November 6, 2001

Dr. David Wehe, Director
Phoenix Memorial Laboratory
Ford Nuclear Reactor
University of Michigan
2301 Bonisteel Blvd.
Ann Arbor, Michigan 48109-2100

Dear Dr. Wehe:

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-002/OL-02-01

During the week of September 30, 2001, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your University of Michigan 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/index.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 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. 50-002

Enclosures:
1. Initial Examination Report No. 50-002/OL-02-01
2. Examination and answer key (RO)

cc w/encls:
Please see next page

cc:

Special Assistant to the Governor
Office of the Governor
Room 1 - State Capitol
Lansing, MI 48909

Mr. Christopher Becker
Phoenix Memorial Laboratory
University of Michigan - North Campus
Ann Arbor, MI 48109

Michigan Department of Environmental Quality
Drinking Water & Radiological
Protection Division
P.O. Box 30630
Lansing, MI 48909-8130

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DISTRIBUTION w/ encls.:

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NAME	PIsaac		EBarnhill		PMadden		EImbro	
DATE	10/ 30 /2001		10/ 31 /2001		10/ 31 /2001		11/ 06 /2001	

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

REPORT NO.: 50-002/OL-02-01

FACILITY DOCKET NO.: 50-002

FACILITY LICENSE NO.: R-28

FACILITY: University of Michigan

EXAMINATION DATES: October 02, 2001

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: /RA/ 10/22/2001
Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of September 30, 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:

Personnel attending: Mr. Christopher Walter Becker, Manager of Operations
Mr. Patrick Isaac, Chief Examiner

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 Michigan

REACTOR TYPE: POOL

DATE ADMINISTERED: 2001/10/02

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

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.

EQUATION SHEET

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

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

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

$SCR = S/(1\text{-}Keff)$

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

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

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

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

$SUR = 26.06/\tau$

$M = 1/(1\text{-}Keff) = CR_1/CR_0$

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

$SDM = (1\text{-}Keff)/Keff$

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

$Pwr = W_f \dot{m}$

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

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

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

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

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

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

$\rho = \Delta Keff/Keff$

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

$\bar{\beta} = 0.0070$

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = \frac{6CiE(n)}{R^2}$ DR ≡ R/hr, Ci ≡ Curies, E ≡ Mev, R ≡ feet

---

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal H_2O ≈ 8 lbm

°C = 5/9 (°F - 32)

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.

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 *****)

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.

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 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.

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

QUESTION (A.1) [1.0]

Given a source strength of 100 neutrons per second (N/sec) and a multiplication factor of 0.8, the expected stable neutron count rate would be?

a. 125 N/sec

b. 250 N/sec

c. 400 N/sec

d. 500 N/sec

QUESTION (A.2) [1.0]

An element decays at a rate of 20% per day. Determine its half-life.

a. 3 hr.

b. 75 hr.

c. 108 hr.

d. 158 hr.

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 factors is the most significant in determining the differential worth of a control rod?

a. The rod speed.

b. Reactor power.

c. The flux shape.

d. The amount of fuel in the core.

QUESTION (A.6) [1.0]

With a 30 second period, power would double in approximately:

a. 15 seconds

b. 21 seconds

c. 30 seconds

d. 60 seconds

QUESTION (A.7) [1.0]

Which one of the following describes how delayed neutrons affect control of the reactor?

a. More delayed neutrons are produced than prompt neutrons resulting in a longer time to reach a stable subcritical countrate.

b. Delayed neutrons are born at higher energies than prompt neutrons resulting in a shorter reactor period from increased leakage.

c. Delayed neutrons take longer to thermalize than prompt neutrons resulting in a longer reactor period.

d. Delayed neutrons increase the average neutron lifetime resulting in a longer reactor period.

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]

Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

c. available above that which is required to make the reactor subcritical.

d. available above that which is required to keep the reactor critical.

QUESTION (A.10) [1.0]

The term "prompt jump" refers to:

a. the instantaneous change in power due to raising a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

c. a reactor which is critical using both prompt and delayed neutrons.

d. a negative reactivity insertion which is less than Beta-effective.

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 of 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]

A subcritical reactor is being started up. A control rod is raised in four equal steps. Which statement most accurately describes the expected reactor response?

a. Power increases by the same amount for each withdrawal.

b. Each withdrawal will add the same amount of reactivity.

c. The time for power to stabilize after each successive withdrawal increases.

d. A lower critical rod height is attained by decreasing the time intervals between withdrawals.

QUESTION (A.14) [1.0]

During normal operations at 2 MW, the typical reactor core coolant temperature profile is such that the temperature peaks are...

a. ...at the top of the core.

b. ...at the bottom of the core.

c. ...between the top and the middle of the core.

d. ...between the bottom and the middle of the core

QUESTION (A.15) [1.0]

Which one of the following describe the difference between a moderator and reflector?

a. A reflector increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

b. A reflector increases the neutron production factor and a moderator increases the fast fission factor.

c. A reflector decreases the thermal utilization factor and a moderator increases the fast fission factor.

d. A reflector decreases the neutron production factor and a moderator decreases the fast non-leakage factor.

QUESTION (A.16) [1.0]

During the neutron cycle from one generation to the next, several processes occur that may increase or decrease the available number of neutrons.

SELECT from the following the six-factor formula term that describes an INCREASE in the number of neutrons during the cycle.

a. Thermal utilization factor.

b. Resonance escape probability.

c. Thermal non-leakage probability.

d. Fast fission factor.

QUESTION (A.17) [1.0]

Which one of the following describes the MAJOR contribution to the production and depletion of xenon in the reactor?

a. Produced from radioactive decay of iodine and depletes by neutron absorption only

b. Produced from radioactive decay of iodine and depletes by radioactive decay and neutron absorption

c. Produced directly from fission and depletes by neutron absorption only

d. Produced directly from fission and depletes by radioactive decay and neutron absorption

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	25
12	33
16	38
20	72
24	134

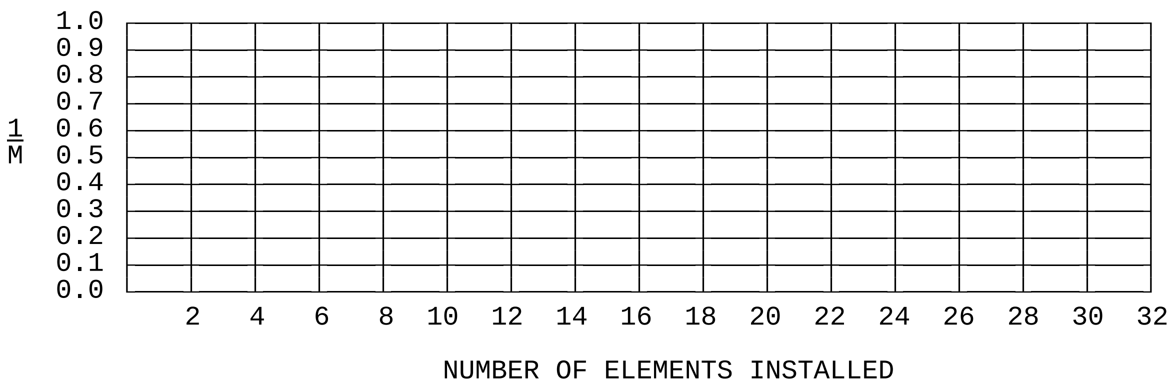
Which one of the following is the number of fuel elements required to make the reactor critical? (The attached figure may be used to determine the correct response.)

a. 22

b. 24

c. 28

d. 32



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 longer period due to long lived delayed neutron precursors.

b. a shorter 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) [1.0]

In accordance with 10 CFR Part 50.54(x), under what conditions can an operator take reasonable action that departs from a license condition or a Technical Specification?

A. In any emergency.

B. In an emergency, when the action is needed to protect health and safety and no other action is immediately apparent.

C. In an emergency declared by the Emergency Director.

D. In an emergency declared by the Emergency Director along with the approval of the Senior Reactor Operator on site.

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 of OHIO requests radiation workers to clean up an accident at Davis-Besse Nuclear facility. While helping out you, an employee of UMich, 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. University of Michigan FNR.

c. Nuclear Regulatory Commission.

d. State of Michigan, (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]

The following measurements are made from a beta-gamma point source:
2 R/hr at six inches 0.5 mR/hr at ten feet.
What are the relative fractions of betas and gammas emitted?

a. (1800/200) = 9

b. (2000/200) = 10

c. (1800/20) = 90

d. (2200/200) = 11

QUESTION (B.7) [1.0]

A sample reading 1 R/hour is placed behind a 2-centimeter lead shield. What will be the resulting exposure rate? Assume no buildup and a linear attenuation equal to 0.52 cm-1.

a. 0.63 R/hr

b. 3.60 R/hr

c. 0.36 R/hr

d. 36 R/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. 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.10) [1.0]

Which one of the following lists required reactor scrams associated with the Technical Specification Safety Limits for the natural convection mode?

a. Reactor thermal power.
Reactor coolant inlet temperature
Height of water above the top of the core.

b. High Power/Header Down.
Reactor coolant exit temperature.
Height of water above the center line of the core.

c. Reactor thermal power.
Height of water above the top of the core.

d. Reactor coolant exit 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]

For which one of the following operating conditions is the recommended action NOT to insert all rods?

a. Inability to exercise control over primary water system components.

b. Loss of FNR exhaust radiation monitor.

c. Malfunction of auto-rundown circuit.

d. Loss of shim safety rod magnet contact light.

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 Reactor Bridge radiation monitor.

b. Continue operation. T.S. allow the unit to be out of service for up to 7 days.

c. Continue operation. Within 24 hours of recognition of failure, replace the unit with a portable gamma-sensitive instrument with alarm.

d. Continue operation as long as a minimum of three other area radiation monitors are operating.

QUESTION (B.15) [1.0]

Which one of the following is TRUE?

a. If a “duress” alarm is received at the control room , the operator on duty should initiate the building alarm.

b. Work scheduled on the Shutdown Maintenance Schedule is considered approved.

c. The magnet power keys are normally in the custody of the SRO on duty.

d. If the reactor is shutdown and the magnet power key switch energized, the minimum control room staffing is a licensed reactor operator.

QUESTION (B.16) [1.0]

Which one of the following statements is TRUE concerning experiments?

a. An experiment approved for control fuel element irradiation may be irradiated in a polyethylene container if the irradiation is for six hours or less.

b. The reactivity worth of any moveable experiment shall not exceed 0.01 ΔK/K.

c. Experiments approved for the sample stringer can be loaded or unloaded from the reactor only during reactor shutdown periods.

d. The total reactivity worth of moveable and secured experiments shall not exceed 0.0436 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]

The T.S. require a minimum Shutdown Margin (SDM) of 0.0045 ΔK/K for a specific core and control rods configuration. Assuming Xenon free conditions and the following worths, which one of the following is the calculated SDM?

	worth %ΔK/K
Shim-Safety rod #1:	2.41
Shim-Safety rod #2:	2.32
Shim-Safety rod #3:	2.49
Control rod (Reg.)	0.084
Excess Reactivity:	1.42
Experiments (Max Worth)	0.60

a. 7.96%

b. 5.28%

c 5.20%

d. 2.71%

QUESTION (B.19) [1.0]

A small radioactive source is to be stored in the reactor building. The source is estimated to contain 2 curies and emit a 1.33 Mev gamma. Assuming no shielding was to be used, a Radiation Area barrier would have to be erected from the source at a distance of approximately:

a. 6 inches

b. 12 inches

c. 21 inches

d. 57 feet

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

QUESTION (C.1) [1.0]

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

a. Primary Coolant Flow = 1100 gpm

b. Coolant Inlet Temperature = 118°F

c. Log N amplifier high voltage at 40 volts

d. Pool Level is 14 inches below normal

QUESTION (C.2) [1.0]

Which one of the following describes the purpose of the control fuel element holddown mechanism?

a. Prevents the inadvertent withdrawal and possible subsequent dropping of a fuel element while withdrawing a control rod.

b. Prevents the inadvertent ejection of the fuel element during a steam explosion caused by a catastrophic reactivity excursion.

c. Provides vertical support to the fuel element thereby preventing tipping or leaning into unanalyzed fuel geometries.

d. Provides horizontal support thereby preventing flow induced vibrations during forced circulation.

QUESTION (C.3) [1.0]

Which one of the following would indicate that a leak has developed between the heavy water tank and the reactor pool?

a. Increase in the gross beta analysis due to tritium in the pool water.

b. Increase in beamport thermal flux due to greater moderation of fast neutrons.

c. Positive reactivity addition as light water dilutes the heavy water in the heavy water tank.

d. Abnormal rod insertions due to greater reflection of neutrons from the heavy water tank into the core.

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 loss of coolant in the event of a coolant leak due to rupture of a beamtube while the beamport is being used for an experiment?

a. Beamport shield door.

b. Flanges at each end of beamport.

c. Damage control plugs.

d. Collimator.

QUESTION (C.6) [1.0]

The bus transfer, which switches the emergency supply from the normal building supply to the emergency generator, is located in:

a. Beamport floor

b. Room 2074

c. Room 1033

d. Room 2077

QUESTION (C.7) [1.0]

Select the choice that completes the following statement.

In the event of a rupture in the Hot Demineralizer system, system isolation is accomplished by a flow switch that:

a. sends a signal to the inlet and outlet pump controllers to stop both pumps and also deenergizes the auto-shut off valve.

b. signals the inlet and outlet pump motor controllers to stop both pumps. The inlet pump motor controller also de-energizes the auto-shut off valve.

c. de-energizes the auto-shut off valve. The closure of the auto-shut off valve causes the inlet and outlet pump motor controllers to stop both pumps.

d. signals the inlet and outlet pump motor controllers to stop both pumps. The auto-shut off valve closes upon sensing a low water pressure.

QUESTION (C.8) [1.0]

The reactor is operating at 2 MW with Primary Pump number 1 providing forced circulation flow. A low pressure is sensed at the Holdup Tank.

Which one of the following describes the impact of these events on the plant?

a. The reactor will scram on high power/low flow due to the Primary Pump tripping on low Net Positive Suction pressure.

b. The reactor will scram due to the low pressure in the holdup tank

c. The Holdup tank will be slowly pumped dry resulting in a high radiation condition due to insufficient N-16 holdup time.

d. The butterfly valve at the inlet of the tank will cause a reactor scram due to a low flow condition.

QUESTION (C.9) [1.0]

Which one of the following does NOT exhaust into PML stack 2?

a. Fuel Vault

b. Hood in room 3103

c. P-tube exhaust

d. PML room 1069

QUESTION (C.10) [1.0]

Which one of the following is NOT a function of the pool level monitoring system?

a. An ultrasonic probe generates a local alarm at -3 inches to warn of decreasing pool levels.

b. An audible alarm is generated at approximately -0.3 inches as a warning during pool fills.

c. A control room alarm is generated at -5 inches.

d. A low pool alarm is sent to the University Department of Public Safety and Security at -12 inches.

QUESTION (C.11) [1.0]

Which one of the following describes the N-16 Power Level Monitor detector?

a. Geiger-Mueller

b. Fission chamber

c. Gamma ion chamber

d. Compensated ion chamber

QUESTION (C.12) [1.0]

Which one of the following describes the operation of the log count rate (LCR) system?

a. To overcome the shim-safety rod inhibit interlock, the LCR fission chamber must be raised to the upper limit.

b. LCR will cause an inhibit interlock to prevent shim-safety rod motion of the LCR recorder if greater than 2 cps.

c. At the bottom of travel, the LCR fission chamber is approximately level with the top of the reactor core.

d. Energizes a switch at 1.8 MW which turns on the Effective Full Power Hour (EFPH) level clock.

QUESTION (C.13 [1.0]

Which one of the following will cause BOTH an alarm and a reactor scram?

a. Stack GAD reads 1100 cpm.

b. Radiation hot DI area monitor reads 30 mrem/hr.

c. Building exhaust NMC reading 1.1 mrem/hr.

d. Fuel Vault NMC reads 7 mrem/hr.

QUESTION (C.14) [1.0]

The reactor is operating with the servo control system maintaining power at 500 kw when compensating voltage is lost to the Linear Level 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 automatic control system dropping out of automatic control.

b. Indicated power will decrease, resulting in the control rod being withdrawn from the core.

c. Indicated power will increase, resulting in the control rod being driven inward.

d. Indicated power will remain constant.

QUESTION (C.15) [1.0]

Which one of the following is an approximate reactivity change introduced by replacing the content of the heavy water tank with H_2O?

a. 1% ΔK/K

b. 3% ΔK/K

c. -.25% ΔK/K

d. -2% ΔK/K

QUESTION (C.16) [1.0]

Which one of the following scram signals is defeated by bypassing the interlock scram section of the magnet current control?

a. High power/header down.

b. Beamport door open.

c. Building exhaust high radiation level.

d. Low pool level.

QUESTION (C.17) [1.0]

The Nitrogen Supply System pressure is decreasing slowly. Which one of the following describes how backup supply is initiated?

a. The Bottle Gas System is manually aligned when the Nitrogen tank pressure decreases below 40 psig.

b. The Bottle Gas System is manually aligned when pressure on G-3 decreases below 20 psig.

c. The Bottle Gas System comes on line automatically when the Nitrogen tank pressure decreases below 50 psig.

d. The Bottle Gas System comes on line automatically when pressure on G-3 decreases below 20 psig..

QUESTION (C.18) [1.0]

When an auto rundown condition occurs from 2 MW, the control rod will...

a. ...be automatically driven into the core until the auto rundown condition is cleared.

b. ...be automatically driven into the core.

c. ...remain in automatic and maintain its current position.

d. ...shift to manual and maintain its current position.

QUESTION (C.19) [1.0]

Waste water is being transferred from RT2 to RT1 using the centrifugal pump. Which one of the following is the reason the breaker for the positive displacement pump must be verified OPEN?

a. The positive displacement pump may over pressurize RT1.

b. The positive displacement pump has no suction from RT2.

c. One START pushbutton controls the start of both the centrifugal pump and the positive displacement pump.

d. The positive displacement pump will automatically start if tank level decreases to 200 gallons.

QUESTION (C.20) [1.0]

Which one of the following radiation monitors is required to be operable for reactor criticality?

a. MAP PML Stack #2

b. North Wall area monitor

c. MAP Beamport Floor

d. Hot Demineralizer area monitor

(*** End of Examination ***)

*ANSWER (A.1)
d
*REFERENCE
CR= S/(1-K)

*ANSWER (A.2)
b
*REFERENCE
$A = A_o e^{-\lambda t}$ $\lambda = .693/T2$ $\ln(A/A_o) = -.693t/T2$ $T2 = -.693t/\ln 0.8 = 75$ hr

*ANSWER (A.3)
d
*REFERENCE
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)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 7.6, p. 7-15.

*ANSWER (A.6)
b
*REFERENCE
Glasstone, *Nuclear Reactor Engineering*, Chapter 5, Section 5.18

*ANSWER (A.7)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988

*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)
d
*REFERENCE
Glasstone and Sesonske, *Nuclear Reactor Engineering*, Chapter 5, Section 5.114

*ANSWER (A.10)
a

*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988

*ANSWER (A.11)
b
*REFERENCE
Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991,
$P = P_o e^{t/T}$ $10 = 1e^{60/T}$ 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 (b), p. 5-4.

*ANSWER (A.13)
c
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Subcritical Multiplication

*ANSWER (A.14)
b
REFERENCE
FNR Exam Question Bank A, page A-22

*ANSWER (A.15)
a
*REFERENCE
Glasstone & Sesonke, *Nuclear Reactor Engineering*, Chapter 1

*ANSWER (A.16)
d
*REFERENCE
Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, Subcritical Multiplication

*ANSWER (A.17)
b
*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)
c
*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 ***)

Section B Normal/Emerg. Procedures & Rad Con

*ANSWER (B.1)
b
*REFERENCE
$Dr_1D_1^2 = Dr_2D_2^2$
$Dr_2 = Dr_1D_1^2 / D_2^2$ = (50 mr/hr x 5 ft^2)/10 ft^2 = 12.5 mr/hr

*ANSWER (B.2)
b
REFERENCE
10 CFR 50.54 (x)

*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)
a
*REFERENCE
Assume beta will not travel 10 feet in air, therefore 0.5 mr is gamma. Gamma dose at ½ ft is:
(DR1) (R12) = (DR2) (R22) → DR2 = (DR1) (R12) / R22 = 0.5 mr x 10 ft2 / 0.5 ft2 = 200 mr/hr
Therefore, beta contribution at ½ ft is 2000 - 200 = 1800 mr/hr.
Beta contribution/Gamma contribution = 1800/200 = 9

*ANSWER (B.7)
c
*REFERENCE
I=Ioe-μχ → I=1R/hr e(-0.52 x 2) = 0.36 R/hr

*ANSWER (B.8)
a, **check**; b, **test**; c, **calibration**; d, **check**
*REFERENCE
FNR Tech. Specs, Definitions pg. 1

*ANSWER (B.9)
b
*REFERENCE
FNR Tech. Specs, Definitions pg. 2

*ANSWER (B.10)
a
*REFERENCE
FNR T.S. 2.2.2

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

*ANSWER (B.12)
a
*REFERENCE
NPP Health Physics pg. 5-20

*ANSWER (B.13)
d
*REFERENCE
Exam Question Bank Section B, pg. B-138
OP-109, Response to Scrams, Alarms, and Abnormal Conditions

*ANSWER (B.14)
a
*REFERENCE
T.S. Table 3.2, pg. 14

*ANSWER (B.15)
b
*REFERENCE
EP-101, OP-101, OP-103

*ANSWER (B.16)
c
*REFERENCE
OP-104 Reactor Experiments and Cobalt-60 Irradiations.
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
OP-105 Core Excess, SDM and Control Rod Reactivity
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.3 p. 6-4.

SDM (cold/clean) = Total Rod worth - K_{excess} - Most reactive rod - Reg Rod - Experiments worth
SDM = (2.41 + 2.32 + 2.49 + 0.084) - 1.42 - 2.49 - 0.084 - 0.60 = 2.71%

*ANSWER (B.19)
d
*REFERENCE
DR= 6CE/(f)(f) = 0.005 = 6(2)(1.33)/x2, x2 = 3192, x = 56.5 feet

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

C. PLANT AND RAD MONITORING SYSTEMS

*ANSWER (C.1)
c
*REFERENCE
T.S. Table 3.1 pg. 13

*ANSWER (C.2)
a
*REFERENCE
FNR System Descriptions, Chapter 3, p. 3-9

*ANSWER (C.3)
a
*REFERENCE
FNR System Descriptions. Ch. 3

*ANSWER (C.4)
c
*REFERENCE
SAR; Abnormal Loss of Coolant; pg. 57

*ANSWER (C.5)
d
*REFERENCE
SAR; Loss of Coolant Analysis; 14.2.4 Beamports

*ANSWER (C.6)
b
*REFERENCE
FNR System Description, Chapter 9, p. 9-1

*ANSWER (C.7)
b
*REFERENCE
FNR System Description; Sect. 7.3.3, pg. 7-2

*ANSWER (C.8)
b
*REFERENCE
FNR System Descriptions Sect. 4.3.4

*ANSWER (C.9)
a
*REFERENCE
System Descriptions Ch. 12 pg. 12-1

C. PLANT AND RAD MONITORING SYSTEMS

*ANSWER (C.10)
a
*REFERENCE
System Descriptions Ch. 13 Sect. 13.11.1

*ANSWER (C.11)
c
*REFERENCE
System Descriptions Ch. 13 Sect. 13.12.1

*ANSWER (C.12)
c
*REFERENCE
FNR System Descriptions, Chapter 13, p. 13-20

*ANSWER (C.13)
c
*REFERENCE
FNR System Descriptions Ch. 13

*ANSWER (C.14)
c
*REFERENCE
FNR System Descriptions Ch. 13 Sect. 13.4
Gladstone & Sesonske, Nuclear Reactor Engineering 3rd Edition, sect. 5.254

*ANSWER (C.15)
d
*REFERENCE
System descriptions Ch. 2

*ANSWER (C.16)
b
*REFERENCE
FNR System Descriptions Sect. 13.9.2

*ANSWER (C.17)
d
*REFERENCE
FNR Supply Question Section C pg. C-329

<u>C. PLANT AND RAD MONITORING SYSTEMS</u>

*ANSWER (C.18)
d
*REFERENCE
FNR System Descriptions Sect. 13.10.2

*ANSWER (C.19)
c
*REFERENCE
FNR supplied question bank Section B, pg. B-717
OP-208, “Operating the RTDI System”, pg. 2

*ANSWER (C.20)
b
*REFERENCE
FNR supplied question bank Section C, pg. C-81

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