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

REPORT NO.: 50-288/OL-99-02

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: Reed College

EXAMINATION DATES: 10/25/99

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: _____ 10/28/99
Patrick Isaac, Chief Examiner — Date

SUMMARY:

During the week of October 25, 1999, NRC administered a retake of Section A of the Operator Licensing Examinations to three Reactor Operator (RO) candidates. All the candidates passed the examinations.

REPORT DETAILS

1. Examiners:

   Patrick Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/0	N/A	3/0
Operating Tests	W	W	W
Overall	3/0	N/A	3/0

3. Exit Meeting:

   N/A

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

FACILITY: Reed College

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1999/10/25

REGION: IV

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% is required to pass the examination. Examinations will be picked up one (1) hour after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	100.0	_____	____	A.REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
		_____ 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 *****)
(***** 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.

12. There is a time limit of one (1) hour for completion of the examination.

*QUESTION (A.1) (1.00)
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: 002 (1.00)
As power level increases, the Prompt Negative Temp. Coefficient (PNTC) causes:

a. 238U to absorb neutrons over a wider range, thus decreasing the number of neutrons available for fission with 235U.

b. Doppler resonance effects to decrease.

b. The hydrogen atoms in the ZrH2 to slow down more neutrons.

c. More thermal neutron absorption by the moderator.

QUESTION: 003 (1.00)
Which ONE of the following statements correctly describes the influence of delayed neutrons on the neutron life cycle?

a. Delayed neutrons decrease the average period of a reactivity addition because they thermalize more quickly than prompt neutrons.

b. Delayed neutrons take longer to thermalize because they are born at higher energies than prompt neutrons.

c. Delayed neutrons cause the length of the average neutron generation time to increase.

d. Delayed neutrons are born later than prompt neutrons and make up a larger fraction of the fission neutrons.

QUESTION: 004 (1.00)
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 238U

d. Removal of a control rod.

QUESTION: 005 (1.00)
With the reactor on a constant period, which transient requires the longest time to occur?

A reactor power change of:

a. 5% power -- going from 1% to 6% pwr

b. 10% power -- going from 10% to 20% pwr

c. 15% power -- going from 20% to 35% pwr

d. 20% power -- going from 40% to 60% pwr

QUESTION: 006 (1.00)
What is the stable Reactor period which produces a power rise from 1 watt to 5 KW in 186 secs?

a. 10 secs.

b. 22 secs.

c. 30 secs.

d. 116 secs.

QUESTION: 007 (1.00)
During a fuel loading, as the reactor approaches criticality, the value of 1/M:

a. decreases toward zero

b. decreases toward one

c. increases toward infinity

d. increases toward one

QUESTION: 008 (1.00)
Which ONE of the following is the reason for the 80 second period following a reactor scram?

a. U-235 affinity for source neutrons.

b. Fuel temp. coefficient adding positive reactivity.

c. Longest lived delayed neutron precursors decay constant.

d. Amount of negative reactivity added on a scram exceeds the shutdown margin.

QUESTION: 009 (1.00)
Which ONE of the following statements describes Count Rate characteristics after a control rod withdrawal with the reactor subcritical? (Assume the reactor remains subcritical.)

a. Count rate will rapidly increase (prompt jump) then gradually increase to a stable value.

b. Count rate will rapidly increase (prompt jump) then gradually decrease to the previous value.

c. Count ratel will rapidly increase (prompt jump) to a stable value.

d. There will be no change in Count rate until criticality is achieved.

QUESTION: 010 (1.00)
In a subcritical reactor, Keff is increased from 0.861 to 0.946. Which ONE of the following is the amount of reactivity that was added to the core?

a. 0.085 delta-K/K

b. 0.220 delta-K/K

c. 0.104 delta-K/K

d. 0.125 delta-K/K

QUESTION: 011 (1.00)
Which one of the following describes "Excess Reactivity"?

a. A measure of the additional fuel loaded to overcome fission product poisoning.

b. A measure of remaining control rod worth with the reactor exactly critical.

c. The combined control rod negative reactivity worth required to keep the reactor shutdown.

d. The maximum reactivity by which the reactor can be shutdown with one control rod fully withdrawn.

QUESTION: 012 (1.00)
Which ONE of the following is a correct statement concerning the factors affecting control rod worth?

a. Fuel burn up causes the rod worth for periphery rods to decrease.

b. Fuel burn up causes the rod worth to increase in the center of the core.

c. The withdrawal of a rod causes the rod worth of the remaining inserted rods to increase.

d. As Reactor power increases rod worth increases.

QUESTION: 013 (1.00)
The Reactor is shutdown by 5% delta-K/K with a count rate of 100 cps on the start up channel. Rods are withdrawn until the count rate is 1000 cps. Which ONE of the following is the condition of the reactor after the rods are withdrawn?

a. Critical with Keff = 1.0

b. Subcritical with Keff = 0.995

c. Subcritical with Keff = 0.950

d. Supercritical with Keff = 1.005

QUESTION: 014 (1.00)
Assume the following rod worths: Safety $4.25, Shim $4.05, Reg. $1.75, and Core excess is $2.5 . Calculate the Shutdown Reactivity to satisfy the T.S. Minimum Shutdown Margin.

a. $3.3

b. $3.5

c. $6.1

d. $7.5

QUESTION: 015 (1.00)
The Reed College Triga Reactor is slightly undermoderated. Which one of the following statements correctly describes the reactor operating characteristic of "Undermoderated"?

a. A decrease in core water temperature will cause a negative reactivity response.

b. Reducing the amount of moderation will cause a positive reactivity response.

c. An increase in core water temperature will cause a positive reactivity response.

d. A decrease in core water density will cause a negative reactivity response.

QUESTION: 016 (1.00)
In a just critical reactor, removing one dollar worth of positive reactivity will cause:

a. The resultant period to be a function of the prompt neutron lifetime.

b. The prompt neutron term to become unimportant

c. The reactor period to be equal to $\frac{(\beta-\rho)}{\lambda\rho}$

d. A sudden drop in neutron flux.

QUESTION: 017 (1.00)
Which statement illustrates a characteristic of Subcritical Multiplication?

a. As Keff approaches unity (1), for the same increase in Keff, a greater increase in neutron population occurs.

b. The number of neutrons gained per generation gets larger for each succeeding generation.

c. The number of fission neutrons remain constant for each generation.

d. The number of source neutrons decreases for each generation.

QUESTION: 018 (1.00)
Which statement best describes the heat transfer mechanism at the Reed College Reactor?

a. From the fuel center line, heat is transferred to the surface of the fuel rod by convection and is carried into the coolant by conduction.

b. Heat is transmitted to the fuel rod surface by thermal radiation and carried to the coolant bt conduction.

c. Heat conducted to the surface of a fuel rod is carried into the coolant and out of the system by convection.

d. The temperature distribution from the fuel center line to the coolant is linear.

QUESTION: 019 (1.00)
Which statement best describes Xe-135 behavior following a Reactor Scram?

a. Xenon concentration decreases due to production rate from fission stops.

b. Xenon concentration decreases due to production rate from I-135 decay increasing.

c. Xenon concentration increases due to production rate from Pm-149 increasing.

d. Xenon concentration increases due to I-135 decay exceeding Xe-135 decay.

QUESTION: 020 (1.00)
The reactor was shutdown after an extended two week, high power, run at 200 kw to irradiate a specimen. How long will it take for the MAXIMUM Xenon poison effect to occur?

a. 30 minutes.

b. 8 to 12 hours.

c. 35 to 45 hours.

d. 1 to 3 hours.

(***** END OF EXAMINATION *****)

ANSWER: 001 (1.00)
d
REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.9, pp. 4-23 — 4-26..

ANSWER: 002 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.98, p. 94.

ANSWER: 003 (1.00)
c
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.20, p. 236.

ANSWER: 004 (1.00)
d
REFERENCE:
Lamarsh, J.R., *Introduction to Nuclear Engineering,* Addison-Wesley Publishing, Reading, Massachusetts, 1983. § 7.2, p. 300
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 3.3, pp. 3-13 — 3-18.

ANSWER: 005 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.

ANSWER: 006 (1.00)
b
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.

ANSWER: 007 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 3.161 — 3,163, pp. 190 & 191

ANSWER: 008 (1.00)
c
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.47, p. 246.

ANSWER: 009 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.31, p. 240.

ANSWER: 010 (1.00)
c
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 3.44, p. 149 & § 5.9, p. 231.

ANSWER: 011 (1.00)
b
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.198, p. 300.

ANSWER: 012 (1.00)
c
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 5.224 — 5.229, pp. 306 — 307.

ANSWER: 013 (1.00)
b
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 3.161 — 3.163, pp. 190 — 191.

ANSWER: 014 (1.00)
a
REFERENCE:
T.S. Section F.3
Reed Requal. Exam 88-89

ANSWER: 015 (1.00)
d
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 7.131 — 7.155, pp. 465 — 472.

ANSWER: 016 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.51, p. 248.

ANSWER: 017 (1.00)
a
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 3.161 — 3.163, pp. 190 — 191.

ANSWER: 018 (1.00)
c
REFERENCE:
Reed Requal Exam 1990

ANSWER: 019 (1.00)
d
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 5.56 — 5.80, pp. 250 — 260.

ANSWER: 020 (1.00)
b
REFERENCE:
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 5.56 — 5.80, pp. 250 — 260.