U.S. NUCLEAR REGULATORY COMMISSION REGION I
OPERATOR LICENSING EXAMINATION REPORT

EXAMINATION REPORT NO.: 87-04 (OL)

FACILITY DOCKET NO.: 50-166

FACILITY LICENSE NO. R-70

LICENSEE: Maryland University Training Reactor
Department of Chemical and Nuclear Engineering
University of Maryland
College Park, Maryland 20742

FACILITY: University of Maryland

EXAMINATION DATES: September 8-11, 1987

CHIEF EXAMINER: Robert L. Turner — 10/19/87
Robert L. Turner, Operations Engineer — Date

REVIEWED BY: [signature] — 19 Oct 87
Barry S. Norris, Senior Operations Engineer — Date

APPROVED BY: [signature] — 10/20/87
Robert M. Keller, Chief, PWR Section
Operations Branch — Date

SUMMARY: Written examinations and operating tests were administered to four senior reactor operator (SRO) and two reactor operator (RO) candidates. All passed and received their licenses. The facility reviewed the examinations on September 8, 1987 immediately after the written examinations were completed. The facility comments are Attachment 3 and the NRC Resolution of those comments is documented in Attachment 4.

DETAILS

TYPE OF EXAMINATIONS: Initial

EXAMINATION RESULTS:

	RO Pass/Fail	SRO Pass/Fail
Written	2/0	4/0
Operating	2/0	4/0
Overall	2/0	4/0

1. CHIEF EXAMINER AT SITE: R. L. Turner, USNRC

2. OTHER EXAMINERS: D. J. Lange, USNRC

3. The following is a summary of generic strengths and noted on the operating tests. This information is being provided to aid the licensee in upgrading license and requalification training programs. No licensee response is required.

STRENGTHS

All of the candidates were proficient in taking the reactor to power within the Operating Procedure envelopes.

4. Personnel Present at Exit Interview:

NRC Personnel

David J. Lange, Senior Operations Engineer

Robert L. Turner, Operations Engineer

Facility Personnel

Dr. Marvin Roush, Chairman - Department of Chemical & Nuclear Engineering

Dr. Frank Munno, Chairman - Nuclear Engineering Programs

Dr. David Ebert, Reactor Director

Dr. Ralph Belcher, Associate Reactor Director

5. Summary of NRC comments made at exit interview:

The facility raised a question as to the impact of the equipment failure during the first examination. The NRC responded that copies of the strip chart generated during that failure would provide the additional information on which to base a judgement. The facility agreed to supply same. The NRC thanked the facility personnel for the cooperation extended throughout the examination process.

6. Summary of facility comments and commitments made at exit interview:

In response to a concern on radiation exposure control, the facility explained that handling of high level radiation samples was limited to their experienced people and their record was good as average exposure for their people working at the reactor was less than 10 mrem/year on the average.

Attachments:
1. Written Examination and Answer Key (RO)
2. Written Examination and Answer Key (SRO)
3. Facility Comments on Written Examinations after Facility Review
4. NRC Response to Facility Comments

ATTACHMENT 1

MASTER

U. S. NUCLEAR REGULATORY COMMISSION
REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: UNIVERSITY OF MARYLAND

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 87/09/08

EXAMINER: TURNER, R.

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
14.50	~~14.50~~ 14.95 RLT			A. PRINCIPLES OF REACTOR OPERATION
14.50	~~14.50~~ 14.95 RLT			B. FEATURES OF FACILITY DESIGN
14.50	~~14.50~~ 14.95 RLT			C. GENERAL OPERATING CHARACTERISTICS
~~14.00~~ 12.00 RLT	~~14.00~~ ~~11.43~~ 12.37 RLT			D. INSTRUMENTS AND CONTROLS
~~14.00~~ 13.00 RLT	~~14.00~~ 13.40 RLT			E. SAFETY AND EMERGENCY SYSTEMS
14.00	~~14.00~~ 14.43 RLT			F. STANDARD AND EMERGENCY OPERATING PROCEDURES
14.50	~~14.50~~ 14.95 RLT			G. RADIATION CONTROL AND SAFETY
~~100.00~~ 97.00 RLT	100.00 RLT			% Totals
		Final Grade		

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

_____
Candidate's Signature

Changes in red and initialed reflect from incorporation of NRC response to Facility comments. See Examination Report No. 50-166/87-04, attachments 3 & 4. RLT 9/24/87

MASTER

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. 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.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

MASTER

18. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION A.01 (2.50)

Name four (4) of the variables that will cause the critical rod position for the reactor to change from startup to startup.

QUESTION A.02 (3.00)

How much reactivity has been added to a subcritical reactor if the count rate has increased from 100 cps to 150 cps and Keff was initially 0.95 ? Show All Work!

QUESTION A.03 (2.00)

a) Assuming the reactor is at 125 watts and on a stable sustained period of 50 seconds, how long will it take to reach 250 KW? Show your work.

b) Assuming the reactor is at 125 watts and is placed on a 50 sec period, explain how the reactor will respond if no further operator actions are taken?

QUESTION A.04 (2.00)

After the reactor is critical on startup what affect will removal of the startup neutron source have on:

a. Detector indication

b. Core reactivity

QUESTION A.05 (1.50)

What affect, if any, will starting the primary coolant pur . have if the reactor is operating at 250 KW? Explain.

QUESTION A.06 (1.00)

If 10,000 neutrons both prompt and delayed are emitted in one generation and 70 of them are delayed what is the value of beta?

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION A.07 (2.00)

Give four possible fates for neutrons produced by fission inside of the MUTR.

QUESTION A.08 (1.00)

Why might it be necessary to make fine adjustments to the regulating rod following a decrease in power? (1.00)

(***** END OF CATEGORY A *****)

QUESTION B.01 (2.00)

Fill in the blanks with the appropriate value:

a) The reactor shall not be operated unless the shutdown margin provided by the control rods, under the most conservative conditions, is greater than $_____.

b) The excess reactivity relative to the cold critical conditions, with or without experiments in place, shall not be greater than $_____.

c) The reactor shall not be operated unless each non-secured experiment has a reactivity value of less than $_____.

d) The scram time measured from the time a rod starts in motion to the time the rod reaches a fully inserted position shall not exceed_____seconds for the slowest scramable rod.

QUESTION B.02 (2.00)

State how the core diffuser system accomplishes its purpose.

QUESTION B.03 (2.00)

What material is used and where is it placed to provide enhanced neutron reflection axially for the MUTR core?

QUESTION B.04 (3.00)

a) What are two design features of the reactor tank cooling piping that normally would limit the reduction in reactor tank level to 20 inches or less in the event there were a severe leak in the inlet or outlet piping? (2.00)

b) What would be the minimum thickness of water shielding above the reactor core even after a cooling piping failure? (1.00)

QUESTION B.05 (3.00)

Sketch a simple schematic of the Reactor Coolant and Purification System Primary loop. Show the five major components, the five major valves, and the five reactor console instruments associated with this system.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION B.06 (2.50)

On the attached Figure 4.1 of the reactor core, show current positions of control rods, nuclear instrumentation detectors, source location and the rabbit hole.

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

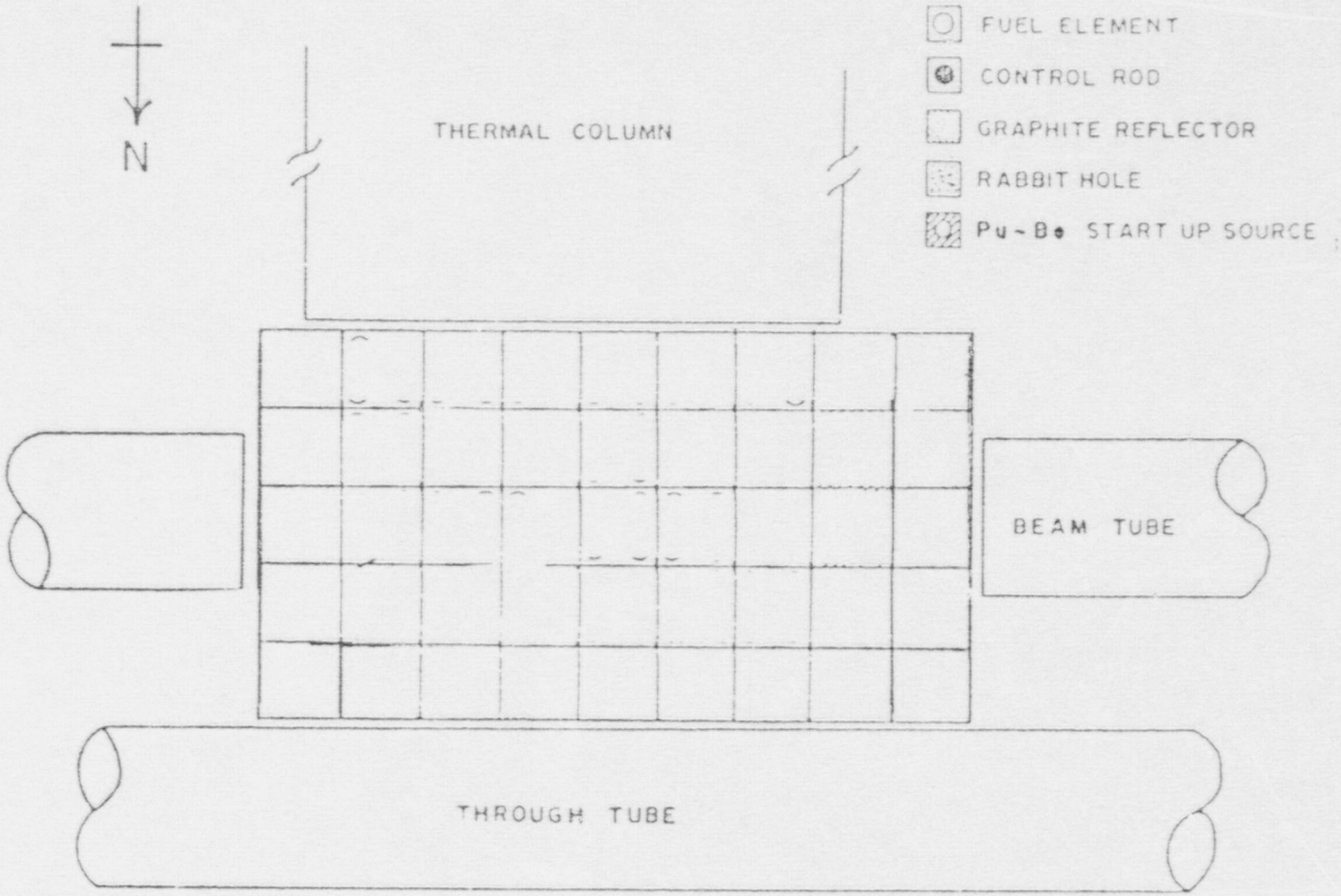

Figure 4.1 MUTR core configuration

QUESTION C.01 (2.50)

After three days of continuous operation at 200 KW, the reactor is shutdown for minor maintenance. It is restarted 8 hours later. (assume constant pool temperature)

a) How will the critical rod position on restart compare to the critical rod position at the time of the previous startup? Give the reason for changes in the critical rod positions.

b) During the first 24 hours after startup, describe the control rod movements that would be necessary to raise the power from just critical to 200 KWs and maintain the power constant after reaching 200 KWs. Explain what causes the need for changes in rod in/out motion.

QUESTION C.02 (2.00)

Describe the radial and axial position in the core where a one inch movement of a control rod tip would have the maximum reactivity effect. Explain your answer.

QUESTION C.03 (2.00)

What are the reactivity values of the following:

a) MUTR core excess reactivity?

b) Shim Rods?

c) Regulating Rod?

d) Shutdown Margin with highest Worth Rod Withdrawn?

QUESTION C.04 (1.00)

During startup when the control rods are being withdrawn, the period meter indicates a positive period; when rods are stationary an infinite period is observed. What is the status of the reactor?

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION C.05 (1.00)

Describe the process/mechanism that produces flow through the core during reactor operation.

QUESTION C.06 (2.00)

If the reactor was on automatic control at full power and the through beam tube began to be flooded, which direction would the regulating rod move and why?

QUESTION C.07 (1.00)

For Reactor Pool Water Conductivity:

a) why is there a conductivity limit?

b) how is the appropriate conductivity maintained?

QUESTION C.08 (3.00)

Assume the plant was initially at 100% power, with all rods in manual control, and cooling to the primary coolant heat exchangers is lost. If no operator action is taken:

a) what two major plant parameters would change?

b) how will the two parameters change?

c) what alarms, if any , will be actuated?

d) Will, or will not, a scram be actuated within an eight hour period?

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

QUESTION D.01 (1.50)
TRUE or FALSE:

a) The linear Power Channel provides a control signal to the servo controller for automatic control of the regulating rod.

b) More than one control rod can be withdrawn at the same time.

c) The regulating rod automatically inserts on a scram signal.

QUESTION D.02 (2.50)

DELETED

A control rod drive assembly has five switches. What is the purpose of each switch?

QUESTION D.03 (3.00)

a) How are water mass and delta temperature measured when in the process of conducting a heat balance on the MUTR?

b) At what power level is a heat balance normally conducted?

c) How is the indicated power level adjusted to agree with the measured and calculated heat balance?

QUESTION D.04 (1.50)

a) What will happen to the indication of fuel temperature if the thermocouple develops an open circuit?

b) What will happen to the indication of fuel temperature if the thermocouple develops a short circuit?

(***** CATEGORY D CONTINUED ON NEXT PAGE *****)

QUESTION D.05 (1.50)

If a shim rod had become disengaged from the drive and was at the full in position and the drive was still full up, which shim rod indicating lights would be on and which would be off?

QUESTION D.06 (1.00)

Explain how the pool temperature is controlled during plant operations at 250 KW.

QUESTION D.07 (2.00)

What instrumentation is provided at the MUTR to assure continuous indication of reactor power level from countrate level to full power?

QUESTION D.08 (1.00)

What is the operating principle of the pool level monitor probe and what triggers the alarm?

(***** END OF CATEGORY D *****)

MASTER

QUESTION E.01 (3.50)

List the scram(s) which are initiated by THE REACTOR SAFETY CHANNELS. Include the number of channel(s) required and the scram setpoint(s).

QUESTION E.02 (1.00)

What is the main purpose of the control rod drop test?

QUESTION E.03 (3.00)

For each of the following interlocks indicate what conditions produce the interlock and what action is prevented?

a) Source Level

b) Beam Plug Position

c) Control Rod

QUESTION E.04 (2.00)

Immediately following a scram, how do you, as an operator, check that the control rods have dropped fully into the core.

QUESTION E.05 (1.00) DELETED RH

What built-in feature of the TRIGA control rod drive system stops the rod at the desired position when the rod is withdrawn or inserted to a new position in the core?

QUESTION E.06 (1.00)

What prevents exhausting radioactive gases from the reactor area through the personnel entrances.

(***** CATEGORY E CONTINUED ON NEXT PAGE *****)

QUESTION E.07 (2.50)

What is the basis for the following conditions:

a) Each non-secured experiment shall have a worth less than one dollar.

b) Explosive materials, such as gunpowder, etc. in quantities greater than 25 milligrams shall not be irradiated in the reactor or experimental facilities.

c) Experiments containing material corrosive to reactor components, compounds highly reactive with water, potentially explosive materials, and liquid fissionable materials shall be doubly encapsulated.

(***** END OF CATEGORY E *****)

QUESTION F.01 (2.50)

a) List four of the six categories of "Reportable Occurences" that are reportable per Technical Specification requirements.

b) Is a reportable occurence report required when the reactor is shutdown?

QUESTION F.02 (3.00)

Assume a fuel bundle is to be moved from the core to a storage area:

a) what are the two purposes for the monitoring of the console instruments by the control room operator?

b) how does the bridge operator assure himself that the fuel handling tool is properly latched before he moves the fuel bundle?

c) What items are recorded in the Control Room Log Book after the fuel move is complete?

QUESTION F.03 (3.00)

The following alarms are received simultaneously; water temperature high, exhaust radiation monitor high, water level low.

a) Which one should be investigated first? Justify your answer.

b) What actions, if any, should be taken to control the situation and determine the problem?

QUESTION F.04 (2.50)

During a standard startup:

a) In what increments are shim rods I and II pulled and what is the target position prior to withdrawal of the regulating rod?

b) In what increments is the regulating rod withdrawn and what is the main concern at this point?

c) When is it appropriate to remove the source from the core?

(***** CATEGORY F CONTINUED ON NEXT PAGE *****)

QUESTION F.05 (1.50)

You are operating the reactor when an experimenter notifies you of a large fire in the building. What immediate actions do you take? (assume SRO on site)

QUESTION F.06 (1.50)

The reactor scrams, what are your next two immediate actions?

(***** END OF CATEGORY F *****)

MASTER

QUESTION G.01 (3.00)

List the three (3) basic VARIABLES which affect an individual's dose in a radiation area AND describe how the dose would change if each VARIABLE was doubled(with the other two variables held constant).

QUESTION G.02 (1.00)

Where can irradiated fuel be stored when it is not in the reactor core at the MUTR? Provide two locations.

QUESTION G.03 (2.00)

A reactor sample has a disintegration rate of 5 X 10E11 disintegrations per second. Each disintegration emits a .6 Mev gamma. What is the dose rate expected five (5) feet from the above sample (assume point source)?

QUESTION G.04 (2.00)

Define or explain per 10 CFR 20:

a) Radiation Area

b) Restricted Area

c) High Radiation Area

d) Airborne Radioactivity Area

QUESTION G.05 (2.00)

If you were working in a radiation zone where the general background was 120 mrem/hr gamma radiation, how long could you stay in that zone before you would exceed the 10CFR 20 whole body quarterly limit?

(***** CATEGORY G CONTINUED ON NEXT PAGE *****)

QUESTION G.06 (1.50)

Where are the three fixed position MUTR radiation monitors located?

QUESTION G.07 (1.00)

What are the sources of the two radioactive isotopes, Argon 41 and Nitrogen 16, produced by the operation of research reactors?

QUESTION G.08 (1.00)

If the reactor was at 250 KW and one central fuel element failed, would the total activity released from the fuel element be in the range of:(Choose one)

A) 0 - 100 millicuries

B) 101 - 1000 millicuries

C) greater than 1000 millicuries

QUESTION G.09 (1.00)

During reactor operation the bridge radiation monitor indicates 180 mrem/hr. What is the RO at the reactor console immediate response?

(***** END OF CATEGORY G *****)
(********** END OF EXAMINATION **********)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER A.01 (2.00)

1. Power history (Xenon).
2. Temperature.
3. Experiments in the reactor.
4. Fuel burnup.
5. Rod location.
6. Fuel location. (Any 4 @.5 each to max. 2.00) (2.00)

REFERENCE
Nuclear Energy Training, Units 6,9,10

ANSWER A.02 (3.00)

cr1 /cr2 = (1-Keff2) / (1-Keff1) (.9)
100/150 = (1-Keff2) / (1-0.95) (.5)
1-Keff2 = 10/15 x 0.05
Keff2 = 0.967 (.1) (1.50)

Change in reactivity = (Keff2-1)/Keff2 - (Keff1-1)/Keff1
= (Keff2 - Keff1) / Keff1 x Keff2 (.9)
= 0.967 - 0.95 / 0.95 x 0.967 (.5)
= 1.85 % delta K/K (.1) (1.50)

REFERENCE
Nuclear Energy Training, pg 6.1-3, 12.1-3

ANSWER A.03 (2.00)

a) P = Po e(t/T) (0.4)
250 KW = 0.125 e(t/50) (0.4)
ln[2000] =ln[e (t/50)]
7.6 = t/50
t= 380 sec or 6.33 min. (0.2) (1.00)

b) Power coefficient would lengthen period and would eventually stabilize power. (1.) (1.00)

REFERENCE
Nuclear Energy Training, Unit 6,pg 6.3-1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER A.04 (2.00)

a) Slight reduction in count rate (.5) due to removal of neutron source which was positioned near detector. (.5)

b) Reduce core reactivity ~~(.5) due to removal of a source of neutrons. (.5)~~ (2.00)

(1.0) RWT 9/24/87

REFERENCE
OP 103 ; Nuclear Energy Training, Unit 11

ANSWER A.05 (1.50)

Reactor power will increase (.6) due to the addition of cold water and MTC feedback. (.9) (1.50)

REFERENCE
OP 104, pg 1

ANSWER A.06 (1.00)

Beta = 70/10000 = .007

REFERENCE
Nuclear Training Manual, 5.2.2

ANSWER A.07 (2.00)

Thermal absorption in fuel
Thermal absorption in non fuel
Cause fast fission
Epithermal resonance capture
fast leakage
thermal leakage (any four @ .5 each) (2.00)

REFERENCE
Nuclear Energy Training, Unit 1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER A.08 (1.00)

To maintain the reactor critical at a steady state level (.5)
due to the delayed neutron effect.^ (.5) (1.00)
or fuel Temp. Change. 8709240187

REFERENCE
MUTR OP 104, pg 3

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER B.01 (2.00)

a) $0.50

b) $3.50

c) $1.00

d) one (.5 each) (2.00)

REFERENCE
MUTR TRIGA TS, pg. 7,8,13

ANSWER B.02 (2.00)

A pump takes a suction from the bottom of the pool (.5) and discharges through a nozzle above the core (.5) and causes a circulation pattern (.5) which allows time for the N16 to decay prior to reaching the pool water surface (.5). (2.00)

REFERENCE
MUTR SAR, pg 8-4

ANSWER B.03 (2.00)

Graphite slugs (1.) placed top and bottom within the fuel rod assembly (1.). (2.00)

REFERENCE
MUTR FSAR pg 4-2

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER B.04 (3.00)

a) 1) The pool water inlet pipe is equipped with a siphon break at the surface of the pool.(1.)

2) The pool water return(outlet) pipe is not more than 20 inches below the overflow outlet pipe.(1.)

b) Fifteen feet (1.) (3.00)

REFERENCE
MUTR TS pg 18 & 19

ANSWER B.05 (3.00)

See figure 5.1, MUTR FSAR pg 5-8
(.2 for each component requested in the question to a max of 3.00) (3.00)

REFERENCE
MUTR FSAR pg 5-8

ANSWER B.06 (2.50)

MUTR SER Figure 4.1 , three control rods, fission chamber, cic chamber, ion chamber, source, and rabbit hole
(.3125 for each of the above components correctly located to a maximum of 2.50 points) (2.50)

REFERENCE
MUTR SER Figure 4.1

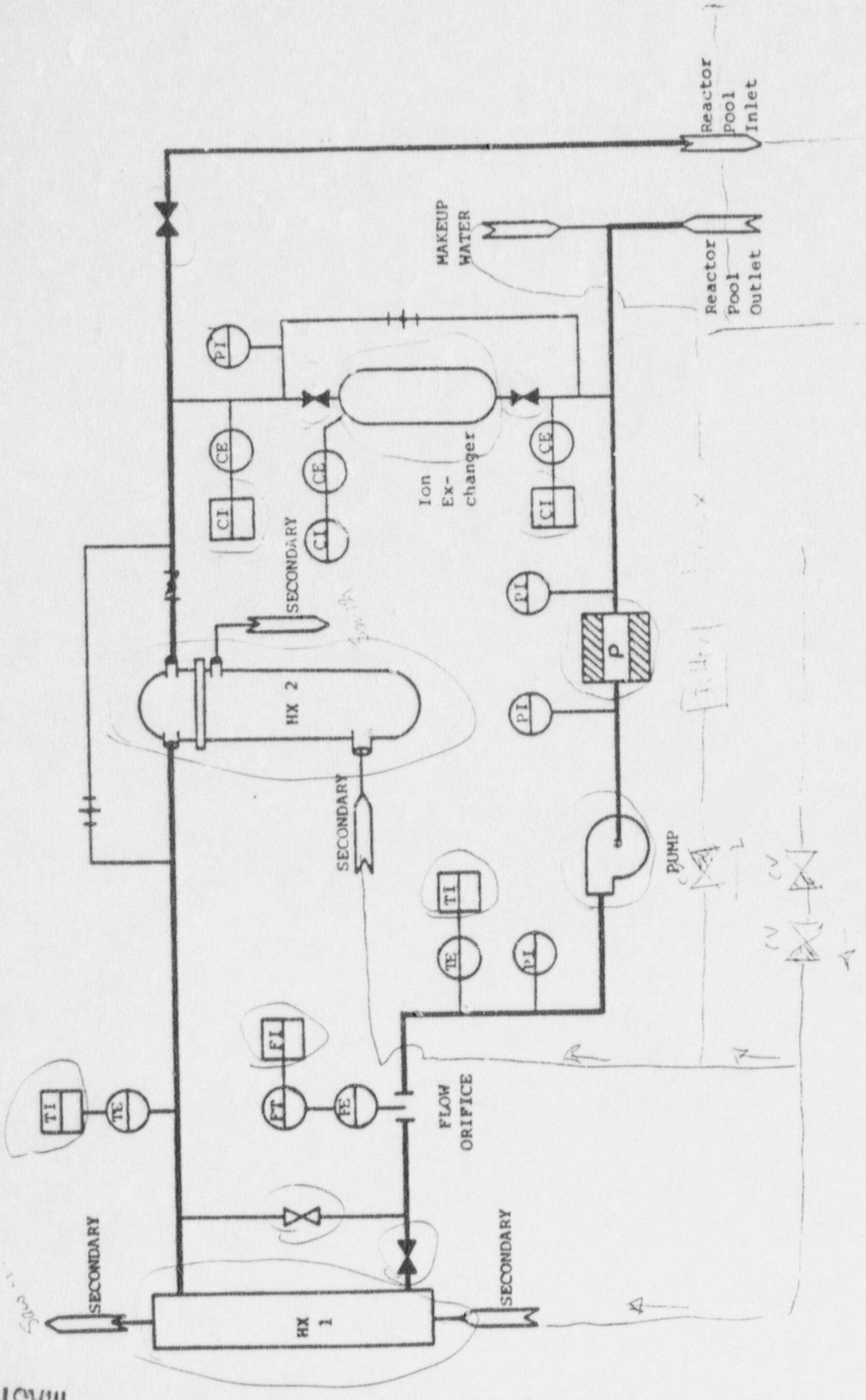

Figure 5.1 Primary coolant system

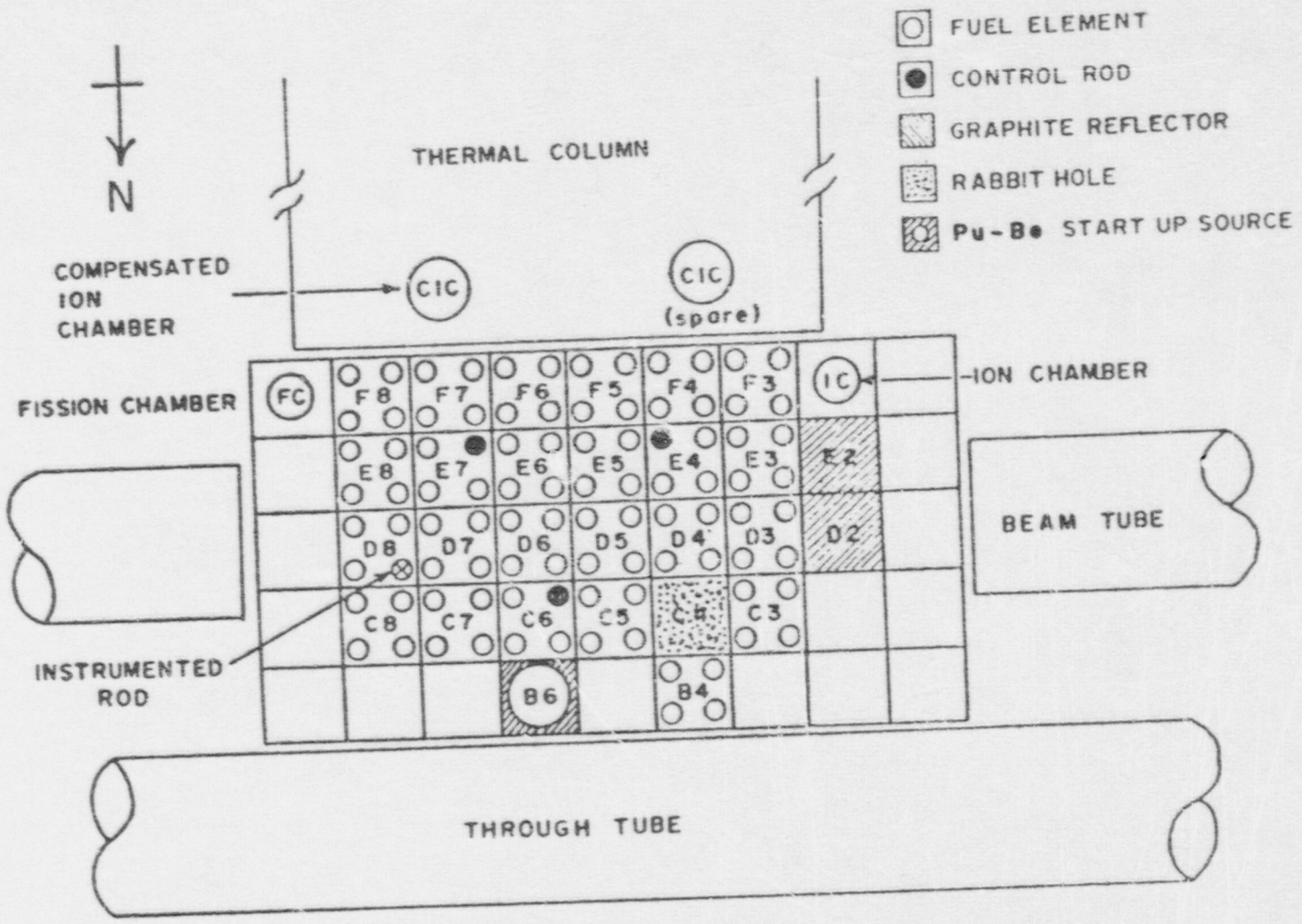

Figure 4.1 MUTR core configuration

ANSWER3 -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER C.01 (2.50)

a) The critical rod height on restart would be higher (0.5) due to the increase in Xenon during shutdown (0.5) (which would have added negative reactivity).

b) Initially, rods must be withdrawn to increase power to 200 KW (0.5). As Xe is burned out from its peak value, rods must be inserted (0.5). Eventually, Xe will reach a minimum value and will begin to increase to its equilibrium value for the steady state power level. At this time, rods will have to be moved out to keep power constant (0.5).

REFERENCE
Nuclear Engineer Training, pg 10.3-1,2,3

ANSWER C.02 (2.00)

In the region of highest flux (i.)
Normally in the center radially (.5) and the middle axially (.5) (2.00)

REFERENCE
Basic Reactor Theory CAF

ANSWER C.03 (2.00)

a) 1.21% dk/k ($1.73) (.5)

b) $5.80 (.5)

c) $2.42 (.5)

d) $3.49 (.5) (2.00)
(Will accept + or - 10%)

REFERENCE
UM SER pg 4-5

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER C.04 (1.00)

The reactor is not yet critical. (The longer it takes for period to die off the closer you are to critical.) (1.00)

REFERENCE
Nuclear Energy Training. pg 12.1-4

ANSWER C.05 (1.00)

Water flow through the core is by natural convection.(1.) (As the water in the core is heated, its density decreases and it tends to rise. It is replaced by cooler water, which heats and also rises.) (1.00)

REFERENCE
MUTR SER, pg 4-3

ANSWER C.06 (2.00)

The regulating rod would move in (1.) to compensate for the increase in reactivity caused by the enhanced reflection of neutrons back to the core as the gas was replaced with water(1.). (2.00)

REFERENCE
Nuclear Energy Training, Unit 1

ANSWER C.07 (1.00)

a) To minimize system corrosion (.5)

b) Maintained by operation of the demineralizer (.5) (1.00)

REFERENCE
UM SER pg 5-1, TS 3.3

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER C.08 (3.00)

a) Pool temperature (.5) and reactor power (.5)

b) Pool Temperature increase (.5), reactor power decrease(.5)

c) High temperature pool alarm (.5)

d) No (.5)

REFERENCE
MUTR SP 202 , pg 1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

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ANSWER D.01 (1.50)

a) True (.5)

b) False (.5)

c) True (.5) (1.50)

REFERENCE
MUTR TRIGA SER, pg 4.7, & 7-1,7-2

ANSWER D.02 (2.50) DELETED

Three indications of rod position (.5 each):

Up (fully withdrawn)
Down (fully inserted)
Down position of the rod

Indicates whether magnet current is on (.5)

Indicates whether the magnet is in contact with the rod (.5) (2.50)

REFERENCE
MUTR SER pg 4-6,4-7

ANSWER D.03 (3.00)

a) The mass of the water is a constant (22,680 kg) when the pool water level is adjusted to the 23 foot mark.(.5) The pool temperature is measured with a thermistor over a period of time when the reactor power is constant(.5)

b) At 100 or 200 KW (1.)

c) The height of neutron detector is adjusted.(1.) (3.00)

REFERENCE
MUTR SP 202

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

MASTER

ANSWER D.04 (1.50)

a) Indication reads off scale high.(.75)

b) Indication reads temperature at short.(.75) (1.50)

REFERENCE
Basic Thermocouple Operation - CAF

ANSWER D.05 (1.50)

~~ROD DOWN LIGHT - ON (.5);~~ ~~OFF~~ Ant 9/24/87

~~MAGNET UP LIGHT - ON (.5); MAGNET DOWN LIGHT - OFF (.5)~~ (1.50)

up to light - on
Control light - on
Down light - off
Magnet Current light - on
Ant (.375 pts each)

REFERENCE
MUTR Safety Evaluation Report pg 4-6

ANSWER D.06 (1.00)

Pool temperature is controlled by operation of the primary cooling system(.5), with heat exchangers in service as required (.5) (1.00)

REFERENCE
MUTR SER Section 5

ANSWER D.07 (2.00)

See Figure 7.2 MUTR SER, pg 7-5 Ant 9/24/87 Ant 9/24/87

Fission Chamber	(.001 watts to 70 watts)	(.5)	
Compensated Ion Chamber Log-n recorder (spare)	(.1 Watts to full power)	(.5)	
Compensated Ion Chamber Linear recorder	(.01 Watts to full power)	(.5)	
Ion Chamber	(100 KW to full power)	(.5)	(2.00)

either log % power or wide range Linear CIC for full credit
DA

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

REFERENCE
MUTR SER PG 7-5

ANSWER D.Ø8 (1.ØØ)

Operates on the principle of a conductivity monitor (.5)
Difference in reading in air as compared to reading in water (.5) (1.ØØ)

REFERENCE
MUTR FSAR pg 7-27

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

MASTER

ANSWER E.01 (3.50)

Safety Channel	No. Required	Trip Setting
1) Reactor Power Level	- two required	- set at 120% of full licensed power
2) PERIOD	ONE	7 → 5 SEC
3) Fuel Element Temp.	- one	- Not to exceed 400 degrees C
4) Reactor Power Ch. Detector Power Supply	- two	- loss of power supply voltage to chamber
5) BRIDGE RAD MONITOR	ONE	50 MR/HR 10 MR/HR
6) Manual Scram	- one	- n/a
7) Console Electrical Supply	- one	- loss of electrical power to the control console

5 SYSTEMS REQUIRED FOR FULL CREDIT

~~(.25 for each correct response)~~ 2/7 9/24/87 (3.50)

REFERENCE
MUTR TRIGA TS, pg 9; SP 205 (MONITOR SET POINTS), pg 12

RWT

ANSWER E.02 (1.00)

To demonstrate compliance with Technical Specification control rod drop time (< 1 second) (1.00)

REFERENCE
MUTR TS 3.2.(1); MP 304 pg 1

ANSWER E.03 (3.00)

a) Source countrate less than setpoint(.5); Prevents any rod withdrawal (.5)

b) A plug from the beam tubes or through tube is removed (.5) Prevents any rod withdrawal (.5) (unless special bypass key is used).

c) Attempt to withdraw second control rod when one rod is being withdrawn (.5) Prevents more than one control rod being withdrawn at a time (.5). (3.00)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

REFERENCE
MUTR SER pg 4-7

ANSWER E.04 (2.00)

Check:
nuclear instrumentation for immediate drop in power (.5)

for - 80 sec period (.5)

rod down lights (.5)

CR drive position - visual check (.5)

REFERENCE
MUTR SER pg 4-6,4-7

ANSWER E.05 (1.00) DELETED RWT

An electronic braking mechanism on the drive (1.)
(permits a lock at .24 inch increments over the 24 inch rod travel) (1.00)

REFERENCE
MUTR FSAR pg 4-8

ANSWER E.06 (1.00)

Negative pressure maintained in reactor room (.5) by
ventilation system (.5) and/or the double door systems (1.00)
RWT

REFERENCE
MUTR SER pg 6-1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER E.07 (2.50)

a) Intended to prevent exceeding the safety limit (.5) if sudden removal of the experiment should occur (.5).

b) Intended to prevent damage to reactor components (.5) from accidental detonation of explosives (.5)

c) Intended to prevent damage to reactor components (.5) (2.50)

REFERENCE
MUTR TS pg 13 & 14

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER F.01 (2.50)

a) Any four of the six listed in TS 1.21.1 through 1.21.6 (at .5 points each for a max. of 2.00 points).

b) No (.5) (2.50)

REFERENCE
MUTR SER pg 6-1

ANSWER F.02 (3.00)

a) The purposes are to be aware of the radiation levels at the bridge (.5) and that the core power level is not rising (.5).

b) By shaking the fuel handling tool to assure that it is latched onto the top handle of the fuel bundle.(.5)

c) Record the time(.5), grid and location number from which the fuel bundle was removed (.5) and the storage bin number to which the bundle was moved (.5) (3.00)

REFERENCE
MUTR MP 303

ANSWER F.03 (3.00)

a) Water level (.5) results in loss of shielding and high radiation levels. (.5)

b) Scram the reactor (.5)
Restrict Access to the bridge (.5)
Notify the Director (.5)
Attemp to control leak (add water) (.5) (3.00)

REFERENCE
MUTR EP 402

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER F.04 (2.50)

a) 10% increments (.5); banked at 80% (.5)

b) 1-5% increments (.5); avoiding reactor period trip (.5)

c) Just before or just after the reactor is critical (.5)

REFERENCE
MUTR OP 103, PG 1

ANSWER F.05 (1.50)

Scram reactor (.5)

Manually trip the ventilation system (.5)

Notify the reactor supervisor (.5)

REFERENCE
MUTR EPP 7.3.3

ANSWER F.06 (1.50)

a) turn off key and secure reactor (.75)

b) Notify Reactor Director of the event (.75)

REFERENCE
MUTR AP 500

ANSWERS -- UNIVERSITY OF MARYLAND -37/09/08-TURNER, R.

ANSWER G.01 (3.00)

1. Time (.5). Time doubles, dose doubles (.5)

2. Distance (.5). Distance doubles, dose rate decreases by 4 (.5) (inverse square law)

3. Shielding (.5). Dose decreases exponentially with thickness(.5) (3.00)

REFERENCE
Basic Radiation Protection
J.R. Lamarsh, Introduction to Nuclear Engineering,pg 480

ANSWER G.02 (1.00)

1. In the fuel racks (13 positions) in the reactor pool.(.5)

2. In the fuel pit , north floor of reactor building.(.5) (1.00)

REFERENCE
MUTR SER, pg 9-1; SAR, Chapter 8

ANSWER G.03 (2.00)

(5 X 10E11 dps)/3.7 X 10E10 dps per Ci = 13.5 Ci (1.00)

DR = (6 X Ci X E)/dE2 = (6 X 13.5 X .6)/25 = 1.9 R/Hr (1.00)

REFERENCE
Glasstone, Principles of Nuclear Engineering pg 545, MUTR SP 205, pg 1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER G.04 (2.00)

a) Any area in which there exists radiation at a level such that a major portion of the body could receive 5 mrem in one hour or 100 mrem in 5 days (.5).

b) Area of controlled access for protection of individuals from exposure to radiation (.5).

c) Any area in which there exists radiation at a level such that a mayor portion of the body could receive 100 mrem in one hour (.5).

d) Area in which concentrations of airborne radioactivity exceed amounts specified in 10 CFR 20, Appendix B (.5). (2.00)

REFERENCE
10 CFR 20, part 20.202

ANSWER G.05 (2.00)

1. 10 CFR 20 whole body quarterly limit for gamma radiation is 1250 mrem(1.)

2. 1250/120 = 10.42 hrs stay time(1.) (2.00)

REFERENCE
10 CFR 20

ANSWER G.06 (1.50)

a) one on bridge above the reactor (~~.5~~ .75) RWT

~~b) one near the water purification system (.5) RWT~~

c) one near the reactor room air exhaust fan ~~(.5)~~ (.75) RWT (1.50)

REFERENCE
MUTR SER 12-2

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER G.07 (1.00)

Radioactive argon is produced by the radiation by neutrons of the argon in air(.5) and nitrogen 16 is produced by the radiation of oxygen in water by neutrons.

REFERENCE
MUTR SER 12.3, SAR 8.5

ANSWER G.08 (1.00)

A) 0 - 100 millicuries (1.00)

REFERENCE
MUTR FSAR 11.2.2.1

ANSWER G.09 (1.00)

The RO shutdowns (.5) and secures the reactor(.5) (1.00)

REFERENCE
Emergency Preparedness Plan, pg 3-3

QUESTION	VALUE	REFERENCE
A.01	2.00	TRL0000554
A.02	3.00	TRL0000555
A.03	2.00	TRL0000556
A.04	2.00	TRL0000557
A.05	1.50	TRL0000558
A.06	1.00	TRL0000559
A.07	2.00	TRL0000560
A.08	1.00	TRL0000561
	14.50	
B.01	2.00	TRL0000563
B.02	2.00	TRL0000564
B.03	2.00	TRL0000581
B.04	3.00	TRL0000582
B.05	3.00	TRL0000586
B.06	2.50	TRL0000587
	14.50	
C.01	2.50	TRL0000562
C.02	2.00	TRL0000566
C.03	2.00	TRL0000583
C.04	1.00	TRL0000588
C.05	1.00	TRL0000589
C.06	2.00	TRL0000590
C.07	1.00	TRL0000593
C.08	3.00	TRL0000594
	14.50	
D.01	1.50	TRL0000567
D.02	2.50	TRL0000568
D.03	3.00	TRL0000579
D.04	1.50	TRL0000595
D.05	1.50	TRL0000596
D.06	1.00	TRL0000597
D.07	2.00	TRL0000598
D.08	1.00	TRL0000599
	14.00	
E.01	3.50	TRL0000565
E.02	1.00	TRL0000585
E.03	3.00	TRL0000600
E.04	2.00	TRL0000601
E.05	1.00	TRL0000602
E.06	1.00	TRL0000603
E.07	2.50	TRL0000604
	14.00	
F.01	2.50	TRL0000569

MASTER

QUESTION	VALUE	REFERENCE
F.02	3.00	TRL0000584
F.03	3.00	TRL0000605
F.04	2.50	TRL0000606
F.05	1.50	TRL0000607
F.06	1.50	TRL0000608
	14.00	
G.01	3.00	TRL0000570
G.02	1.00	TRL0000572
G.03	2.00	TRL0000573
G.04	2.00	TRL0000574
G.05	2.00	TRL0000575
G.06	1.50	TRL0000576
G.07	1.00	TRL0000577
G.08	1.00	TRL0000578
G.09	1.00	TRL0000580
	14.50	
	100.00	

ATTACHMENT 2

MASTER

U. S. NUCLEAR REGULATORY COMMISSION
SENIOR REACTOR OPERATOR LICENSE EXAMINATION

FACILITY: UNIVERSITY OF MARYLAND

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 87/09/08

EXAMINER: TURNER, R.

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:

Use separate paper for the answers. Write answers on one side only. Staple question sheet on top of the answer sheets. Points for each question are indicated in parentheses after the question. The passing grade requires at least 70% in each category. Examination papers will be picked up six (6) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
20.00	~~20.00~~ 20.5 RLT			H.	REACTOR THEORY
20.00	~~20.00~~ 20.5 RLT			I.	RADIOACTIVE MATERIALS HANDLING DISPOSAL AND HAZARDS
~~20.00~~ 17.5 RLT	~~20.00~~ 17.95 RLT 9/25/87 +2.04 RLT			J.	SPECIFIC OPERATING CHARACTERISTICS
20.00	~~20.00~~ 20.5 RLT			K.	FUEL HANDLING AND CORE PARAMETERS
20.00	~~20.00~~ 20.5 RLT			L.	ADMINISTRATIVE PROCEDURES, CONDITIONS AND LIMITATIONS
~~00.00~~ 97.5 RLT	100. RLT				Totals
		Final Grade		%	

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

_____
Candidate's Signature

Changes in red & initialed result from incorporation of NRC response to Facility comments. See Examination Report No. 50-166/87-04, Attachments 3 & 4. RLT 9/25/87

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. 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.

3. Use black ink or dark pencil only to facilitate legible reproductions.

4. Print your name in the blank provided on the cover sheet of the examination.

5. Fill in the date on the cover sheet of the examination (if necessary).

6. Use only the paper provided for answers.

7. Print your name in the upper right-hand corner of the first page of each section of the answer sheet.

8. Consecutively number each answer sheet, write "End of Category __" as appropriate, start each category on a new page, write only on one side of the paper, and write "Last Page" on the last answer sheet.

9. Number each answer as to category and number, for example, 1.4, 6.3.

10. Skip at least three lines between each answer.

11. Separate answer sheets from pad and place finished answer sheets face down on your desk or table.

12. Use abbreviations only if they are commonly used in facility literature.

13. The point value for each question is indicated in parentheses after the question and can be used as a guide for the depth of answer required.

14. Show all calculations, methods, or assumptions used to obtain an answer to mathematical problems whether indicated in the question or not.

15. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

16. If parts of the examination are not clear as to intent, ask questions of the examiner only.

17. You must sign the statement on the cover sheet that indicates that the work is your own and you have not received or been given assistance in completing the examination. This must be done after the examination has been completed.

B. When you complete your examination, you shall:

a. Assemble your examination as follows:

(1) Exam questions on top.

(2) Exam aids - figures, tables, etc.

(3) Answer pages including figures which are part of the answer.

b. Turn in your copy of the examination and all pages used to answer the examination questions.

c. Turn in all scrap paper and the balance of the paper that you did not use for answering the questions.

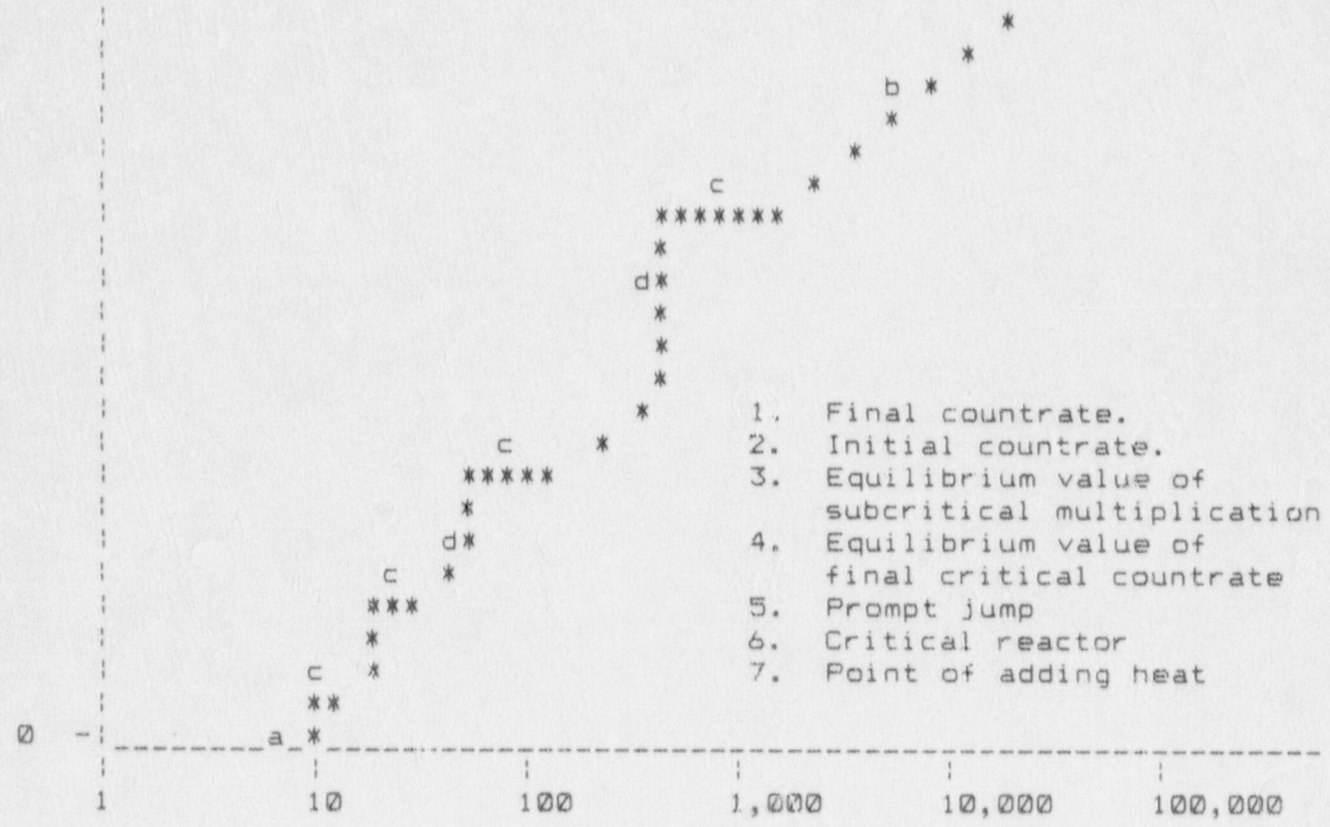
d. Leave the examination area, as defined by the examiner. If after leaving, you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION H.01 (2.00)

Name four (4) of the variables that will cause the critical rod position for the reactor to change from startup to startup.

QUESTION H.02 (2.00)

Match the labeled areas of the chart below showing countrate as a function of time during a reactor startup with the appropriate description. (NOTE: Several areas have the same label.)



QUESTION H.03 (3.00)

How much reactivity has been added to a subcritical reactor if the count rate has increased from 100 cps to 150 cps and Keff was initially 0.95? Show All Work!

(***** CATEGORY H CONTINUED ON NEXT PAGE *****)

MASTER

QUESTION H.04 (2.50)

Name the different modes of heat transfer by which the heat of fission is removed from the fuel. Include major components involved in the heat removal process starting with the fuel and ending at the ultimate heat sink.

QUESTION H.05 (2.00)

a) Assuming the reactor is at 125 watts and a period of 50 seconds is maintained, how long will it take to reach 250 KW? Show your work.

b) Assuming the reactor is at 125 watts and a 50 second period is initially established, explain how and why the reactor will respond if no further operator actions are taken.

QUESTION H.06 (2.00)

Explain the two properties of Zirconium Hydride fuel that account for the large,prompt, and negative temperature coefficient.

QUESTION H.07 (2.00)

After the reactor is critical on startup what affect will removal of the startup neutron source have on: (justify your responses)

a) Detector indication

b) Core reactivity

QUESTION H.08 (2.00)

a) Under steady-state operation, would there be any significant difference between the control rod positions at 100 watts and 200 watts? Explain.

b) Under steady-state operation, would there be any significant difference between the control rod positions at 100 KW and 200 KW? Explain.

(***** CATEGORY H CONTINUED ON NEXT PAGE *****)

QUESTION H.09 (1.50)

What affect, if any, will starting the primary coolant pump have if the reactor is operating at 250 KW? Explain.

QUESTION H.10 (1.00)

If 10,000 neutrons both prompt and delayed are emitted in one generation and 70 of them are delayed what is the value of beta?

(***** END OF CATEGORY H *****)

QUESTION I.01 (3.00)

List the three (3) basic VARIABLES which affect an individual's dose in a radiation area AND describe how much the dose would change if each VARIABLE was doubled (with the other two variables held constant).

QUESTION I.02 (1.50)

What are the three (3) principle sources of low level radioactive liquid waste at the MUTR?

QUESTION I.03 (1.00)

Where can irradiated fuel be stored when it is not in the reactor core at the MUTR? Provide two locations.

QUESTION I.04 (2.00)

A reactor sample has a disintegration rate of 5 X 10E11 disintegrations per second. Each disintegration emits a .6 Mev gamma. What is the dose rate expected five (5) feet from the above sample (assume point source)?

QUESTION I.05 (2.00)

Define or explain per 10 CFR 20:

a) Radiation Area

b) Restricted Area

c) High Radiation Area

d) Airborne Radioactivity Area

QUESTION I.06 (2.00)

If you were working in a radiation zone where the general background was 120 mrem/hr gamma radiation, how long could you stay in that zone before you would exceed the 10CFR 20 whole body quarterly limit?

(***** CATEGORY I CONTINUED ON NEXT PAGE *****)

QUESTION I.07 (3.00)

What are three purposes of a "radiation safety and personnel protection program"?

QUESTION I.08 (1.50)

Where are the three fixed position MUTR radiation monitors located?

QUESTION I.09 (1.00)

What are the sources of the two radicactive isotopes, Argon 41 and Nitrogen 16, produced by the operation of research reactors?

QUESTION I.10 (3.00)

If the reactor was at 250 KW and one central fuel element failed:

a) what four radioactive gases would escape?

b) would the total activity released from the fuel element be in the range of:(Choose one)

A) 0 - 100 millicuries

B) 101 - 1000 millicuries

C) greater than 1000 millicuries

(***** END OF CATEGORY I *****)

QUESTION J.01 (2.50)

After three days of continuous operation at 200 KW, the reactor is shutdown for minor maintenance. It is restarted 8 hours later.

a) How will the critical rod position on restart compare to the critical rod position at the time of the previous startup? Give the reason for changes in the critical rod positions.

b) During the first 24 hours after startup, describe the control rod movements that would be necessary to raise the power from just critical to 200 KW and maintain the power constant after reaching 200 KW. Explain what causes the need for changes in rod in/out motion.

QUESTION J.02 (2.00)

Fill in the blanks with the appropriate value:

a) The reactor shall not be operated unless the shutdown margin provided by the control rods, under the most conservative conditions, is greater than $_____.

b) The excess reactivity relative to the cold critical conditions, with or without experiments in place, shall not be greater than $_____.

c) The reactor shall not be operated unless each non-secured experiment has a reactivity value of less than $_____.

d) The scram time measured from the time a rod starts in motion to the time the rod reaches a fully inserted position shall not exceed_____seconds for the slowest scramable rod.

QUESTION J.03 (2.00)

State how the core diffuser system accomplishes its purpose.

QUESTION J.04 (3.50)

List the scram(s) which are initiated by THE REACTOR SAFETY CHANNELS. Include the number of channel(s) required and the scram setpoint(s).

(***** CATEGORY J CONTINUED ON NEXT PAGE *****)

QUESTION J.05 (1.00)

What are the components of the fuel temperature monitor?

QUESTION J.06 (2.00)

Describe the radial and axial position in the core where a one inch movement of a control rod tip would have the maximum effect. Explain your answer.

QUESTION J.07 (1.50)

TRUE or FALSE

a) The linear power channel provides a control signal to the servo controller for automatic control of the regulating rod.

b) More than one control rod can be withdrawn at the same time.

c) The regulating rod automatically inserts on a scram signal.

QUESTION J.08 (2.50) Deleted RLT

A control rod drive assembly has five switches. What is the purpose of each switch?

QUESTION J.09 (3.00)

a) Why is the ventilation system considered an engineered safety system?

b) In what two ways is the safety function of the the ventilation system actuated?

(***** END OF CATEGORY J *****)

QUESTION K.01 (1.50)

What is the length, number, and percent U235 enrichment of the fuel rods in the MUTR core?

QUESTION K.02 (1.00)

Define "Reactor Shutdown".

QUESTION K.03 (3.00)

In accordance with MP 303, what are the licensed personnel requirements to perform fuel movements in the reactor pool tank? (Include type of license, number required, and location of personnel)

QUESTION K.04 (2.00)

What material is used and where is it placed to provide enhanced neutron reflection axially for the MUTR core?

QUESTION K.05 (1.00)

In accordance with Technical Specifications fuel element cladding stress will be less than the ultimate stress if the fuel temperature is less than _____ and the fuel cladding is _____cooled. (fill in the blanks)

QUESTION K.06 (3.00)

a) What are two design features of the reactor tank cooling piping that normally would limit the reduction in reactor tank level to 20 inches or less in the event there were a severe leak in the inlet or outlet piping? (2.00)

b) What would be the minimum thickness of water shielding above the reactor core even after a cooling piping failure? (1.00)

(***** CATEGORY K CONTINUED ON NEXT PAGE *****)

QUESTION K.07 (2.00)

What are the reactivity values of the following:

a) MUTR core excess reactivity?

b) Shim Rods?

c) Regulating Rod?

d) Shutdown Margin with highest Worth Rod Withdrawn?

QUESTION K.08 (3.00)

Assume a fuel bundle is to be moved from the core to a storage area:

a) what are the two purposes for the monitoring of the console instruments by the control room operator?

b) how does the bridge operator assure himself that the fuel handling tool is properly latched before he moves the fuel bundle?

c) What items are recorded in the Control Room Log Book after the fuel move is complete?

QUESTION K.09 (1.00)

What are the two purposes of the rod drop test after maintenance or replacement of a control rod?

QUESTION K.10 (2.50)

How are the following TS objectives accomplished:

a) prevent criticality in stored fuel?

b) prevent attainment of unsafe temperatures in stored fuel?

(***** END OF CATEGORY K *****)

QUESTION L.01 (2.00)

In compliance with MUTR Technical Specifications, what four operations must be supervised by a licensed senior reactor operator?

QUESTION L.02 (1.00)

In accordance with MUTR Technical Specifications, if a safety limit is exceeded what must happen before the reactor operation is resumed?

QUESTION L.03 (3.00)

a) How are water mass and delta temperature measured when in the process of conducting a heat balance on the MUTR?

b) At what power level is a heat balance normally conducted?

c) How is the indicated power level adjusted to agree with the measured and calculated heat balance?

QUESTION L.04 (3.00)

What is the approval level required for the following:

a) Special Experiments

b) Routine Experiments

c) Modified Routine Experiments

QUESTION L.05 (1.50)

Based on EP 404, what are three major objectives in the event there is a major radioactive spill?

QUESTION L.06 (1.00)

Why is there a specification on the maximum conductivity of the pool water?

(***** CATEGORY L CONTINUED ON NEXT PAGE *****)

QUESTION L.07 (3.50)

During reactor operation the bridge radiation monitor indicates 180 mrem/hr. What is the RO at the reactor console immediate response and what is the Duty SRO's responsibilities?

QUESTION L.08 (2.50)

In the event of a civil disturbance, what three offices should be notified and what two protective actions should be taken per EP 405?

QUESTION L.09 (2.50)

a) List four of the six categories of "Reportable Occurrences" that are reportable per Technical Specification requirements.

b) Is a reportable occurrence report required when the reactor is shutdown?

(***** END OF CATEGORY L *****)
(********** END OF EXAMINATION **********)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER H.01 (2.00)

1. Power history (Xenon).
2. Temperature.
3. Experiments in the reactor.
4. Fuel burnup.
5. Rod location.
6. Fuel location. (Any 4 @.5 each to max. 2.00) (2.00)

REFERENCE
Nuclear Energy Training, Units 8,9,10

ANSWER H.02 (2.00)

a. 2; b. 6; c. 5; d. 3 (.5 each to a max of 2.00) (2.00)

REFERENCE
Basic Nuclear Theory & Reactor Operations

ANSWER H.03 (3.00)

a) cr1 /cr2 = (1-Keff2) / (1-Keff1) (.9)
100/150 = (1-Keff2) / (1-0.95) (.5)
1-Keff2 = 10/15 x 0.05
Keff2 = 0.967 (.1) (1.50)

b) Change in Reactivity = (Keff2 - 1)/Keff2 - (Keff1 - 1)/Keff1
= (Keff2 -Keff1)/Keff2*Keff1 (.9)
= (0.967-0.95)/0.967*0.95 (.5)
= 1.85 % delta K/K (.1) (1.50)

REFERENCE
Nuclear Energy Training, pg 6.1-3,12.1-3

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER H.04 (2.50)

Conduction through fuel. (Radiation across fuel gap)
Conduction transfer from fuel to coolant.
Forced convection to heat exchanger.
Conduction across heat exchanger tubes.
Convection of cooling water in heat exchanger (Ø.5 pts each) (2.50)

REFERENCE
Introduction to Nuclear Engineering, chapter 8; J R Lamarsh

ANSWER H.05 (2.ØØ)

a) $P = P_L\, e(t/T)$ (Ø.4)
$250\ KW = Ø.125\ \ e(t/5Ø)$ (Ø.4)
$\ln[2ØØØ] = \ln[e\ (t/5Ø)]$
$7.6 = t/5Ø$
$t = 38Ø$ sec or 6.33 min. (Ø.2) (1.ØØ)

b) Power coefficient would lengthen period (.5) and would eventually stabilize power. (.5) (1.ØØ)

REFERENCE
Nuclear Energy Training, Unit 6, pg 6.3-1

ANSWER H.06 (2.ØØ)

ZrHx shifts the neutron spectrum at elevated temperature (Ø.5) which increases the leakage of slow neutrons from the fuel bearing region. (Ø.5)
or decrease in fission cross section
Doppler broadening (.5) which causes more absorption in the U238 resonance absorption region at elevated temperatures. (.5) (2.ØØ)
RLT

REFERENCE
SER, p 4-4

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER H.07 (2.00)

a) Slight reduction in count rate (.5) due to removal of neutron source which was positioned near detector. (.5)

b) Reduce core reactivity ~~(.5) due to removal of a source of neutrons. (.5)~~ (2.00)

REFERENCE
OP 103 ; Nuclear Energy Training, Unit 11

ANSWER H.08 (2.00)

a) No difference (.5) because the reactor is below heat range and the power coefficient does not add any negative reactivity. (.5)

b) Rods would be further withdrawn at 200 KW (.5) to compensate for the negative reactivity added by the power coefficient. (.5) (2.00)

REFERENCE
Nuclear Energy Training, Unit 13

ANSWER H.09 (1.50)

Reactor power will increase (.6) due to the addition of cold water and MTC feedback. (.9) (1.50)

REFERENCE
OP 104, p 1

ANSWER H.10 (1.00)

Beta = 70/10000 = .007

REFERENCE
Nuclear Training Manual, 5.2.2

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER I.01 (3.00)

1. Time (.5). Time doubles, dose doubles (.5)

2. Distance (.5). Distance doubles, dose rate decreases by 4 (.5) (inverse square law)

3. Shielding (.5). Dose decreases exponentially with thickness(.5) (3.00)

REFERENCE
Basic Radiation Protection
J.R. Lamarsh, Introduction to Nuclear Engineering,pg 480

ANSWER I.02 (1.50)

1. Drainage from grill work at the base of the reactor.

2. (Two) sinks located in the West Balcony Laboratories.

3. Pool overflow (.5 each) (1.50)

REFERENCE
SAR, Chapter 9

ANSWER I.03 (1.00)

1. In the fuel racks (13 positions) in the reactor pool.(.5)

2. In the fuel pit , north floor of reactor building.(.5) (1.00)

REFERENCE
MUTR SER, pg 9-1; SAR, Chapter 8

ANSWER I.04 (2.00)

(5 X 10E11 dps)/3.7 X 10E10 dps per Ci = 13.5 Ci (1.00)

DR = (6 X Ci X E)/dE2 = (6 X 13.5 X .6)/25 = 1.9 R/Hr (1.00)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

REFERENCE
Glasstone, Principles of Nuclear Engineering pg 545, MUTR SP 205, pg 1

ANSWER I.05 (2.00)

a) Any area in which there exists radiation at a level such that a major portion of the body could recieve 5 mrem in one hour or 100 mrem in 5 days (.5).

b) Area of controlled access for protection of individuals from exposure to radiation (.5).

c) Any area in which there exists radiation at a level such that a mayor portion of the body could receive 100 mrem in one hour (.5).

d) Area in which concentrations of airborne radioactivity exceed amounts specified in 10 CFR 20, Appendix B (.5). (2.00)

REFERENCE
10 CFR 20, part 20.202

ANSWER I.06 (2.00)

1. 10 CFR 20 whole body quarterly limit for gamma radiation is 1250 mrem(1.)

2. 1250/120 = 10.42 hrs stay time(1.) (2.00)

REFERENCE
10 CFR 20

ANSWER I.07 (3.00)

1. To prevent internal contamination

2. To minimize exposure to external radiation

3. To guard against damage to property or injury to personnel from the use of radioisotopes or radiation producing equipment.
(1 point each) (3.00)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/06-TURNER, R.

REFERENCE
MUTR Procedures, EP104

ANSWER I.08 (1.50)

a) One on bridge above the reactor (.5).

~~b) One near the water purification system (.5).~~

c) One near the reactor room exhaust air fan (.5). (1.50)

REFERENCE
MUTR SER, pg 12.2

ANSWER I.09 (1.00)

Radioactive argon is produced by the radiation by neutrons of the argon in air(.5) and nitrogen 16 is produced by the radiation of oxygen in water by neutrons.

REFERENCE
MUTR SER 12.3, SAR 8.5

ANSWER I.10 (3.00)

a) Bromine, Iodine, Krypton, Xenon (.5 each) (2.00)

b) A) 0 - 100 millicuries (1.00)

REFERENCE
MUTR FSAR 11.2.2.1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER J.01 (2.50)

a) The critical rod height on restart would be higher (0.5) due to the increase in Xenon during shutdown (0.5) which would have added negative reactivity.

b) Initially, rods must be withdrawn to increase power to 200 KW (0.5). As Xe is burned out from its peak value, rods must be inserted (0.5). Eventually, Xe will reach a minimum value and will begin to increase to its equilibrium value for the steady state power level. At this time, rods will have to be moved out to keep power constant (0.5). (2.50)

REFERENCE
Nuclear Engineer Training, Pg 10.3-1,2,3

ANSWER J.02 (2.00)

a) $0.50

b) $3.50

c) $1.00

d) one (.5 each) (2.00)

REFERENCE
MUTR TRIGA TS, pg. 7,8,13

ANSWER J.03 (2.00)

A pump takes a suction from the bottom of the pool (.5) and discharges through a nozzle above the core (.5) and causes a circulation pattern (.5) which allows time for the N16 to decay prior to reaching the pool water surface (.5). (2.00)

REFERENCE
MUTR SAR, pg 8-4

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER J.04 (3.50)

Safety Channel	No. Required	Trip Setting
Reactor Power Level	- two required	- set at 120% of full licensed power
Fuel Element Temp.	- one	- Not to exceed 400 degrees C
Reactor Power Ch. Detector Power Supply	- two	- loss of power supply voltage to chamber
Manual Scram	- one	- n/a
Console Electrical Supply	- one	- loss of electrical power to the control console

~~(.25 for each correct response)~~ (3.50)

REFERENCE
MUTR TRIGA TS, pg 9, #12; SP205 (monitor setpoints)

ANSWER J.05 (1.00)

The fuel temperature monitor is a meter-operated optical relay (.5) that derives its signal directly from a thermocouple imbedded in an instrumented fuel assembly (.5). (1.00)

REFERENCE
MUTR TRIGA SER, pg 7-3

ANSWER J.06 (2.00)

In the region of the highest flux (1)

Normally in the center radially (.5) and the middle axially (.5) (2.00)

REFERENCE
Basic Reactor Theory CAF

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER J.07 (1.50)

a) TRUE (.5)

b) FALSE (.5)

c) TRUE (.5) (1.50)

REFERENCE
MUTR TRIGA SER, pg 4.7, & 7-1,7-2

ANSWER J.08 (2.50) Deleted 4/25/88

Three indications of rod position (.5 each):

Up (fully withdrawn)
Down (fully inserted)
Down position of the rod

Indicates whether magnet current is on (.5)

Indicates whether the magnet is in contact with the rod (.5) (2.50)

REFERENCE
MUTR SER pg 4-6,4-7

ANSWER J.09 (3.00)

(0.5 Dpent 4/25/88)

a) Controls release of radioactive gases during normal operation(.5)
Prevents release during abnormal or accident conditons(.5).

b) 1) Emergency Manual Shutdown (from four locations in the reactor other locations in the reactor building(.5)

2) All reactor scrams (1.) (3.00)

REFERENCE
MUTR SER pg 6-1

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER K.01 (1.50)

Length - .9 meters (.5)

Number - 93 (.5)

Percent U235 enrichment - 20% (.5) (1.50)

REFERENCE
MUTR SER , pg 4-1,4-2, Fig. 4.1

ANSWER K.02 (1.00)

The reactor is in a shutdown condition when sufficient control rods are inserted to assure that the reactor is subcritical by at least $1.00 of reactivity (.5), with the fuel and moderator at ambient temperature(.5). (1.00)

REFERENCE
MUTR TS, pg 4

ANSWER K.03 (3.00)

One (.5) SRO (.5) on the reactor bridge (.5)(supervises the fuel move)
One (.5) RO (.5) at the reactor console(.5) (3.00)

REFERENCE
MUTR MP303, pg 1

ANSWER K.04 (2.00)

Graphite slugs (1.) placed top and bottom within the fuel rod assembly (1.). (2.00)

REFERENCE
MUTR FSAR pg 4-2

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER K.05 (1.00)

1000 degrees Centigrade (.5)

water cooled (.5) (1.00)

REFERENCE
MUTR TS pg 6

ANSWER K.06 (3.00)

a) 1) The pool water inlet pipe is equipped with a siphon break at the surface of the pool.(1.)

2) The pool water return(outlet) pipe is not more than 20 inches below the overflow outlet pipe.(1.)

b) Fifteen feet (1.) (3.00)

REFERENCE
MUTR TS pg 18 & 19

ANSWER K.07 (2.00)

a) 1.21% dk/k ($1.73) (.5)

b) $5.80 (.5)

c) $2.42 (.5)

d) $3.49 (.5) (2.00)
(Will accept + or - 10%)

REFERENCE
UM SER pg 4-5

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER K.08 (3.00)

a) The purposes are to be aware of the radiation levels at the bridge (.5) and that the core power level is not rising (.5).

b) By shaking the fuel handling tool to assure that it is latched onto the top handle of the fuel bundle.(.5)

c) Record the time(.5), grid and location number from which the fuel bundle was removed (.5) and the storage bin number to which the bundle was moved (.5) (3.00)

REFERENCE
MUTR MP 303

ANSWER K.09 (1.00)

a) To demonstrate compliance with Technical Specification control rod drop time.(.5) (< 1 second)

b) To assure that the rod is properly aligned.(.5) (1.00)

REFERENCE
MUTR TS 3.2.(1); MP 304 pg 1

ANSWER K.10 (2.50)

a) Store in a geometrical array (.5) where the keff is less than 0.8 (.5) for all conditions of moderation (.5)

b) Store in an array which will permit sufficient natural convection(.25) in water (.25) or air (.25) so design temperature values are not exceeded (.25). (2.50)

REFERENCE
MUTR TS 5.3, pg 19 & 20

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER L.01 (2.00)

a) Fuel manipulations in the core.(.5)

b) When experiments are being manipulated in the core that have an estimated worth greater than $.080. (.5)

c) Removal of control rod(s) (.5)

d) Resumption of operation following an unscheduled shutdown (.5) (2.00)

REFERENCE
MUTR Technical Specifications, pg 20 & 23

ANSWER L.02 (1.00)

The NRC must authorize restart. (1.0) (1.00)

REFERENCE
MUTR TS pg 26

ANSWER L.03 (3.00)

a) The mass of the water is a constant (22,680 kg) when the pool water level is adjusted to the 23 foot mark.(.5) The pool temperature is measured with a thermistor over a period of time when the reactor power is constant(.5)

b) At 100 or 200 KW (1.)

c) The height of neutron detector is adjusted.(1.) (3.00)

REFERENCE
MUTR SP 202

ANSWER L.04 (3.00)

a) Reactor Safety Committee (.75) and the Facility Director (.75)

b) Duty Senior Reactor Operator (.75).

c) Facility Director (.75) (3.00)

REFERENCE
MUTR OP 105

ANSWER L.05 (1.50)

Protect personnel (.5); isolate spill (.5) and notify necessary personnel to remedy situation(.5) (Radiation Safety Officer) (1.50)

REFERENCE
MUTR EP 404, pg 2

ANSWER L.06 (1.00)

Conductivity is specified to minimize the degree of fuel element cladding corrosion (.5) and the subsequent consequences of dissolved metals in the reactor pool(.5) (exact wording not required) (1.00)

REFERENCE
MUTR TS pg 11

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

ANSWER L.07 (3.50)

The RO shutdowns (.5) and secures the reactor(.5)

The SRO becomes the acting emergency director and is responsible for:

1) placing the reactor in a safe shutdown condition(.5)

2) terminating or minimizing releases of radioactive material(.5)

3) protecting facility personnel and visitors(.5)

4) assessing severity of the event, and(.5)

5) notifying the Reactor Director(.5) (3.50)

REFERENCE
Emergency Preparedness Plan, pg 3-3

ANSWER L.08 (2.50)

a) Notify the Division of Public Safety Office(.5)

b) Notify the Reactor Director(.5)

c) Notify the Radiation Safety Office(.5)

d) Secure all doors to reactor building and containment area(.5)

e) Activate the intrusion alarm system.(.5) (2.50)

REFERENCE
MUTR EP 405

ANSWER L.09 (2.50)

a) Any four of the six listed in TS 1.21.1 through 1.21.6 at .5 points each for a max of 2.00 points.

b) No (.5) (2.50)

ANSWERS -- UNIVERSITY OF MARYLAND -87/09/08-TURNER, R.

REFERENCE
MUTR Technical Specification 1.21.1-1.21.6 dated August 17, 1984

UESTION	VALUE	REFERENCE
H.01	2.00	TRL0000504
H.02	2.00	TRL0000505
H.03	3.00	TRL0000506
H.04	2.50	TRL0000507
H.05	2.00	TRL0000508
H.06	2.00	TRL0000509
H.07	2.00	TRL0000510
H.08	2.00	TRL0000511
H.09	1.50	TRL0000512
H.10	1.00	TRL0000522
	20.00	
I.01	3.00	TRL0000513
I.02	1.50	TRL0000514
I.03	1.00	TRL0000515
I.04	2.00	TRL0000516
I.05	2.00	TRL0000517
I.06	2.00	TRL0000518
I.07	3.00	TRL0000519
I.08	1.50	TRL0000520
I.09	1.00	TRL0000521
I.10	3.00	TRL0000523
	20.00	
J.01	2.50	TRL0000524
J.02	2.00	TRL0000525
J.03	2.00	TRL0000526
J.04	3.50	TRL0000527
J.05	1.00	TRL0000528
J.06	2.00	TRL0000529
J.07	1.50	TRL0000530
J.08	2.50	TRL0000531
J.09	3.00	TRL0000532
	20.00	
K.01	1.50	TRL0000533
K.02	1.00	TRL0000534
K.03	3.00	TRL0000535
K.04	2.00	TRL0000536
K.05	1.00	TRL0000537
K.06	3.00	TRL0000538
K.07	2.00	TRL0000539
K.08	3.00	TRL0000540
K.09	1.00	TRL0000543
K.10	2.50	TRL0000544
	20.00	
L.01	2.00	TRL0000545

MASTER

QUESTION	VALUE	REFERENCE
L.02	1.00	TRL0000546
L.03	3.00	TRL0000547
L.04	3.00	TRL0000548
L.05	1.50	TRL0000549
L.06	1.00	TRL0000550
L.07	3.50	TRL0000551
L.08	2.50	TRL0000552
L.09	2.50	TRL0000553
	20.00	
	100.00	

ATTACHMENT 3 9/9/87

I = Information Only
R = Response Requested

(1)

Notes & Comments on the R.O. & SRO Exams. of 9/8/87

— David D. Ebert —
Reactor Director.

I A.01 - Don't have much xe in reactor. Difficult to see any effect.
Temperature may be divided into fuel & water w/ separate effects.
Very little fuel burnup from run to run.
Don't move the fuel in this reactor.

A.02 - O.K.

I A.03 - a. operator will have to adjust the rod positions to maintain 50sec. period.

b. O.K.

R A.04 - a. OK.
b. Reduce ρ due to fact that neutron source is made of PU.

I A.05 - Power level will increase due to cold water addition & MTC feedback but in a complicated way since we have measured the MTC to be positive overall.

A.06 - O.K.

A.07 - O.K.

A.08 - Delayed neutrons and also adjustment due to fuel temperature.

B.01 - O.K.

B.02 - O.K.

B.03 - O.K. ~~also could say water effects~~.

B.04 - O.K.

B.05 - O.K.

B.06 - O.K.

C.01 - we don't observe any Xe effects in our reactor since we are restricted to less than 250 kW and very little Xe is built up at this power. I think this question should be discarded.

C.02 - O.K.

C.03 - ~~C.03~~ should have ~~an~~ a larger allowable range. This information is available at the console.

C04 - O.K.

C.05 - O.K. But also flow due to primary pumps & diffuser pumps on if on.

C.06 - FSAR says that flooding produces a very small amount of + ρ addition (a few ¢), therefore the reg. rod may not move much if any.

I

C.07 - (a). also to minimize neutron activation products.

Y

(b). O.K.

C.08 - (a). Fuel temp would change, but Water and MTC is +. Fuel temp. would change some quickly because of change in heat transfer coeff.

But

(b). also fuel temp increase.

(c). it may be that the 120% power limit is exceeded because of + MTC.

(d). see above.

D.01 - O.K. condition for b & c is not to be in automatic mode.

I

D.02 - This question is very misleading. There are not five switches, only three microswitches which control the lights on console in a complicated way - not one to one relationship.

R

D.03 – (a). water mass isn't measured directly but indirectly by starting at overflow level. Power calibration rather than heat balance.
I (b). OK.
(c). OK.

D.04 – O.K. But I am not sure how much this would relate to safe operation
I

D.05 – UP Light = On
Cont. Light = off
R Down Light = off
Mag. current = On

D.06 – O.K.

D.07 – 1. Log % power which is connected to Fission chamber covers full range.
R 2. Wide range linear CIC which is connected to red pen covers almost the full range depending on over compensation.

D.08 – Pool level monitor not in service at present. Pool level ~~not~~ monitoring not required by Tech Specs.
Y Radiation level is required by Tech. Specs.

E.01 – O.K.

E.02 – O.K.

E.03 – O.K.

E.04 – Down light doesn't come on until CRD mech drives down (~1 min) Then both CONT & DOWN come on.

E.05 – This question is very misleading & and should be discarded.

E.06 – With exhaust fan off, the two sets of doors prevent radioactive gases from escaping through doorways.

E.07 – O.K.

F.01 – O.K.

F.02 – O.K.

F.03 – O.K.

F.04 – O.K.

F.05 – O.K.

F.06 – O.K.

G.01 - O.K.

G.02 - O.K.

G.03 - O.K.

G.04 - O.K.

G.05 - O.K.

G.06 - water room monitor not in service.

G.07 - O.K.

G.08 - O.K.

G.09 - The reactor would automatically scram on high level.

* = covered on R.O. exam - see comments

H.01 - *

H.02 - O.K. A little misleading. Time should be X-axis label?

H.03 - *

H.04 - Depends if secondary cooling is on or off. Ultimate heat sink is subjective!

H.05 - *

H.06 - Also decrease in fission cross-section & due to increase in neutron spread.

H.07 - *

H.08 - O.K.

H.09 - *

H.10 - *

I.01 - *

I.02 - O.K.

I.03 - *

I.04 - *

I.05 - *

I.06 - *

I.07 - O.K.

I.08 - *

I.09 - *

I.10 - (a). There are more than these 4 possible.
↳ (G). *

J.01 - *

J.02 - *

J.03 - *

J.04 - *

J.05 - Also there is an electronic cold junction on the bridge. The meter measures voltage which is converted into temperature.
↳

J.06 - *

J.07 - *

J.08 - *

J.09 - O.K.

K.01 - O.K. - Fuel length is ≈ 20".

K.02 - O.K.

K.03 - O.K.

K.04 - *

K.05 - O.K.

K.06 - *

K.07 - *

K.08 - *

K.09 - O.K.

K.10 - O.K.

L.01 - OK.

L.02 - O.K.

L.03 - *

L.04 - O.K.

L.05 - O.K.

L.06 - *

L.07 - O.K.

L.08 - Actually the best way would be to call the emergency # X3555 and the emergency plan would be set into action. Most of the time, notification of Reactor Director is sufficient.

L.09 - *

Attachment 4

NRC Response to Facility Comments

The Facility Comments on the written RO and SRO examinations given on September 8, 1987 are part of this exam report as Attachment 3. This response addresses those comments where a response was requested as indicated by the "R" in front of specific questions of Attachment 3.

RO Written Examination:

A.04 b Same as H.07 on SRO Examination

Full credit (one point) will be given for a decrease in or reduction of reactivity response.

A.08

One half point for either a delayed neutron or a fuel temperature change response.

C.01 Same as J.01 on SRO Examination

The question is based on the training material submitted and is applicable to reactor operation. The fact that very little xenon is generated in the MUTR will be considered during grading.

C.05

The fact that the cooling and or diffuser pump operation will enhance core cooling will be considered during grading.

D.02 Same as J.08 on SRO examination

The question will be deleted from this examination. Section value total will be appropriately adjusted.

D.05

Answer will be modified to the following response:

Up Light	on	
Contact Light	off	
Down Light	off	
Magnet Current Light	on	(.375 points each)

Section total value and question value will be appropriately adjusted.

D.07

The intent of the question was to solicit the complete nuclear instrumentation provided at the MUTR. Will accept for full credit either instrumentation system that provides full range coverage, i.e., log percent power instrumentation or Wide Range Linear CIC.

E.05

This question will be deleted from this examination as training material did not address this information. The section value will be appropriately adjusted.

E.01 Same as J.04 on SRO Examination

The answer was modified based on information gained at the facility so that a listing of five of the systems that initiate scrams including number required and setpoints will be adequate for full credit, i.e., .7 points per system. (Also includes systems not listed in TS page 9)

E.06

Double-door system will be an acceptable alternate answer for full credit of one point.

G.06 Same as I.08 on SRO Examination

Full credit will be given if only the monitors in service are listed.

G.09

Full credit will be given for "secure the reactor" response.

SRO Written Examination:

H.06

Will accept "decrease in fission cross-section" as an alternate response corresponding to increase in leakage.

H.07

Full credit will be given for a decrease or reduction of reactivity response.

I.08

Full credit will be given if only the monitors in service are listed. Training material did not indicate the water room monitor was not in service.

J.08

This question will be deleted from this examination. Section value total will be appropriately changed.

Questions noted as being the same as those addressed for the RO Examination will be treated in the same manner as the RO resolution.