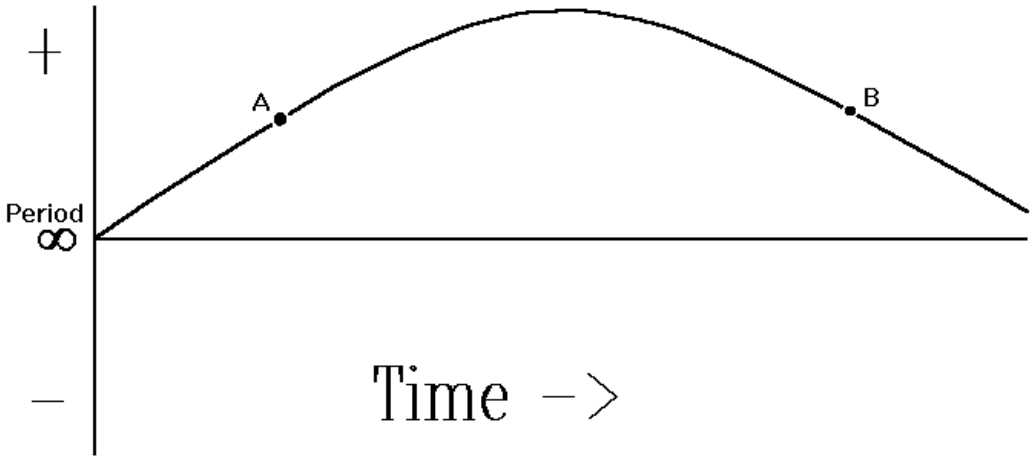
QUESTION: 020 (1.00)
Shown below is a trace of reactor period as a function of time. Between points A and B, reactor power is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



QUESTION B.1 [1.0 point]
Which ONE of the following types of experiments is NOT required to be doubly encapsulated? Experiments which contain …

a. explosive materials.

b. solid fissionable materials

c. materials corrosive to reactor components.

d. compounds highly reactive with water.

QUESTION B.2 [2.0 points, 0.5 each]
Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

QUESTION B.3 [1.0 point]
Which ONE of the following is the 10 CFR 20 definition of TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)?

a. The sum of the deep does equivalent and the committed effective dose equivalent.

b. The dose that your whole body receives from sources outside the body.

c. The sum of the external deep dose and the organ dose.

d. The dose to a specific organ or tissue resulting from an intake of radioactive material.

QUESTION B.4 [1.0 point]
Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an additional four inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr

b. 50 mR/hr

c. 75 mr/hr

d. 100 mr/hr

QUESTION B.5 [1.0 point]
According to Technical Specification 3.4.1.a “A moveable experiment shall have a reactivity worth less than …

a. $.25

b. $.50

c. $.75

d. $1.0

QUESTION B.6 [1.0 point]
Which ONE of the following is the Emergency Plan definition of Action Levels?

a. conditions that call for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

b. specific readings, or observations; radiological dose or dose rates; or specific contamination levels of airborne, waterborne, or surface-deposited radioactive materials used as thresholds for establishing emergency classes and initiating appropriate emergency methods.

c. classes of accidents grouped by severity level for which predetermined emergency measures should be taken or considered.

d. allowable concentrations of radioactive effluents that may be released to the environment as specified by applicable regulations.

QUESTION B.7 [1.0 point]
The scram time for the scrammable control element were last measured on July 31, 2001. Which one of the following dates is the latest the maintenance may be performed again without exceeding a Technical Specifications requirement?

a. Feb. 14, 2002

b. Jul. 31, 2002

c. Oct. 31, 2002

d. Jan. 31, 2003

QUESTION B.8 [1.0 point]
Per Technical Specifications regarding the Ar41 Radiation Monitor: If the Ar41 monitor is not operable, operating the reactor with the auxiliary air purge system shall be limited to a period of

a. one day

b. two days

c. five days

d. ten days

QUESTION B.9 [2.0 points, 0.5 each]
Match the 10CFR55 requirements for maintaining an active operator license in column A with the corresponding time period from column B.

	Column A	Column B
a.	Renew License	1 year
b.	Medical Exam	2 years
c.	Pass Requalification Written Examination	4 years
d.	Pass Requalification Operating Test	6 years

QUESTION B.10 [1.0 point, 0.25 each]
Identify the PRIMARY source (irradiation of air, irradiation of water, or fission product) of EACH of the radioisotopes listed.

a. 1H3

b. 18Ar41

c. 7N16

d. 54Xe135

QUESTION B.11 [2.0 points, 0.5 each]
Identify each of the following actions as either a channel CHECK, a channel TEST, or a channel CALIBRATION.

a. Prior to startup you place a known radioactive source near a radiation detector, noting meter movement and alarm function operation.

b. During startup you compare all of your nuclear instrumentation channels ensuring they track together.

c. At power, you perform a heat balance (calorimetric) and determine you must adjust Nuclear Instrumentation readings.

d. During a reactor shutdown you note a -80 second period on Nuclear Instrumentation.

QUESTION B.12 [2.0 points, 0.5 each]
Identify each of the following as either a Safety Limit (SL) a Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO).

a. The maximum transient reactivity insertion for the pulse operation of the reactor shall be 2.2%Δk/k in the pulse mode.

b. Maximum excess reactivity shall be 4.9% Δk/k.

c. “The temperature of a fuel element shall not exceed 1150°C for fuel element temperatures less than 500°C…”

d. During steady-state operation a minimum of three Reactor Power Level Channels shall be operable.

QUESTION B.13 [1.0 point]
The CURIE content of a radioactive source is a measure of

a. the number of radioactive atoms in the source.

b. the amount of energy emitted per unit time by the source

c. the amount of damage to soft body tissue per unit time.

d. the number of nuclear disintegrations per unit time.

QUESTION B.14 [1.0 point]
Following an evacuation due to a radiological emergency, who by procedure may authorize re-entry?

a. Emergency Director with concurrence of the Health Physicist

b. Senior Reactor Operator on Duty with concurrence of the Health Physicist

c. University Police with the concurrence of the Health Physicist

d. Emergency Director

QUESTION B.15 [1.0 point]
Which ONE of the following is NOT a condition for the Technical Specification limit on Shutdown Margin?

a. All experiments in most reactive state.

b. Maximum Xenon.

c. Most reactive rod in fully out position.

d. core at ambient temperature.

QUESTION B.16 [1.0 point]
WHO may authorize restart of the Reactor following a violation of a Safety Limit?

a. The Reactor Supervisor

b. The Reactor Operations Committee

c. The President of the College

d. The Nuclear Regulatory Commission

QUESTION C.1[1.0 point]
WHICH ONE of the following is the purpose of the pool stirrer?

a. Increase mixing within the core, for a more accurate reading of bulk pool temperature.

b. Increase transport time for N16 to reach surface of pool.

c. Increase mixing within the core, for a more accurate reading of pool water conductivity.

d. Break up of O16 bubbles in pool, thereby decreasing production of N16.

QUESTION C.2[1.0 point]
In order to minimize release of Ar41 from the pneumatic tube (rabbit) system, the …

a. exhaust of the system is connected to the Ar41 purge system.

b. piping is a recirculating loop with a CO_2 purge.

c. piping is a recirculating loop with an N_2 purge.

d. exhaust of the system is located in the facility exhaust stack.

QUESTION C.3[1.0 point]
Which ONE of the following methods is used to monitor reactor power during a pulse? Placing the mode switch in the Pulse position …

a. changes NPP-1000 channel input to a photo tube with output proportional to power (detection of Cherenkov radiation).

b. modifies the gain setting for the NPP-1000 channel, with input from the fission chamber in campbelling mode.

c. modifies the gain setting for the NPP-1000 channel, with input from the ion chamber.

d. changes NPP-1000 channel input to a Geiger-Müller tube with no amplification.

QUESTION C.4[1.0 point]
The reactor protection system will generate a scram signal if neutron detector high voltage drops by …

a. 10%

b. 20%

c. 80%

d. 90%

QUESTION C.5[1.0 point]
The purpose of the differential pressure sensor in the secondary system is to …

a. maintain secondary coolant (chill water) pressure 1 psi higher than primary pressure to prevent primary coolant leaking into the secondary.

b. maintain secondary coolant (chill water) pressure 1 psi lower than primary pressure to prevent chill water leaking into the primary.

c. maintain secondary coolant (chill water) temperature less than 90°F to protect the chill water system.

d. maintain primary temperature less than 120°F, to protect the purification system.

QUESTION C.6[1.0 point]
Each fuel element contains a top and bottom reflector plugs which are made of …

a. zirconium

b. zirconium hydride

c. graphite

d. polyethylene

QUESTION C.7[2.0 points, 0.4 each]
Classify the five beam ports. Each Beam Port has only one answer.

a. Beam Port 1 Tangential

b. Beam Port 2 Thru

c. Beam Port 3 Radial

d. Beam Port 4

e. Beam Port 5

QUESTION C.8[1.0 point]
WHICH ONE of the following detectors is used primarily to measure N16 release to the environment?

a. NONE, N16 has too short a half-life to require environmental monitoring.

b. Stack Gas Monitor

c. Stack Particulate Monitor

d. Bridge Area Monitor

QUESTION C.9[2.0 points, 0.5 each]
Match the purification system functions in column A with the purification component listed in column B. (Note items from column B may be used more than once, or not at all.)

Column A	Column B
a. remove floating dust, bug larvae, etc.	1. Demineralizer (Ion Exchanger)
b. remove dissolved impurities	2. Skimmer
c. remove suspended solids	3. Filter
d. maintain pH	

QUESTION C.10 [1.0 point]
WHICH ONE of the following experimental facilities can be modified to supply a highly collimated beam of neutron and gamma radiation?

a. Lazy Susan

b. Pneumatic Transfer system

c. Hollow Element Assembly

d. Central Thimble

QUESTION C.11 [1.0 point]
According to Technical Specification 3.3.3, the Air Particulate Detector (APD) normally provides the automatic signal to isolate the ventilation system. If the APD is not available, the output from the …

a. Pool Level Area Radiation Monitor will provide an automatic signal to isolate the ventilation system.

b. Ar41 monitor will provide an automatic signal to isolate the ventilation system.

c. Pool Level Area Radiation Monitor will be used to manually isolate the ventilation system.

d. Ar41 monitor will be used to manually isolate the ventilation system.

QUESTION C.12 [1.0 point]
Which ONE of the following methods is used to determine control rod position? As the rod goes out...

a. a lead screw moves into a coil, the change in impedance is used as an input signal to determine rod position.

b. a magnet on the rod assembly closes limit switches located along the length of the rod movement producing a signal of rod position.

c. a potentiometer mechanically coupled to the rod drive motor generates a signal proportional to rod position.

d. a motor electrically coupled to a set of contacts in the rod out circuit, generates a signal proportional to rod position.

QUESTION C.13 [1.0 point]
Which ONE of the following is the neutron absorbing medium in the control rods?

a. Halfnium

b. Boron carbide

c. Xenon

d. Samarium

QUESTION C.14 [1.0 point]
Which ONE of the following is the purpose of the ½-inch aluminum safety plate suspended beneath the lower grid plate?

a. Prevents the control rods from dropping out of the core if the mechanical connections fail.

b. Provides structural support for the lower grid plate and the suspended core.

c. Provides a catch plate for small tools and hardware dropped while working on the core.

d. Prevents fuel rods from dropping out of the core.

QUESTION C.15 [1.0 point]
The reactor is in the AUTOMATIC mode at a power level of 500 kW. The neutron detector from which the control system receives its input signal fails low (signal suddenly goes to zero). As a result:

a. the control system inserts the regulating rod to reduce power, to try to match the power of the failed detector.

b. the control system withdraws the regulating rod to increase power.

c. the control system drops out of the AUTOMATIC mode into the MANUAL mode.

d. the reactor scrams.

QUESTION C.16 [1.0 point]
Which ONE of the following is a control rod interlock?

a. Above reactor power of 1 kW, the transient rod cannot be operated in the PULSE mode.

b. Only one standard rod at a time can be withdrawn in the PULSE mode.

c. Control rods cannot be withdrawn unless the count rate is greater than 1.2 CPS in the SQUARE WAVE mode.

d. Two control rods cannot be withdrawn at the same time above 1 kW in the MANUAL mode.

QUESTION C.17 [1.0 point]
Which one of the following devices is tested during the PRESTART checks?

d. Low water level

e. Magnet power key switch

f. Source level trip

g. External scram circuits

QUESTION C.18 [1.0 point]
Half way through a 6 hour reactor operation you discover that the normal ventilation exhaust damper has been blocked open by a student performing experiments. You cannot move the damper because it is damaged. Which one of the following actions should you take?

a. Immediately secure reactor operations and comply with the requirements for reportable events.

b. Continue with reactor operations. Up to one week is allowed to repair the damper.

c. Continue with reactor operations. The CAM will offer adequate protection.

d. Immediately secure reactor. This event is not reportable if the damper is repaired within 48 hours.

***** END OF EXAMINATION*****

A.1 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 1, pg. 61.

A.2 b
REF: UT-TRIGA Training Manual, Vol. IV, Interactions of Neutrons with Matter.
Probability = $\Sigma f/(\Sigma f + \Sigma c) = (0.2x582)/(0.2x582 + 0.2x99 + 0.8x3) = 0.840$

A.3 b
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 3.

A.4 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 23.

A.5 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 19.
For K = 0.955, reactivity = (K-1)/K = -0.045/0.955 = -4.71% $\Delta K/K$; -4.71% + 3.50% = -1.21%, i.e. subcritical.

A.6 c
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 29.

A.7 a
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 21.
Positive reactivity added by control rod = (0.001 $\Delta K/K$/inch)(10 inches) = +0.01 $\Delta K/K$. This balances the negative reactivity of the fuel temperature change: $(-0.01\ \Delta K/K)/(-1.25x10^{-4}\ \Delta K/K/^{\circ}C) = +80^{\circ}C$.

A.8 a
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 2.

A.9 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 35.

A.10 a
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 3, pg. 8.

A.11 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg.11.

A.12 d
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory,, Module 4, pg. 33.

A.13 a
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 2, pg. 24.

A.14 c
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pp. 17.

A.15 b
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 5.

A.16 c
REF: UT-TRIGA Technical Specifications, 1.26. Any process which adds negative reactivity increases the shutdown margin.

A.17 c
REF: UT-TRIGA Training Manual, Vol. IV, Pulsed Reactors.

A.18 c
REF: Insertion of a control rod inserts negative reactivity to balance the positive reactivity added when removing a neutron absorber.

A.19 a
REF: UT-TRIGA Training Manual, Vol. II, Description of TRIGA Mark II Reactor, pg. 16.

A.20 a
REF: UT-TRIGA Training Manual, Vol. IV, Nuclear Physics and Reactor Theory, Module 4, pg. 11.
Since the period is always positive, power must be increasing.

B.1 b
REF: Technical Specification 3.4.2.a

B.2 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

B.3 a
REF: 10 CFR 20.1003 Definititions

B.4 b
REF: Basic Radiological Controls knowledge: “Half-Thickness and Tenth-Thickness".

B.5 d
REF: Technical Specification 3.4.1.a.

B.6 b
REF: Emergency Plan, § 1.1 Definitions

B.7 c
REFERENCE T.S. §§ 4.2.1.b and 1.31.3 (15 months)

B.8 d
REF: Technical Specifications 3.3.3.b 2nd ¶.

B.9 a, 6; b, 2; c, 2; d, 1
REF: 10CFR55.

B.10 a, Water; b, Air; c, Water; d, Fission
REF: Standard NRC question.

B.11 a, Test; b, Check; c, Cal; d, Check or Test
REF: Technical Specification 1.2.1-3

B.12 a, LSSS; b, LCO; c, SL; d, LCO
REF: Technical Specifications §§ 2.1, 2.2.3, 3.1.1 and 3.2.4 (table).

B.13 d
REF: Standard Health Physics Definition.

B.14 d
REF: Emergency Plan, § 2.1.1, 4th ¶.

B.15 b
REF: Technical Specifications § 1.20 Definition of Reference Core and § 3.1.4 Shutdown Margin.

B.16 d
REF: Tech. Specs, § 6.5.1.a Action to be taken in the Event a Safety Limit is Exceeded. p. 32.

C.1 a
REF: Rx Description, § 4.1.4, p. 28.

C.2 b
REF: Operation Support systems, § 3.2 1st ¶.

C.3 c
REF: Rx Description, § 2.1.3.3, p. 19.

C.4 b
REF: Rx Description, § 2.1.6.2.2 on page 29. (Note: hand written change from 20% to 10%.)

C.5 a
REF: SAR § 5.2.1, 3rd ¶.

C.6 c
REF: SAR § 4.4.5 2nd ¶.

C.7 a, Thru b, Tangential; c, Radial; d, Radial; e, Thru
REF: Operation Support Systems §§ 3.4.1 – 3.4.3.

C.8 a
REF: Standard NRC Question

C.9 a, 2; b, 1; c, 3; d, 1
REF: SAR § 5.2.2., also Operational Support Systems, §

C.10 d
REF: Rx Description, § 3.3, p. 21.

C.11 d
REF: Technical Specification 3.3.3.

C.12 c
REF: Rx Description, § 3.7.1, p. 20.

C.13 b
REF: Reactor Description, § 3.7, 1st and 3rd paragraphs.

C.14 a
REF: UT-TRIGA Training Manual, Vol. II, Description of TRIGA Mark II Reactor, page 14.

C.15 b
REF: UT-TRIGA Training Manual, Vol. II, Control Console Operator's Manual, page 5-3.

C.16 a
REF: UT-TRIGA Training Manual, Vol. V, ICS System Surveillance Interlock and SCRAM Features.

C.17 c
REF: GA Control Console Operator's Manual pg. 2-5

C.18 a
REF Tech. Specs 3.3.2.a (Reportable - LCO violated)