February 7, 2000

Dr. William Vernetson
Director of Nuclear Facilities
202 Nuclear Reactor Building
Department of Nuclear
Engineering Sciences
University of Florida
Gainesville, Florida 32611

Dear Dr. Vernetson:

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-083/OL-00-01

During the week of January 03, 2000, the NRC administered an initial examination to an employee of your facility who had applied for a license to operate your University of Florida 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 placed in the NRC Public Document Room.

Should you have any questions concerning this examination, please contact me at (301) 415-1168.

Sincerely,

/RA/
Ledyard B. Marsh, Chief
Events Assessment, Generic Communications and
Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-083

Enclosures: 1. Initial Examination Report
No. 50-083/OL-00-01
2. Examination and answer key

cc w/encls:
Please see next page

DISTRIBUTION w/enclosures:
PIsaac
PUBLIC FILE CENTER
TMichaels, PM
Facility File (EBarnhill) (O6-D17)
Docket File (50-083)

DISTRIBUTION w/o enclosures:
REXB r/f
LMarsh
DMatthews
Document Control
LTremper, LFDCB (T-9 E-10)

TEMPLATE #: NRC-074

DOCUMENT NAME: G:\REXB\ISAAC\FLA2000.RPT.WPD

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	HOLB:DRCH	E	REXB:RE	E	REXB:BC	
NAME	EBarnhill		PIsaac		LMarsh	
DATE	02/01/00		01/27/00		~~LMarsh~~ 02/07/00	

OFFICIAL COPY

DFO1

THE CC LIST IS THE APPROPRIATE SERVICE LIST FOR THIS FACILITY

Mr. James S. Tulenko, Chairman
Nuclear Engineering Sciences
Department
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

Dr. Rolan E. Hertel, Director
Neely Nuclear Research Center
Georgia Institute of Technology
900 Atlantic Drive, N.W.
Atlanta, GA 30332

Mr. Pedro B. Perez, Associate Director
Nuclear Reactor Program
North Carolina State University
P.O. Box 7909
Raleigh, NC 27695-7909

Dr. R. U. Mulder, Director
UVA Reactor Facility
Department of Nuclear Engineering
Charlottesville, VA 22903-2442

Administrator
Department of Environmental Regulation
Power Plant Siting Section
State of Florida
2600 Blair Stone Road
Tallahassee, FL 32301

State Planning and Development
Clearinghouse
Office of Planning and Budgeting
Executive Office of the Governor
The Capitol Building
Tallahassee, FL 32301

Mary E. Clark, Chief
Office of Radiation Control
Department of Health
and Rehabilitative Services
1317 Winewood Boulevard
Tallahassee, FL 32999

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

REPORT NO.: 50-083/OL-00-01

FACILITY DOCKET NO.: 50-083

FACILITY LICENSE NO.: R-56

FACILITY: University of Florida

EXAMINATION DATES: January 06 - 07, 2000

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: Patrick Isaac, Chief Examiner   1/27/00
Date

SUMMARY:

During the week of January 03, 2000, the NRC administered Operator Licensing Examinations to one Senior Reactor Operator Instant (SROI) candidate. The candidate passed the examination.

REPORT DETAILS

1. Examiners: Patrick Isaac, Chief Examiner

2. Results:

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

3. Exit Meeting:

Dr. William Vernetson, Director of Nuclear Facilities
James W. Wolf, Reactor Manager
Patrick Isaac, NRC, Chief Examiner

The facility management requested and the Chief Examiner agreed to accept two correct answers, (a) and (d), for question C.10 of the written examination. There were no generic concerns raised by the Chief Examiner.

ENCLOSURE 1

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

FACILITY: University of Florida

REACTOR TYPE: ARGONAUT

DATE ADMINISTERED: 2000/01/06

REGION: II

CANDIDATE: ____________________

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each section 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

ANSWER SHEET

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

ANSWER SHEET

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 ___ e ___

019 a b c d ___

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

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER SHEET

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 ___ e ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a ___ b ___ c ___ d ___ e ___ f ___

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 ___

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

EQUATION SHEET

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0077$

$DR_1 D_1^2 = DR_2 D_2^2$

$\text{Cycle Efficiency} = \dfrac{\text{Net Work (out)}}{\text{Energy (in)}}$

$SCR = S/(1-Keff)$

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

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

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

$SDM = (1-Keff)/Keff$

$Pwr = W_f \dot{m}$

$\ell^* = 1 \times 10^{-5}$ seconds

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

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

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

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

---

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5°C + 32

°C = 5/9 (°F - 32)

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 <u>only</u> 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 (A.1) [1.0]
A reactor is critical at 1 Watt. Subsequent rod motion causes a power increase at an indicated period of 30 seconds. Reactor power 2 minutes later will be approximately:

a. 55 Watts

b. 35 Watts

c. 15 Watts

d. 5 Watts

Question (A.2) [1.0]
Which one of the following describes the response of the subcritical reactor to equal insertions of positive reactivity as the reactor approaches criticality at low power?

a. Each reactivity insertion causes a SMALLER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

b. Each reactivity insertion causes a LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

c. Each reactivity insertion causes a SMALLER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

d. Each reactivity insertion causes a LARGER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

Question (A.3) [1.0]
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 process

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

Question (A.4) [1.0]
Which one of the following statements describes why installed neutron sources are used in reactor cores?

a. To increase the count rate by an amount equal to the source contribution.

b. To increase the count rate by 1/M (M = Subcritical Multiplication Factor).

c. To provide neutrons to initiate the chain reaction.

d. To provide a neutron level high enough to be monitored by instrumentation.

Question (A.5) [1.0]
A reactor contains three safety blades and a regulating blade. Which one of the following would result in a determination of the excess reactivity of this reactor?

a. The reactor is critical at a low power level, with all safety blades full out and the regulating blade at some position. The reactivity remaining in the regulating blade (i.e. its worth from its present position to full out) is the excess reactivity.

b. The reactor is shutdown. Two safety blades are withdrawn until the reactor becomes critical. The total blade worth withdrawn is the excess reactivity.

c. The reactor is at full power. The total worth of all blades withdrawn is the excess reactivity.

d. The reactor is at full power. The total worth remaining in all the safety blades and the regulating blade (i.e. their worth from their present positions to full out) is the excess reactivity.

Question (A.6) [1.0]
Which one of the following statements concerning reactivity values of equilibrium (at power) xenon and peak (after shutdown) xenon is correct? Equilibrium xenon is __________ of power level; peak xenon is ________ of power level.

a. **INDEPENDENT** **INDEPENDENT**

b. **INDEPENDENT** **DEPENDENT**

c. **DEPENDENT** **INDEPENDENT**

d. **DEPENDENT** **DEPENDENT**

Question (A.7) [1.0]
Reactor A increases power from 10% to 20% with a period of 50 seconds. Reactor B increases power from 20% to 30% with a period of also 50 seconds. Compared to Reactor A, the time required for the power increase of Reactor B is:

a. longer than A.

b. exactly the same as A.

c. twice that of A.

d. shorter than A.

Question (A.8) [1.0]
A safety blade was withdrawn two (2) inches. The steady reactor period following blade withdrawal is observed to be sixty (60) seconds.

Which one of the following is the differential blade worth?

a. 1.0×10^{-3} delta k/k per inch

b. 5.6×10^{-3} delta k/k per inch

c. 1.12×10^{-4} delta k/k per inch

d. 5.0×10^{-4} delta k/k per inch

Question (A.9) [1.0]
A reactor is subcritical with a shutdown margin of 0.0526 delta k/k. The addition of a reactor experiment increases the indicated count rate from 10 cps to 20 cps. Which one of the following is the new keff of the reactor?

a. .53

b. .90

c. .975

d. 1.02

Question (A.10) [1.0]
Reactor power decreases on a stable negative period after a reactor scram, following an initial prompt drop. Which ONE (1) of the following is the reason for this?

a. This rate of power change is dependent on the **MEAN** lifetime of the longest lived delayed neutron precursor.

b. This rate of power change is dependent on the **MEAN** lifetime of the shortest lived delayed neutron precursor.

c. All prompt neutrons decay during the prompt drop, and the subsequent rate of power change is dependent **ONLY** on the half-life of the longest lived prompt gamma emitter.

d. This rate of power change is dependent on the **CONSTANT** decay rate of prompt neutrons following a scram.

Question (A.11) [1.0]
Which one of the following is the principal source of heat in the reactor after a shutdown from extended operation at 100 KW?

a. Production of delayed neutrons

b. Subcritical reaction of photoneutrons

c. Spontaneous fission of U^{238}

d. Decay of fission fragments

Question (A.12) [1.0]
Which one of the following factors is the most significant in determining the differential worth of a safety blade?

a. The blade speed.

b. Reactor power.

c. The flux shape.

d. The amount of fuel in the core.

Question (A.13) [1.0]
Which one of the following represents the amount of reactivity that will cause the reactor to go "Prompt Critical"?

a. $\rho<\beta eff/(1\text{-}80L)$

b. $\beta eff > \rho > 0$

c. $\rho > \beta eff$

d. $\rho = \beta eff/(1+\lambda T)$

Question (A.14) [1.0]
The reason why the regulating blade must be repeatedly "bumped down" after reaching a 1 watt critical position is:

a. Moderature temperature coefficient.

b. Delayed neutrons.

c. Fuel temperature coefficient.

d. Xe-135 burning out.

Question (A.15) [1.0]
Which one of the following conditions would **INCREASE** the shutdown margin of a reactor?

a. Inserting an experiment adding positive reactivity.

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

c. Depletion of a burnable poison.

d. Depletion of uranium fuel.

Question (A.16) [1.0]
A reactor with an initial population of 24000 neutrons is operating with K_{eff} = 1.01. Of the CHANGE in population from the current generation to the next generation, how many are prompt neutrons?

a. 24

b. 238

c. 240

d. 24240

Question (A.17) [1.0]
Following a significant reactor power increase, the moderator temperature coefficient becomes increasingly more negative. This is because:

a. as moderator density decreases, less thermal neutrons are absorbed by the moderator than by the fuel.

b. the change in the thermal utilization factor dominates the change in the resonance escape probability.

c. a greater density change per degree F occurs at higher reactor coolant temperatures.

d. the core transitions from an under-moderated condition to an over-moderated condition.

Question (A.18) [1.0]
The following data was obtained during a reactor fuel load.

No. of Elements	Detector A (cps)
0	20
8	30
16	50
24	150
28	4000

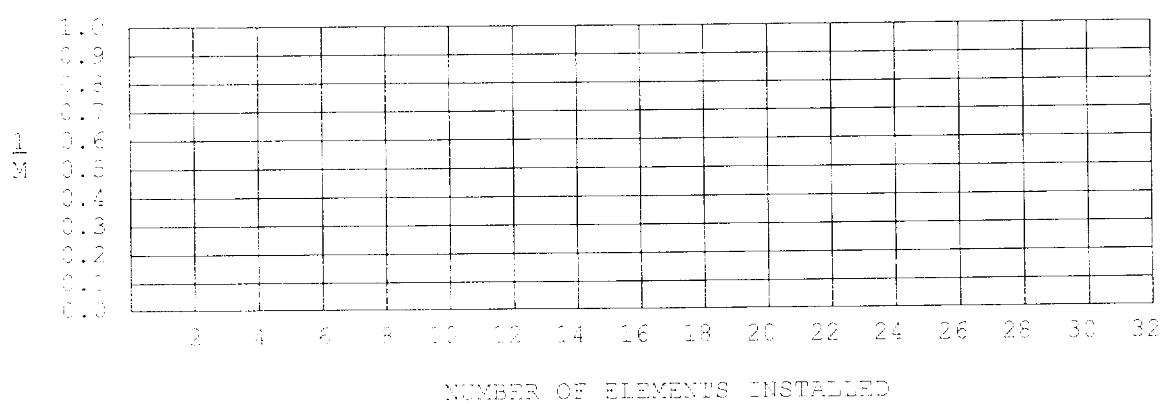
Which one of the following is the closest number of fuel elements required to make the reactor critical? (The attached figure may be used to determine the correct response.)

a. 16

b. 28

c. 32

d. 40



Question (A.19) [1.0]
Which one of the following will be the resulting stable reactor period when a 0.00175 ΔK/K reactivity insertion is made into an exactly critical reactor core?

a. 18 seconds

b. 30 seconds

c. 38 seconds

d. 50 seconds

Question (A.20) [1.0]
Which alteration or change to the core will most strongly affect the thermal utilization factor.

a. Build up of fission products in fuel.

b. Removal of moderator.

c. Addition of U^{238}

d. Removal of a Safety Blade.

(*** End of Section A ***)

*QUESTION (B.1) [1.0]
In order to ensure the health and safety of the public, 10CFR50 allows the operator to deviate from Technical Specifications. What is the minimum level of authorization needed to deviate from Tech. Specs?

a. USNRC

b. Reactor Supervisor

c. Licensed Senior Reactor Operator.

d. Licensed Reactor Operator.

*QUESTION (B.2) [1.0]
Safety Limits are ...

a. limits on process variables found to be necessary to protect the integrity of the fuel cladding.

b. settings for automatic protective devices related to those variable having significant safety functions.

c. settings for ANSI 15.8 suggested reactor scrams and/or alarms which form the protective system for the reactor or provide information which requires manual protective action to be initiated.

d. the lowest functional capability or performance levels of equipment required for safe operation of the reactor.

*QUESTION (B.3) [1.0]
Based on the Requalification Plan for operators, each licensed operator must complete a minimum of ____ reactivity control manipulations during each 2 year cycle.

a. 4

b. 10

c. 20

d. 28

*QUESTION (B.4) [1.0]
Which one of the following signs should be posted prior to using the rabbit system?

a. "Do Not Enter -- Class in Progress" on the back door of NAA Lab.

b. "Warning: High Radiation Area" on the front door of NAA Lab.

c. "Warning: High Radiation Area" on the back door of NAA Lab.

d. "Hazardous Material Area" on the front door of NAA Lab.

*QUESTION (B.5) [1.0]
What is the best type of shielding material to protect from a thermal neutron beam?

a. Lead

b. Heavy clothing

c. Rubber

d. Boron-10

*QUESTION (B.6) [1.0]
Which one of the following is the definition of Committed Dose Equivalent?

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

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

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

d. The 50 year dose equivalent to an organ or tissue resulting from an intake of radioactive material.

*QUESTION (B.7) [1.0]
Which ONE of the following statements is **NOT** a UFTR Safety Limits specification?

a. Primary coolant flow rate shall not be less than 18 gpm at all power levels greater than 1 watt.

b. Primary coolant outlet temperature from any fuel box shall not exceed 150°F.

c. Specific resistivity of primary coolant shall be greater than 0.4 megohm-cm for periods of reactor operations of greater than 4 hrs.

d. Steady state power level shall not exceed 100 Kwt..

*QUESTION (B.8) [1.0]
Select the MINIMUM amount of time that must be spent performing license activities in order to maintain your license active.

a. 4 hours per month

b. 8 hours per month

c. 4 hours per quarter

d. 8 hours per quarter

*QUESTION (B.9) [1.0]
When a radioactive material was removed from the core, it read 25 rem/hr gamma at a distance of 5 feet. Five hours later it read 1.5 rem/hr at 5 feet. How long after the material was removed from the core would it take for the sample to decay to 200 mr/hr?

a. 1.23 hr

b. 4.52 hr

c. 6.97 hr

d. 8.57 hr

*QUESTION (B.10) [1.0]
According to Technical Specifications, the reactor is shutdown when:

a. It contains insufficient fissile material or moderator to attain criticality.

b. Control blades are inserted, their electrical power switched off and the switch key is in proper custody.

c. All control blades are inserted and the reactor is subcritical by a margin greater than 2% delta-K/K.

d. Keff is 0.99 or less.

*QUESTION (B.11) [1.0]
Which one of the following conditions is a violation of Technical Specifications which requires the reactor to be shutdown?

a. The reactor vent system diluting fan has an exhaust flow rate of 11000 cfm.

b. The reactor vent system flow rate through the reactor cavity is 250 cfm.

c. The stack monitor indicates 8 cps and the reactor vent system is secured to replace a faulty absolute filter.

d. The Stack Radiation Monitor alarm is set at 4000 cps.

*QUESTION (B.12) [1.0]
Which one of the following meets the definition of a Channel Check per the Technical Specifications?

a. Immersing a temperature detector in an ice bath and verifying a reading of 32° F.

b. Placing a source next to a radiation detector and observing meter movement.

c. Performing a precise determination of reactor power, then adjusting reactor power meters to correspond to correct power.

d. Comparing Safety Channel #1 to Safety Channel #2.

*QUESTION (B.13) [1.0]
A room contains a source which, when exposed, results in a general area dose rate of 175 mr/hr. This source is scheduled to be exposed continuously for 25 days. Select an acceptable method for controlling radiation exposure from the source within this room.

a. Post the area with words "Danger-Radiation Area".

b. Equip the room with a device to visually display the current dose rate within the room.

c. Equip the room with a motion detector that will alarm in the control room.

d. Lock the room to prevent inadvertent entry into the room.

*QUESTION (B.14) [1.0]
Which classes of experiments shall be approved by the Reactor Safety Review Subcommittee (RSRS)?

a. II and IV

b. II and III

c. III and IV

d. I and III

*QUESTION (B.15) [1.0]
Which one of the following statements is TRUE concerning experiments?

a. When determining the absolute reactivity worth of an experiment, the reactivity effects associated with the moderator temperature are to be considered

b. The reactivity worth of any moveable experiment shall not exceed 0.1 %ΔK/K.

c. No experiment shall be inserted or removed unless all control blades are fully inserted.

d. The total reactivity worth of moveable and secured experiments shall not exceed 2.3%ΔK/K.

*QUESTION (B.16) [1.0]
Which one of the following could be allowed to act as the principal investigator for an experiment to be inserted into the UFTR?

a. Senior Reactor Operator

b. Graduate Student in NRE Department

c. Undergraduate Student in NRE Department

d. Researcher at General Electric Company in Tampa

*QUESTION (B.17) [1.0]
Which one of the following would be considered an unscheduled shutdown requiring completion of UFTR Form SOP-0.6B (Unscheduled Shutdown Review and Evaluation) prior to restart.

a. Shutdown of the reactor due to the loss of the AIM 3BL air particulate detector with the AMS[4] air particulate detector continuing in service.

b. Shutdown of the reactor due to operator observing improper shielding and ALARA concerns at the South Beam Port

c. Shutdown of the reactor to replace the green pen on the two-pen recorder with the green pen replacement readily available in the control room.

d. Shutdown of the reactor because a reactor operator failed to get a relief and needed to go to a meeting.

*QUESTION (B.18) [2.0, 0.4 each]
Match the letter of the power level on the right with the action on the left. (NOTE: Some power levels may be used more than once or not at all.)

a.	Neutron source required	1.	400 cps
		2.	200 cps
b.	Equipment pit must be closed	3.	10 cps
		4.	<2 cps
c.	PuBe source shall be removed	5.	1 watt
		6.	10 watts
d.	Extended range out	7.	1 kW
		8.	10 kW
e.	Automatic control is first allowed		

*QUESTION (B.19) [1.0]
In the event of an emergency evacuation without securing the reactor and reentry not allowed, which one of the following breakers on the main AC distribution panel in the northwest corner of the radiochemistry laboratory may be used to trip the reactor?

a. Breaker No. 1

b. Breaker No. 7

c. Breaker No. 9

d. Breaker No. 22

(*** End of Section B ***)

Section C Plant and Radiation Monitoring Systems

QUESTION (C.1) [1.0]
How is primary coolant flow rate adjusted?

a. Rate varies on the bypass flow through demineralizer loop.

b. Throttle valve on outlet of primary pump.

c. Speed adjust of primary pump.

d. Not adjustable, cooling rate is determined by pump size and system characteristics.

QUESTION (C.2) [1.0]
To clear the secondary flow scram, reactor power level must drop below ...

a. 1000 watts

b. 700 watts

c. 100 watts

d. 1 watt

QUESTION (C.3) [1.0]
What is the purpose of the Spent fuel pit which **DOES NOT** have a special control lock?

a. Storage of removable Pu-Be neutron source.

b. Storage of New (Unirradiated Fuel).

c. Storage of Hurricane Rods.

d. No storage allowed, hole used to check water level.

QUESTION (C.4) [1.0]
Which one of the following is **NOT** a purpose of the Shield Tank?

a. Experimental Port

b. Cooling for experiments

c. Neutron Shielding of core

d. Vent mechanism for contaminated samples.

QUESTION (C.5) [2.0, 0.4 each]
Match the method for gamma compensation given in column b for the detector(s) (and modes) listed in column B. Note each item in column A will have only one answer, methods in column B may be used more than once.

	Column A		**Column B**
a.	Fission Chamber & B-10 (WR)	1.	Intrinsic
b.	Fission Chamber in Ion Chamber Mode (WR)	2.	None
c.	Fission Chamber in Cambelling Mode (WR)	3.	Active Gamma Comp. (Summing Inversion)
d.	Uncompensated Ion Chamber	4.	Pulse Height Discrimination
e.	Compensated Ion Chamber	5.	Photo-multiplication

QUESTION (C.6) [1.0]
Which one of the following does **NOT** open the Dump valve?

a. shield tank low level.

b. loss of power to the dump valve.

c. nuclear instrumentation trip with 2 control blades fully out.

g. loss of high voltage power supply 2 when at full power.

QUESTION (C.7) [1.0]
With water in the core and all control blades removed, insertion of the Hurricane rods assures the UFTR core will have a shutdown margin of at least:

a. 5% delta-K/K

b. 0.8% delta-K/K

c. 1.0% delta-K/K

d. 1.3% delta-K/K

QUESTION (C.8) [1.0]
The reactor is at 10 KW when the rupture disc accidentally ruptures. Which one of the following conditions will first cause a reactor trip? (Assume no operator actions)

a. Reduction of primary coolant level

b. PC pump off

c. Reduction of primary coolant flow (fill line)

d. High temperature primary coolant return from the reactor.

QUESTION (C.9) [2.0, 0.33 each]
Match the following situations to their flow rate values. (NOTE: Some flow rates may be used more than once or not at all.)

a.	Primary coolant safety limit at $\geq$1 watt	1.	200 gpm
b.	Primary coolant flow trip	2.	160 gpm
c.	Normal primary coolant flow	3.	140 gpm
d.	Demineralizer flow rate (PC pump on)	4.	44 gpm
e.	Nominal deep well secondary flow rate	5.	30 gpm
f.	Secondary coolant flow warning	6.	18 gpm
		7.	1.0 gpm
		8.	0.5 gpm

QUESTION (C.10) [1.0]
Which statement describes the operation of Secondary Cooling Water scram modes?

a. In the city water scram mode, the flow trip is set at 8 gpm with no delay.

b. In the well water scram mode, the flow trip is set at 8 gpm with a 10 sec delay.

c. In the city water scram mode, the flow trip is set at 60 gpm with a no delay.

d. In the well water scram mode, the flow trip is set at 60 gpm with a 10 sec delay.

QUESTION (C.11) [1.0]
Which feature of the primary coolant system helps eliminate air entrapment in the coolant?

a. Coolant storage tank vent line.

b. Aluminum bucket baffle.

c. Fuel boxes vent line vacuum breaker.

d. Primary coolant pump bleed valve.

QUESTION (C.12) [1.0]
The reactor vent system must be IMMEDIATELY secured if:

a. the stack monitor indicates less than 10 counts per second.

b. the stack monitor recorder is inoperable.

c. air flow is less than 400 cfm.

d. the absolute filter is dirty.

QUESTION (C.13) [1.0]
Which one of the following conditions is NOT required for taking automatic control of the UFTR?.

a. Power at or above 1 watt.

b. Regulating blade less than 650 units removed.

c. Power within 20% of desired power.

d. Near infinite period.

QUESTION (C.14) [1.0]
Which one of the following will automatically actuate the evacuation alarm?

a. Two area radiation monitors alarm high.

b. An air particulate monitor has an alarm condition.

c. Rupture disk pressure exceeds 7 psid.

d. The dump valve opens.

QUESTION (C.15) [2.0, 0.5 each]
Match the event in Column A with the resulting automatic action in Column B.

NOTE: Items in Column B may be used more than once or not at all.

	Column A (EVENT)		Column B (AUTOMATIC ACTION)
a.	PC Pump On	1.	Cell air conditioner secures
b.	Dump Valve Opens	2.	Primary coolant pump secures
c.	Dilute Fan Off	3.	Demineralizer pump secures
d.	PC Pit Alarm	4.	Core vent fan secures
		5.	No action

QUESTION (C.16) [1.0]
Which of the following describes why the regulating blade has a higher clutch current than the safety blades?

a. The clutches for safety blades must release quicker.

b. It has different gearing with more torque to overcome.

c. To assure no slippage in automatic flux control.

d. It is heavier than the safety blades.

QUESTION (C.17) [1.0]
Vent fan flow is normally about ________ and required to be in the range of ________ by technical specifications.

a. 250 cfm, 1-400 cfm.

b. 150 cfm, 10-400 cfm.

c. 250 cfm, 10-400 cfm.

d. 150 cfm, 100-400 cfm.

ANSWER (A.01)
a
REFERENCE
$P=P_o e^{t/\tau} = 1e^{120sec/30sec} = 54.6$

ANSWER (A.02)
b
REFERENCE
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 3.161 — 3.163, pp. 190 — 191.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Chapt. 5, pp. 5-1 — 5-28.

ANSWER (A.03)
c
REFERENCE
Lamarsh, J.R., *Introduction to Nuclear Engineering,* - 1983. § 7.1, pp. 280 — 284.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, §§ 3.2.2 — 3.2.3, pp. 3-7 — 3-12.

ANSWER (A.04)
d
REFERENCE
Standard NRC Question
Burn, R., © 1982, §5.2, p. 5-1

ANSWER (A.05)
a
REFERENCE
T.S. Definition 1.8
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §§ 6.2.1, pp. 6-2.

ANSWER (A.06)
d
REFERENCE
Lamarsh, J.R., *Introduction to Nuclear Engineering,* - 1983. § 7.4, pp. 316 — 322.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §§ 8.1 — 8.4, pp. 8-3 — 8-14.

ANSWER (A.07)
d
REFERENCE
The power of reactor A increases by a factor of 2, while the power of reactor B increases by a factor of 1.5. Since the periods are the same (rate of change is the same), power increase B takes a shorter time.

ANSWER (A:08)
d
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 7.2 & 7.3, pp. 7-1 — 7-9.

$$T = \frac{\beta eff - \rho}{\lambda eff\ \rho} \Rightarrow \rho = \frac{\beta eff}{(\lambda\ \tau) + 1}$$

ρ = 0.007/((0.1 * 60) + 1) = 0.007/7
ρ = 1 x 10^{-3} delta k/k
ρ/inch = 1 x 10^{-3} delta k/k/2 inches = 5.0 x 10^{-4} delta k/k per inch

ANSWER (A.09)
c
REFERENCE:
SDM = 1-K_{eff}/K_{eff} → K_{eff} = 1/SDM + 1 → K_{eff} = 1/0.0526 + 1 → K_{eff} = .95
CR_1/CR_2 = (1 - K_{eff2}) / (1 - K_{eff1}) → 10/20 = (1 - K_{eff2}) / (1 - 0.95)
(0.5) x (0.05) = (1 - K_{eff2}) → K_{eff2} = 1 - (0.5)(0.05) = 0.975

ANSWER (A.10)
a
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.7, p. 4-21.

ANSWER (A.11)
d
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.9, pp. 4-23 — 4-26.

ANSWER (A.12)
c
REFERENCE
Lamarsh, J.R., *Introduction to Nuclear Engineering,* 1983. § 7.2, p. 303.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 7.2 & 7.3, pp. 7-1 — 7-9.

ANSWER (A.13)
c
REFERENCE
Glasstone S. and Sesonske, Nuclear Reactor Engineering, 1991, p. 264.

ANSWER (A.14)
b
REFERENCE
1991 NRC Exam.

ANSWER (A.15)
d
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.3, p. 6-4.

ANSWER (A.16)
b
REFERENCE
24000 neutrons in current generation * 1.01 = 24240 neutrons in next generation
240 neutrons added - 0.7% delayed neutron fraction = 238 prompt neutrons added

ANSWER (A.17)
c
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 6.4.1, pp. 6-5.

ANSWER (A.18)
b
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 5.5, pp. 5-18 — 5-25.

ANSWER (A.19)
b
REFERENCE
Glasstone, S. and Sesonske, A. *Nuclear Reactor Engineering,* 1991, § 5.18, p. 234.
$T = (\beta - \rho)/\lambda\rho$ $T = (.0070 - .00175)/.1 \times .00175 = 30$ seconds

ANSWER (A.20)
d
REFERENCE
Lamarsh, J.R., *Introduction to Nuclear Engineering,* - 1983. § 7.2, p. 300
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 3.3, pp. 3-13 — 3-18.

(*** End of Section A ***)

ANSWER (B.1)
c
REFERENCE
10CFR50.54(y)

ANSWER (B.2)
a
REFERENCE
TS 2.1

ANSWER (B.3)
b
REFERENCE
Requalification Plan

ANSWER (B.4)
a
REFERENCE
UFTR Reactor Operator Requalification Program Training Exam. Question 20

ANSWER (B.5)
d
REFERENCE
Westinghouse Rad Con & Chem. Trng Ch. 4

ANSWER (B.6)
d
REFERENCE
10CFR20.1003

ANSWER (B.7)
b
REFERENCE
T.S. 2.1

ANSWER (B.8)
c
REFERENCE
10 CFR 55.53

ANSWER (B.9)
d
REFERENCE
Nuclear Power Plant Health Physics and Radiation Protection, Ch. 4

ANSWER (B.10)
c
REFERENCE
T.S. Section 1.0 Definitions

ANSWER (B.11)
c
REFERENCE
T.S. 3.3 & 3.4

ANSWER (B.12)
d
REFERENCE
T.S. Section 1.0 Definitions

ANSWER (B.13)
d
REFERENCE
Health Physics Manual pg. 13, Sect. 8.5

ANSWER (B.14)
c
REFERENCE
T.S. 3.5 (2)

ANSWER (B.15)
d
REFERENCE
T.S. 3.5 (3)

ANSWER (B.16)
d
REFERENCE
UFTR Standard Operating Procedures - Q & A Bank, Question 13

ANSWER (B.17)
b
REFERENCE
UFTR Standard Operating Procedures - Q & A Bank, Question 71

ANSWER (B.18)
a. 4 - b. 8 - c. 7 - d. 1 - e. 5
REFERENCE
UFTR Standard Operating Procedures - Q & A Bank, Question 93

ANSWER (B.19)
c
REFERENCE
UFTR Standard Operating Procedures - Q & A Bank, Question 213

(End of Section B)

ANSWER (C.1)
b
REFERENCE
Training Material on UFTR Design & Operating Characteristics, p. 19

ANSWER (C.2)
b
REFERENCE
Training Material on UFTR Design & Operating Characteristics, p. 21

ANSWER (C.3)
c
REFERENCE
Training Material on UFTR Design & Operating Characteristics, p. 31

ANSWER (C.4)
d
REFERENCE
Training Material on UFTR Design & Operating Characteristics, p. 8

ANSWER (C.5)
a, 4; b, 2; c, 1; d, 2; e, 3
REFERENCE
2/97 NRC exam. question #C.16

ANSWER (C.6)
a
REFERENCE
UFTR SAR p. 7-15

ANSWER (C.7)
c
REFERENCE
UFTR SOP-B.4

ANSWER (C.8)
a
REFERENCE
Training Material on UFTR Design & Operating Characteristics, Fig. 5.1

ANSWER (C.9)
a, 6 - b, 5 - c, 4 - d, 7 - e, 1 - f, 3
REFERENCE
UFTR Design & Operating Characteristics QA Bank p. 36

ANSWER (C.10)
a, d
REFERENCE
UFTR Design & Operating Characteristics p. 23

ANSWER (C.11)
b
REFERENCE
UFTR SAR 5.1.1

ANSWER (C.12)
b
REFERENCE
UFTR TS pg 10, 3.3.1.(1)

ANSWER (C.13)
b
REFERENCE
UFTR Standard Operating Procedures - Q&A Bank 119, pg. 24

ANSWER (C.14)
a
REFERENCE
TS 3.6, pg 15

ANSWER (C.15)
a 3
b 2
c 4
d 5
REFERENCE
2/97 NRC Exam question C.10

ANSWER (C.16)
c
REFERENCE
UFTR Design & Operating Characteristics QA Bank #221 p. 52.
2/97 NRC Exam question C.11

ANSWER (C.17)
a
REFERENCE
UFTR Design & Operating Characteristics QA Bank #185 p. 44 & T.S. 3.3(2)

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