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

REPORT NO.:	50-193/OL-97-01
FACILITY DOCKET NO.:	50-193
FACILITY LICENSE NO.:	R-95
FACILITY:	Rhode Island Atomic Energy Commission
EXAMINATION DATES:	May 28 - 29, 1997
EXAMINER:	Patrick Isaac, Chief Examiner
SUBMITTED BY:	Patrick Isaac, Chief Examiner — 06/07/97 Date

SUMMARY:

During the week of May 26, the NRC administered Operator Licensing Examinations to one Senior Reactor Operator Instant (SROI) candidate. The candidate passed all portions of the examinations.

ENCLOSURE 1

REPORT DETAILS

1. Examiners:

   Patrick Isaac, Chief Examiner

2. Results:

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

3. Exit Meeting:

   Personnel attending:

   Mr. Wayne Simoneau, Assistant Director, RINSC
   Patrick Isaac, Chief Examiner

   Following his review of the written examination, Mr. Simoneau requested the following changes to the written examination:

   Question B.10: Delete due to the lack of a correct answer.
   Question B.15: Accept answers "a" and "c" as correct.
   Question C.15d: Change the correct answer to choice "3".

   The NRC examiner agreed with the request and the examination answer key was modified accordingly.

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

FACILITY: Rhode Island Nuclear Science Center

REACTOR TYPE: POOL

DATE ADMINISTERED: 1997/05/28

REGION: I

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	33.9	______	____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
19.00	32.2	______	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.9	______	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
59.00		______ FINAL GRADE	____%	TOTALS

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

____
Candidate's Signature

ENCLOSURE 2

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

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.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

ANSWER SHEET

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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 *****)

ANSWER SHEET

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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 ___

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

ANSWER SHEET

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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 ___

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

EQUATION SHEET

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

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

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

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

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

$$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$
$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

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

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}}$$

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

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

$$SDM = \frac{(1 - K_{eff})}{K_{eff}}$$

$$P = P_0\, e^{\frac{t}{T}}$$

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

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

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1} \times K_{eff_2}}$$

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

$$T_{½} = \frac{0.693}{\lambda}$$

$$\rho = \frac{(K_{eff} - 1)}{K_{eff}}$$

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

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

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

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

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

1 Curie = 3.7 x 10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54 x 10^3 BTU/hr

1 Mw = 3.41 x 10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_p = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C

Section A R Theory, Thermo & Fac. Operating Characteristics

QUESTION (A.1) [1.0]

Given the following information concerning a 10 microgram sample of U-233:

* Atomic density - 3.64 x 10E21 atoms/cc
* Microscopic fission cross section - 531 barns

Which one of the following is the measured reaction rate if the incident neutron flux at the sample is 4.2 x 10E9 n/cm²-sec?

a. 1.6 x 10E7 fissions/cc-sec

b. 3.1 x 10E7 fissions/cc-sec

c. 6.2 x 10E9 fissions/cc-sec

d. 8.1 x 10E9 fissions/cc-sec

QUESTION (A.2) [1.0]

What is the stable Rx 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 (A.3) [1.0]

The reactor has scrammed following an extended period of operation at full power.
Which one of the following accounts for generation of a majority of the heat one (1) hour after the scram?

a. Spontaneous fissions

b. Delayed neutron fissions

c. Alpha fission product decay

d. Beta fission product decay

QUESTION (A.4) [1.0]

In a subcritical Rx, 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. 0.090 delta-K/K

b. 0.220 delta-K/K

c. 0.104 delta-K/K

d. 0.125 delta-K/K

QUESTION (A.5) [1.0]

Which one of the following is a correct statement concerning the factors affecting control rod worth?

a. With all other rods withdrawn, a inserted rod exhibits maximum worth.

b. As the temperature of the moderator increases, rod worth decreases.

c. As Rx power increases rod worth increases.

d. With all other rods inserted, a withdrawn rod exhibits its greatest total worth.

QUESTION (A.6) [1.0]

A reactor startup is in progress by withdrawing a control rod and then waiting until count rate stabilizes. The reactor is not critical. Assume that the control rod is being withdrawn in equal amounts each time and each control rod withdrawal adds equivalent amounts of reactivity.

Compare two consecutive control rod withdrawals.

a. Time for power to stabilize will be equal for both withdrawals and the power increase will be the same for both withdrawals.

b. The power increase will be the same for both withdrawals but the time for power to stabilize will be less for the second withdrawal.

c. The power increase will be the same for both withdrawals but time for power to stabilize will be longer for the second withdrawal.

d. The power increase will be larger for the second withdrawal and the time for power to stabilize will be longer for the second withdrawal.

QUESTION (A.7) [1.0]

Two critical reactors are identical with the exception that Reactor 1 has a beta fraction of .0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors.

Which one of the following will be the response of Reactor 2?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be shorter.

d. The resulting period will be longer.

QUESTION (A.8) [1.0]

Assume that reactor power is 50% and equilibrium Xenon is attained. Reactor power is then increased to 100%. Which one of the following correctly describes the new equilibrium Xenon value?

a. The 100% equilibrium xenon is half the 50% value

b. The 100% equilibrium xenon is equal to the 50% value.

c. The 100% equilibrium xenon is higher than the 50% value but not twice as high.

d. The 100% equilibrium xenon is twice as high as the 50% value.

QUESTION (A.9) [1.0]

Which one of the following six factor formula terms are affected most by temperature?

a. Thermal utilization and resonance escape probability

b. Fast fission factor and resonance escape probability

c. Fast fission factor and reproduction factor

d. Reproduction factor and thermal utilization

Section A R Theory, Thermo & Fac. Operating Characteristics

QUESTION (A.10) [1.0]

Which one of the following describes how doubling the time a target nuclide is irradiated affects the activity level.

a. Less than doubles the activity.

b. More than doubles the activity.

c. Exactly doubles the activity.

d. Increases the activity by a factor of e.

QUESTION (A.11) [1.0]

If reactor power is increasing by a decade every minute, it has a period of:

a. 13 sec

b. 26 sec

c. 52 sec

d. 65 sec

QUESTION (A.12) [1.0]

Which one of the following is the primary reason a neutron source is installed in the core?

a. To allow for testing and irradiation experiments when the reactor is shutdown.

b. To supply the neutrons required to start the chain reaction for subsequent reactor startups.

c. To provide a neutron level high enough to be monitored for a controlled reactor startup.

d. To increase the excess reactivity of the reactor which reduces the frequency for refueling.

QUESTION (A.13) [1.0]

If Keff equals 1.0, how much reactivity must be added to make the reactor prompt critical?

a. The beta fraction.

b. The amount to make Keff equal to 1.1.

c. The amount to make the reactor period infinite.

d. The amount needed to increase the mean neutron lifetime to 0.080 seconds.

QUESTION (A.14) [1.0]

Assuming that you pull Blade 3 at the maximum reactivity insertion rate allowed per Technical Specifications. How long would it take to add 2.0 %ΔK/K worth of reactivity? (Assume a linear rod worth.)

a. 52.5 secs

b. 100 secs

c. 181 secs

d. 226 secs

QUESTION (A.15) [1.0]

The reactor is subcritical with a Keff of 0.95 and a source range count rate of 15 counts per second. Control rods are withdrawn until the source range count rate equals 45 counts per second.

Which of the following is the Keff of the core after the control rod withdrawal?

a. 0.953

b. 0.970

c. 0.983

d. 0.995

QUESTION (A.16) [1.0]

The regulating 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. 9×10^{-4} 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. 4.6×10^{-4} delta k/k per inch

QUESTION (A.17) [1.0]

Which one of the following figures most closely depicts the reactivity versus time plot for xenon for the following series of evolutions:

TIME	EVOLUTION
1	2 MW startup, clean core;
2	Operation at 2 MW for four days;
3	Shutdown for 15 hours;
4	1 MW for 29 hours.

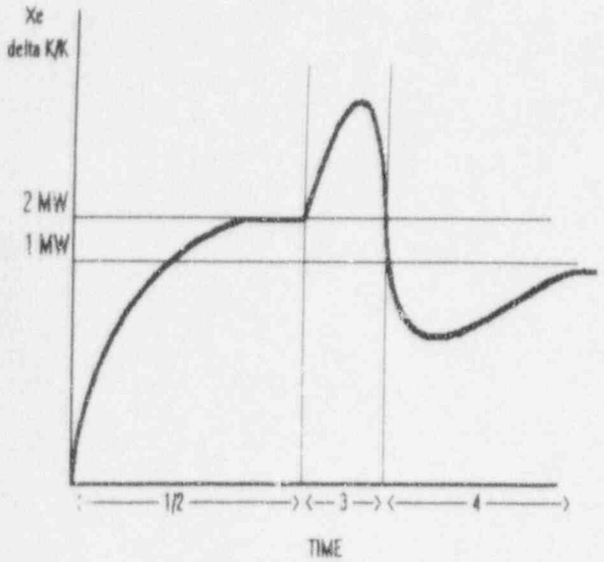
a. 1

b. 2

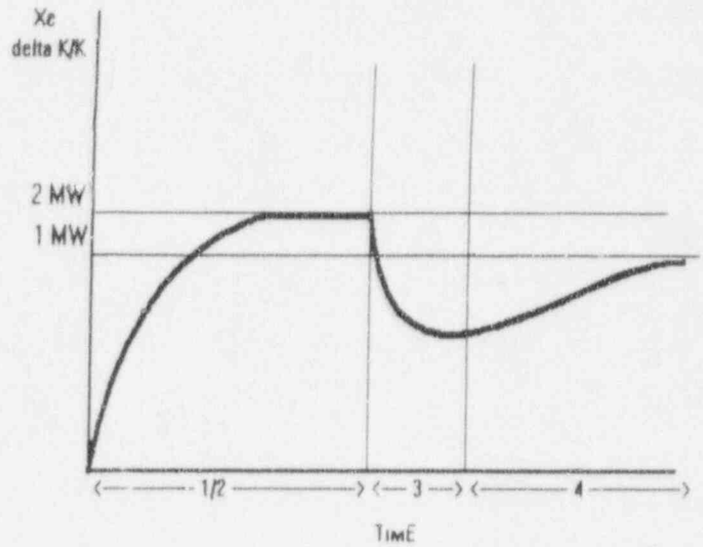
c. 3

d. 4

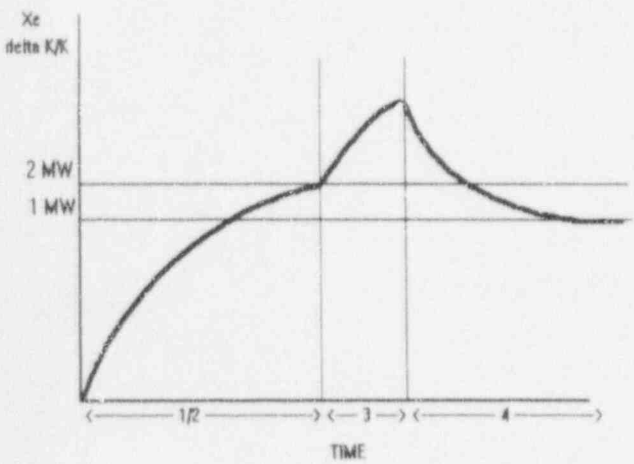
(See attached figures on next page for choice selections.)


Xe
delta K/K
2 MW
1 MW
1/2
3
4
TIME

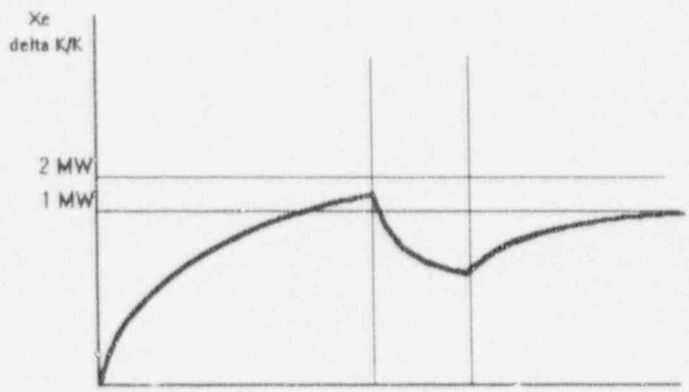
a


Xe
delta K/K
2 MW
1 MW
1/2
3
4
TIME

b


Xe
delta K/K
2 MW
1 MW
1/2
3
4
TIME

c


Xe
delta K/K
2 MW
1 MW

d

QUESTION (A.18) [1.0]

Following a scram, the value of the stable reactor period is:

a. approximately 50 seconds, because the rate of negative reactivity insertion rapidly approaches zero.

b. approximately -10 seconds, as determined by the rate of decay of the shortest lived delayed neutron precursors.

c. approximately -80 seconds, as determined by the rate of decay of the longest lived delayed neutron precursors.

d. infinity, since neutron production has been terminated.

QUESTION (A.19) [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

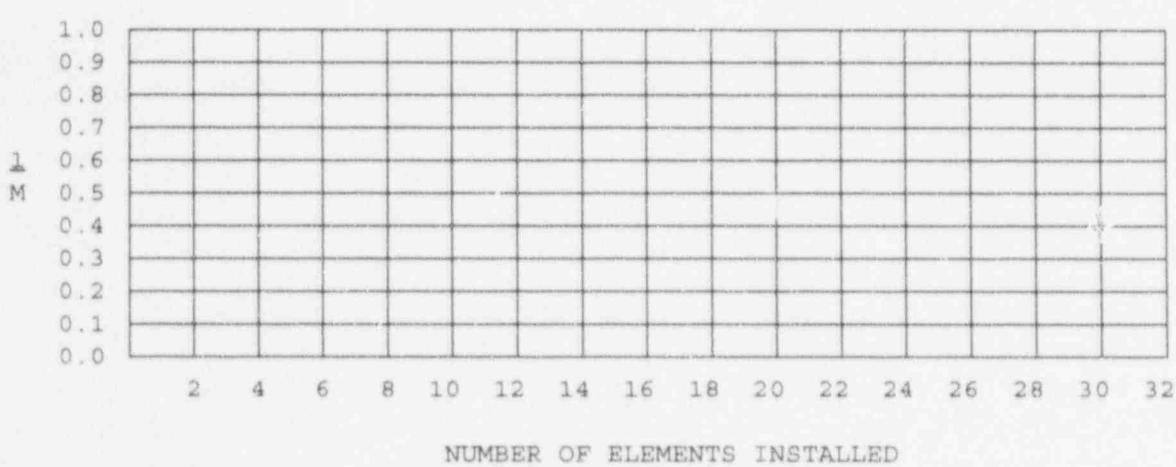
Which one of the following is the number of fuel elements required to make the reactor critical? (The attached figure may be used to determine the correct response.)

a. 16

b. 28

c. 32

d. 40



QUESTION (A.20) [1.0]

The reactor is operating at 100 KW. The reactor operator withdraws the Regulating Rod allowing power to increase. The operator then inserts the same rod to its original position, decreasing power. In comparison to the rod withdrawal, the rod insertion will result in:

a. a slower period due to long lived delayed neutron precursors.

b. a faster period due to long lived delayed neutron precursors.

c. the same period due to equal amounts of reactivity being added.

d. the same period due to equal reactivity rates from the rod.

***** END OF SECTION A *****

QUESTION (B.1) [1.0]

A point source of gamma radiation measures 50 mr/hr at a distance of 5 ft. What is the exposure rate (mr/hr) from the source at a distance of 10 ft.

a. 25 mr/hr

b. 12.5 mr/hr

c. 6.25 mr/hr

d. 17.5 mr/hr

QUESTION (B.2) [2.0]

Match the requirements for maintaining an active operator license in column A with the correct time period from column B.

	Column A		Column B
a.	Renewal of license	1.	1 year
b.	Medical Examination	2.	2 years
c.	Requalification Written examination	3.	4 years
d.	Requalification Operating Test	4.	6 years

QUESTION (B.3) [1.0]

Which one of the following does NOT require NRC approval for changes?

a. License

b. Requalification plan

c. Emergency Implementation Procedures

d. Emergency Plan

QUESTION (B.4) [1.0]

The governor requests radiation workers to clean up an accident at Millstone Nuclear facility. While helping out you receive a dose of 6 Rem. 10 CFR 20 requires that this dose be tracked as a Planned special exposure. Who is responsible for maintaining a permanent record of this dose?

a. Federal Emergency Management Agency (FEMA)

b. RINSC.

c. Nuclear Regulatory Commission.

d. State of Rhode Island, (an agreement state).

QUESTION (B.5) [1.0]

Total Effective Dose Equivalent (TEDE) is defined as the sum of the deep dose equivalent and the committed effective dose equivalent. The deep dose equivalent is related to the ...

a. dose to organs or tissues.

b. external exposure to the skin or an extremity.

c. external exposure to the lens to the eyes.

d. external whole-body exposure

QUESTION (B.6) [1.0]

Since he started employment at RINSC a radiation worker has accumulated a dose of 3.27 R. So far this year, the worker has received a dose of 1.25 R. How long can he remain in an area with a gamma dose rate of 75 mR/hr without exceeding the 10CFR20 TEDE limit? (Assume zero committed dose.)

a. 6 hours

b. 23 hours

c. 50 hours

d. 66 hours

QUESTION (B.7) [1.0]

A radioactive source generates a dose of 100 mr/hr at a distance of 10 feet. With two inches of lead shielding the reading drops to 50 mr/hr at a distance of 10 feet. If you were to add **ANOTHER** four inches of the same type of shielding, the reading at 10 feet would drop to ...

a. 25 mr/hr

b. 12½ mr/hr

c. 6¼ mr/hr

d. 3⅛ mr/hr

QUESTION (B.8) [2.0]

Identify each of the actions listed below as either a **Channel Check**, **Channel Test**, or **Channel Calibration.**

a. Verifying overlap between Nuclear Instrumentation meters.

b. Replacing an RTD with a precision resistance decade box, to verify proper channel output for a given resistance.

c. Performing a calorimetric (heat balance) calculation on the primary system, then adjusting Nuclear Instrumentation to agree.

d. During shutdown you verify that the period meter reads -80 seconds.

QUESTION (B.9) [1.0]

Limiting Safety System Settings (LSSS) are ...

a. limits on very important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

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

c. combinations of sensors, interconnecting cables of lines, amplifiers and output devices which are connected for the purpose of measuring the value of a variable.

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

QUESTION (B.10) [1.0] ***DELETED***

The Technical Specification Safety Limits for the forced convection mode of operation are based on core thermal and hydraulic performances. Which one of the following lists the four reactor scrams associated with this performance?

a. Reactor thermal power.
Reactor short period.
Reactor coolant flow rate.
Reactor pool temperature.

b. Reactor coolant inlet temperature.
Reactor coolant outlet temperature.
Primary coolant system operable.
Height of water above the center line of the core.

c. Reactor short period.
Reactor coolant outlet temperature.
Primary coolant system operable.
Reactor pool temperature.

d. Reactor thermal power.
Reactor coolant flow rate.
Reactor coolant inlet temperature.
Height of water above the top of the core.

QUESTION (B.11) [1.0]

Consider two point sources, each having the same curie strength. Source A's gammas have an energy of 1 MEV whereas Source B's gamma have an energy of 2 MEV. You obtain a reading from the same Geiger counter 10 feet from each source. Concerning the two readings, which one of the following statements is correct?

a. The reading from Source B is four times that of Source A.

b. The reading from Source B is twice that of Source A.

c. Both readings are the same.

d. The reading from Source B is half that of Source A.

QUESTION (B.12) [1.0]

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.13) [1.0]

Which one of the following is a definition of "Emergency Planning Zone" (EPZ) for the RINSC?

a. The Rhode Island Nuclear Science Center located on 3 acres of the Narragansett Bay Campus of the University of Rhode Island.

b. The Narragansett Bay Campus of the University of Rhode Island.

c. The geographical area that is beyond the site boundary where the Emergency Coordinator has direct authority over all activities.

d. The operations boundary which consists of the reactor building and the basement area beneath and north of the reactor building.

QUESTION (B.14) [1.0]

The reactor is in steady-state power at 90% when you, the operator, notice that the reactor bridge area radiation monitor is inoperable. Which one of the following describes the correct action you should take?

a. Shutdown the reactor. Technical Specifications (T.S.) do not allow operations of the reactor without a fully operating radiation monitoring system.

b. Continue operation. T.S. allow the unit to be out of service for up to 6 hours.

c. Continue operation. Within 15 minutes of recognition of failure, replace the unit with a portable gamma-sensitive instrument with alarm.

d. Continue operation as long as a minimum of one area radiation monitor on the "ground floor level" of the reactor building is operating.

QUESTION (B.15) [1.0]

Which of the following conditions COMPLETELY satisfies the technical specification definition of "Reactor Secured?"

a. When the reactor contains insufficient fissile material or moderator present in the reactor, control rods or adjacent experiments to attain criticality under optimum available conditions of moderation and reflection.

b. When the reactor is subcritical by at least the shutdown margin in the Reference Core Condition plus the reactivity worth of all experiments.

c. The master switch is in the off position and no work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods and no experiments are in the reactor.

d. When all scramable rods have been fully inserted and verified down and the console key has been removed from the console.

QUESTION (B.16) [1.0]

Which one of the following statements is TRUE concerning experiments?

a. In position B9, the sample holder for an incore experiment must be oriented so that a cut-off corner is towards the ion chamber.

b. The reactivity worth of any experiment NOT fixed in place shall not exceed 0.6% ΔK/K.

c. Samples measuring >200 mrem/hr on contact are not allowed out of the reactor room without special permission.

d. The reactivity worth of an experiment containing fissionable material shall be limited to 0.08% ΔK/K.

QUESTION (B.17) [1.0]

Following an irradiation of a specimen, the resulting radioisotope is expected to equal 200 curies. The radioisotope will decay by the emission of two gamma rays per disintegration with energies of 1.10 Mev and 1.29 Mev.

Which one of the following is the radiation exposure rate (R/hr) at one (1) foot from the specimen with no shielding?

a. 1708 R/hr

b. 2868 R/hr

c. 3405 R/hr

d. 5736 R/hr

QUESTION (B.18) [1.0]

Calculate the T.S. Shutdown Margin. Assume the following worths:

	worth %ΔK/K
Blade #1:	2.41
Blade #2:	2.32
Blade #3:	2.49
Blade #4:	2.37
Regulating Blade:	0.084
Excess Reactivity:	1.42
Experiments (Max Worth)	0.60

a. 8.5%

b. 8.17%

c 5.30%

d. 5.0%

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

QUESTION (C.1) [1.0]

While operating in the Natural Convection Flow Mode which one of the following will result in a reactor scram?

a. Primary Coolant Flow = 1100 gpm

b. Coolant Outlet Temperature = 123°F

c. Log N amplifier high voltage at 40 volts

d. Reactor Power = 110 kw

QUESTION (C.2) [1.0]

What design feature of the system prevents draining of the pool in the event of a pipe failure downstream of the primary coolant pump?

a. Signal from a float switch which shuts a valve in the primary coolant pump suction line.

b. Signal from a float switch which shuts off the primary coolant pump.

c. After the level in the pool drops to the level of the primary pipes, air will be admitted to the high points in the system, breaking the siphon.

d. Level in the pool drops below the minimum Net Positive Suction Head (NPSH) of the primary coolant pump.

QUESTION (C.3) [1.0]

Which one of the following is the reason why the T.S. limits the pool temperature to less than 130°F?

a. To provide an acceptable safety margin to the maximum fuel cladding temperature.

b. To prevent incipient boiling event if transient power rises to the thermal power trip limit.

c. To prevent nucleate boiling of the reactor coolant.

d. To provide protection for the cleanup resins.

QUESTION (C.4) [1.0]

Which one of the following is the reason for the pool level scram setpoint?

a. To provide an acceptable safety margin to the maximum fuel cladding temperature.

b. To prevent incipient boiling event if transient power rises to the thermal power trip limit.

c. To assure that an adequate pool volume is available to provide cooling of the core in the event of a loss a coolant accident.

d. To maintain an adequate pool level for the dash-pot action of the control blades in the event of a scam.

QUESTION (C.5) [1.0]

Which one of the following will limit the size of the leakage area in the event of a coolant leak due to failure of the Through Tube?

a. Fixed experiment barriers.

b. Flanges at each end of through tube.

c. Anti-siphon valves.

d. Through tube shutter.

QUESTION (C.6) [1.0]

Based upon the LOCA analysis, which one of the following is NOT assumed in order to conclude that the loss of coolant event would not cause core damage?

a. All beamport fixed experiments are designed to withstand a minimum of 25.09 feet of water pressure.

b. No beamport experiment will be installed with a barrier having an opening greater than the equivalent area of a 1/2 inch diameter hole.

c. The capacity of the normal pool make-up system shall exceed the loss of coolant flow rate.

d. The maximum loss of coolant flow rate is 20 gallons.

QUESTION (C.7) [1.0]

During performance of a power calibration indicated power differed from calculated power by 15 Kwatts. Which one of the following actions is required for the Linear Power and Percent Power channels?

a. Adjust the detector high voltage on the detectors.

b. Adjust the compensating voltages on the detectors.

c. Adjust the detector heights.

d. No adjustment necessary.

QUESTION (C.8) [1.0]

Which one of the following describes the control blade nominal travel and scram times?

a. Blade Speed ... 3.5 in/min
Release Time ... 90 msecs
Drop Time ... 800 msecs

b. Blade Speed ... 3.5 in/min
Release Time ... 200 msecs
Drop Time ... 900 msecs

c. Blade Speed ... 35 in/min
Release Time ... 100 msecs
Drop Time ... 800 msecs

d. Blade Speed ... 78 in/min
Release Time ... 100 msecs
Drop Time ... 900 msecs

QUESTION (C.9) [1.0]

Which one of the following automatic functions will NOT occur if the evacuation button is depressed?

a. Evacuation horn blows.

b. Air conditioning and normal ventilation turn off.

c. Dampers on all ventilating ducts leading to the outside close.

d. Building cleanup system air scrubber turns off.

QUESTION (C.10) [1.0]

Which one of the following increase in radioactive contaminants would be an indication of a leaking fuel element at RINSC.

a. Co-60 activity.

b. Tritium activity.

c. I-133 activity.

d. Sr-90 activity.

QUESTION (C.11) [1.0]

Which one of the following describes a condition that will prevent the operator from withdrawing control blades?

a. The Power Level Selector switch is in the 5 MW position.

b. The Log N amplifier switch is in the "operate position".

c. Reactor period is 30 seconds.

d. The startup channel neutron count rate is 8 counts per second.

QUESTION (C.12) [1.0]

Which one of the following conditions will generate an alarm when the Power Level Selector switch is in the "0.1 MW" position?

a. Thermal Column flow sensor reads zero.

b. Bridge movement is detected by sensor.

c. Secondary coolant flow rate is 750 gpm

d. Core outlet temperature is 122 °F

QUESTION (C.13 [1.0]

Which one of the following nuclear instrumentation amplifiers sends a signal to the servo system?

a. Start-up preamplifier 10AR1

b. Log-N Period Amplifier 11AR1

c. Stable Picoammeter 12AR1

d. Stable Picoammeter 12AR2

QUESTION (C.14) [1.0]

The reactor is operating with the servo control system maintaining power at 500 kw wh n compensating voltage is lost to the control system Compensated Ion Chamber. Which one of the following describes the response of the plant to this malfunction?

a. Indicated power will decrease, resulting in the servo control system dropping out of automatic control.

b. Indicated power will decrease, resulting in the regulating blade being withdrawn from the core at normal speed.

c. Indicated power will increase, resulting in the regulating blade being driven inward at normal speed.

d. Indicated power will remain constant.

QUESTION (C.15) [2.0]

For each of the parameters listed in column a, match the correct plant response from column b.

COLUMN A	COLUMN B
a. Control Blade Disengaged	1. Scram only
b. Short Period (4 sec)	2. Alarm only
c. Manual Scram switch	3. Alarm and Scram
d. Neutron Detector High Voltage Failure	

QUESTION (C.16) [1.0]

The Demineralizer Room Sump Pump may not be lined up to pump directly to:

a. 15,000 gal. tank

b 3000 gal. tank

c. 1000 gal. tank

d. discharge line (L-2)

QUESTION (C.17) [1.0]

The thermal column design prevents radiation streaming by:

a. a movable lead shutter that is normally closed.

b. concrete filler plugs.

c. installation of portable shielding around experiment.

d. a stepped closure door.

QUESTION (C.18) [1.0]

Which one of the following electrical loads is powered by the Nuclear Center Generator when normal power is lost?

a. Primary coolant pump

b. Sump pump

c. Stack monitor CAM

d. Console power

QUESTION (C.19) [1.0]

Identify the control blade assembly component that provides the “Stop” signal to the drive assembly at either end of blade travel.

a. Drive shaft worm gear.

b. Helical potentiometer

c. Motor limit switch

d. Electromagnetic clutch

(*** End of Examinatiuon ***)

*ANSWER (A.1)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988 pg. 2-50
$R = N\sigma\phi$
barns = 1 x 10 (-24) cm².
R = [4.2 x 10 (9)] x [3.64 x 10 (21)] x [531 x 10 (-24)] = 8.1 x 10E9

*ANSWER (A.2)
b
*REFERENCE
$P_f = P_o e^{t/T}$
$T = \ln (P_f/P_o)/t$ = 186 secs/(ln 5000) = 21.8 secs

*ANSWER (A.3)
d
*REFERENCE
"Introduction To Nuclear Engineering", Lamarsh, 2nd Edition, page 350.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988 pg. 3-4

*ANSWER (A.4)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 3.3.4, p. 3-21.

*ANSWER (A.5)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 7.2 & 7.3, pp. 7-1 — 7-9.

*ANSWER (A.6)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, Chapt. 5, pp. 5-1 — 5-28.

*ANSWER (A.7)
c.
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 3.3.4, pp. 3-20 — 3-22.
$T = (\beta - \rho)/\lambda_{eff}\beta \rightarrow$

*ANSWER (A.8)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §§ 8.2 — 8.4, pp. 8-3 — 8-14, Fig. 8-2

*ANSWER (A.9)
a
*REFERENCE
"Introduction To Nuclear Engineering", Lamarsh, 2nd Edition, page 313.
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 3.3, pp. 3-13 -- 3-19

*ANSWER (A.10)
a
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, pp. 2-65

*ANSWER (A.11)
b
*REFERENCE
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.
$P = P_o e^{t/T}$ $10 = 1e^{60/T}$
$\ln 10 = 60/T$ $2.3 = 60/T$
$T = 60/2.3$ $T = 26$ seconds

*ANSWER (A.12)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 5.2, p. 5-2.

*ANSWER (A.13)
a
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.2, p. 4-1.

*ANSWER (A.14)
b
REFERENCE
Tech. Specs. 3.2
2.0 %ΔK/K / 0.02 %ΔK/K/sec = 100 secs

*ANSWER (A.15)
c
*REFERENCE
$CR_1/CR_2 = (1-Keff_2)/(1-Keff_1)$
$15/45 = (1-Keff_2/(1-0.95) \rightarrow (0.05)(0.3333) = 1-Keff_2$
$Keff_2 = 1- 0.016665 = 0.983$

*ANSWER (A.16)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 7.2 & 7.3, pp. 7-1 — 7-9.

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

$\rho = 0.0065/((0.1 * 60) + 1) = 0.0065/7$
$\rho = 9 \times 10^{-4}$ delta k/k
ρ/inch = 9×10^{-4} delta k/k/2 inches = 4.6×10^{-4} delta k/k per inch

*ANSWER (A.17)
a
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §§ 8.1 —8.4, pp. 8-3 — 8-14.

*ANSWER (A.18)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.6, p. 4-16.

*ANSWER (A.19)
b
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 5.5, pp. 5-18 — 5-25.

*ANSWER (A.20)
a
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, §§ 3.2.2 — 3.2.3, pp. 3-7 — 3-12.

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

*ANSWER (B.1)
b
*REFERENCE
$Dr_1 D_1^2 = Dr_2 D_2^2$
$Dr_2 = Dr_1 D_1^2 / D_2^2 = (50 \text{ mr/hr} \times 5 \text{ ft}^2)/10 \text{ ft}^2 = 12.5 \text{ mr/hr}$

*ANSWER (B.2)
a, 4; b, 2; c, 2; d, 1
REFERENCE
10 CFR 55

*ANSWER (B.3)
c
*REFERENCE
10 CFR 50.54 (q); 10 CFR 50.59; 10 CFR 55.59

*ANSWER (B.4)
b
*REFERENCE
10 CFR 20

*ANSWER (B.5)
d
*REFERENCE
10 CFR 20.1201

*ANSWER (B.6)
c
*REFERENCE
10 CFR 20 Whole Body Limit = 5 R
Time = [(5 R - 1.25 R) / 0.075 R/hr] = 50 hours

*ANSWER (B.7)
b
*REFERENCE
Two inches = one-half thickness ($T_{½}$). Using 3 half-thickness will drop the dose by a factor of $(½)^3 = ⅛$. 100/8 = 12.5

*ANSWER (B.8)
a, **check**; b, **test**; c, **calibration**; d, **check**
*REFERENCE
RINSC Tech. Specs, Definitions pg. 3

*ANSWER (B.9)
b
*REFERENCE
RINSC Tech. Specs, Definitions pg. 3

*ANSWER (B.10)
d
*REFERENCE
RINSC T.S. 2.1.1

*ANSWER (B.11)
c
*REFERENCE
Gm is not sensitive to energy.

*ANSWER (B.12)
a
*REFERENCE
RINSC Radiation Safety Guide; Form NSC-02

*ANSWER (B.13)
d
*REFERENCE
E-Plan Sect. 6 pg. 14

*ANSWER (B.14)
c
*REFERENCE
T.S. 3.7.1

*ANSWER (B.15)
a, c
*REFERENCE
Technical Specification Definition 1.19.1 pg. 5

*ANSWER (B.16)
c
*REFERENCE
Use of Pneumatic Irradiation Facilities pg. 12-4
T.S. 3.1

*ANSWER (B.17)
b
*REFERENCE
R = 6 C E n
R = 6 (200 ci) (1.10 + 1.29 Mev) (1 disintegration)
R = 2868 R/hr

*ANSWER (B.18)
d
*REFERENCE
RINSC Annual Reactor Tests and Inspections
SDM = SDM (cold/clean) - Max worth blade - Reg Blade - Max Experiment
SDM (cold/clean) = Total Blade worth - K_{excess} = 9.59% - 1.42% = 8.17%
SDM = 8.17% - 2.49% - 0.084% - 0.60% = 5.0%

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

*ANSWER (C.1)
c
*REFERENCE
T.S. Table 3.1 pg. 22

*ANSWER (C.2)
c
*REFERENCE
Operation and Maintenance Manual Section 1.4.2.3 pg. 1-24

*ANSWER (C.3)
d
*REFERENCE
SAR for HEU to LEU Conversion; Appendix F pg. 43

*ANSWER (C.4)
a
*REFERENCE
T.S. 2.2.1 Bases

*ANSWER (C.5)
b
*REFERENCE
SAR (HEU to LEU Conv.); Loss of Coolant Analysis pg. 17

*ANSWER (C.6)
c
*REFERENCE
SAR (HEU to LEU Conv.); Loss of Coolant Analysis pg. 17-18

*ANSWER (C.7)
c
*REFERENCE
Operation and Maintenance Manual Sect. 1.3.7 pg.1-21

*ANSWER (C.8)
a
*REFERENCE
NSC-13 "Pre-Startup Check Sheet; Quarterly Addendum"

*ANSWER (C.9)
d
*REFERENCE
T.S. pg 43

*ANSWER (C.10)
c
*REFERENCE
Fission products detected in UVAR pool water

*ANSWER (C.11)
a
*REFERENCE
SAR (HEU to LEU) pg. 11

*ANSWER (C.12)
b
*REFERENCE
SAR (HEU - LEU) Table F.1

*ANSWER (C.13)
c
*REFERENCE
Operation and Maintenance Manual Table 1-2 pg. 1-47

*ANSWER (C.14)
c
*REFERENCE
Gladstone & Sesonske, Nuclear Reactor Engineering 3rd Edition, sect. 5.254

*ANSWER (C.15)
a. 2 b. 3 c. 3 d. 3
*REFERENCE
SAR (HEU - LEU) Table F.1

*ANSWER (C.16)
a
*REFERENCE
Operating Procedures J "Demineralizer Room Sump Pump Operation" pg. J-3 - J-4

*ANSWER (C.17)
d
*REFERENCE
NRC Exam 1992

*ANSWER (C.18)
b
*REFERENCE
NRC exam 1992

*ANSWER (C.19)
c
*REFERENCE
Operation and Maintenance Manual Section IV Table 4-1 pg. 4.4

(*** End of Section C ***)
(***** End of Examination *****)