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

EXAMINATION REPORT NO.	50-225/87-02(OL)
FACILITY DOCKET NO.	50-225
FACILITY LICENSE NO.	CX-22
LICENSEE:	Rensselaer Polytechnic Institute Troy, New York 12181
FACILITY:	Rensselaer Polytechnic Institute
EXAMINATION DATES:	December 1-2, 1987

CHIEF EXAMINER: *B. Norris* — Barry S. Norris, Senior Operations Engineer (Examiner/Inspector) — *29 Jan 88* Date

APPROVED BY: *R M Keller* — Robert M. Keller, Chief, PWR Section, Division of Reactor Safety — *Feb 1, 1988* Date

SUMMARY: Written and operating examinations were administered to two Senior Reactor Operator (SRO) candidates. One candidate failed the operating examination, the other candidate was issued a license.

EXAMINATION DETAILS

TYPE OF EXAMINATIONS: Replacement

EXAMINATION RESULTS:

	SRO Pass/Fail
Written Exam	2 / 0
Operating Exam	1 / 1
Overall	1 / 1

EXAMINER AT SITE: L. S. Defferding (PNL)

1. Personnel Present at Exit Interview:

   NRC Contractor Personnel
   L. S. Defferding (PNL)

   Facility Personnel
   P. Rodriquez, Operations Supervisor

2. The written examination was reviewed by the facility after the candidates had completed the examination. The reviewer was P. Rodriquez. The facility comments and the NRC resolution to those comments is enclosed as Attachment 2.

Attachments:
1. SRO Written Examination and Answer Key
2. Facility Comments and NRC Resolution on Written Examination

ATTACHMENT 1

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

FACILITY: RENSSELAER

REACTOR TYPE: TEST

DATE ADMINISTERED: 87/12/01

EXAMINER: UPTON, J.

CANDIDATE: FINAL

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			H. REACTOR THEORY
20.00	20.00			I. RADIOACTIVE MATERIALS HANDLING DISPOSAL AND HAZARDS
20.00	20.00			J. SPECIFIC OPERATING CHARACTERISTICS
20.00	20.00			K. FUEL HANDLING AND CORE PARAMETERS
20.00	20.00			L. ADMINISTRATIVE PROCEDURES, CONDITIONS AND LIMITATIONS
100.00		Final Grade	%	Totals

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

Candidate's Signature

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.

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 H.01 (1.00)

If a fission fragment decayed by two successive beta-minus emissions to 62-Sm-149, the original fission fragment was: (CHOOSE the correct statement below.) (1.0)

(a.) 62-Sm-151.

(b.) 62-Sm-147.

(c.) 60-Nd-149.

(d.) 64-Gd-149.

QUESTION H.02 (1.00)

If the reactor power increased by 1/2 decade in one minute, WHAT would be the reactor period? (1.0)

QUESTION H.03 (2.50)

The "in-hour" equation, as given below, relates reactivity to reactor period.

$$rho = \frac{l^*}{T} + \sum_{i}^{6} \frac{\beta_i}{1+T\lambda_i}$$

a. DEFINE the symbols l-*, beta-i, and lambda-i. (1.5)

b. WHY does the sum go from 1 to 6? (1.0)

QUESTION H.04 (1.50)

Figure H-1 provides the graphical relationship for the RPI facility between reactivity and reactor period. If the reactor period were measured as 30 seconds, WHAT would be the value of k-eff for the core? (1.5)

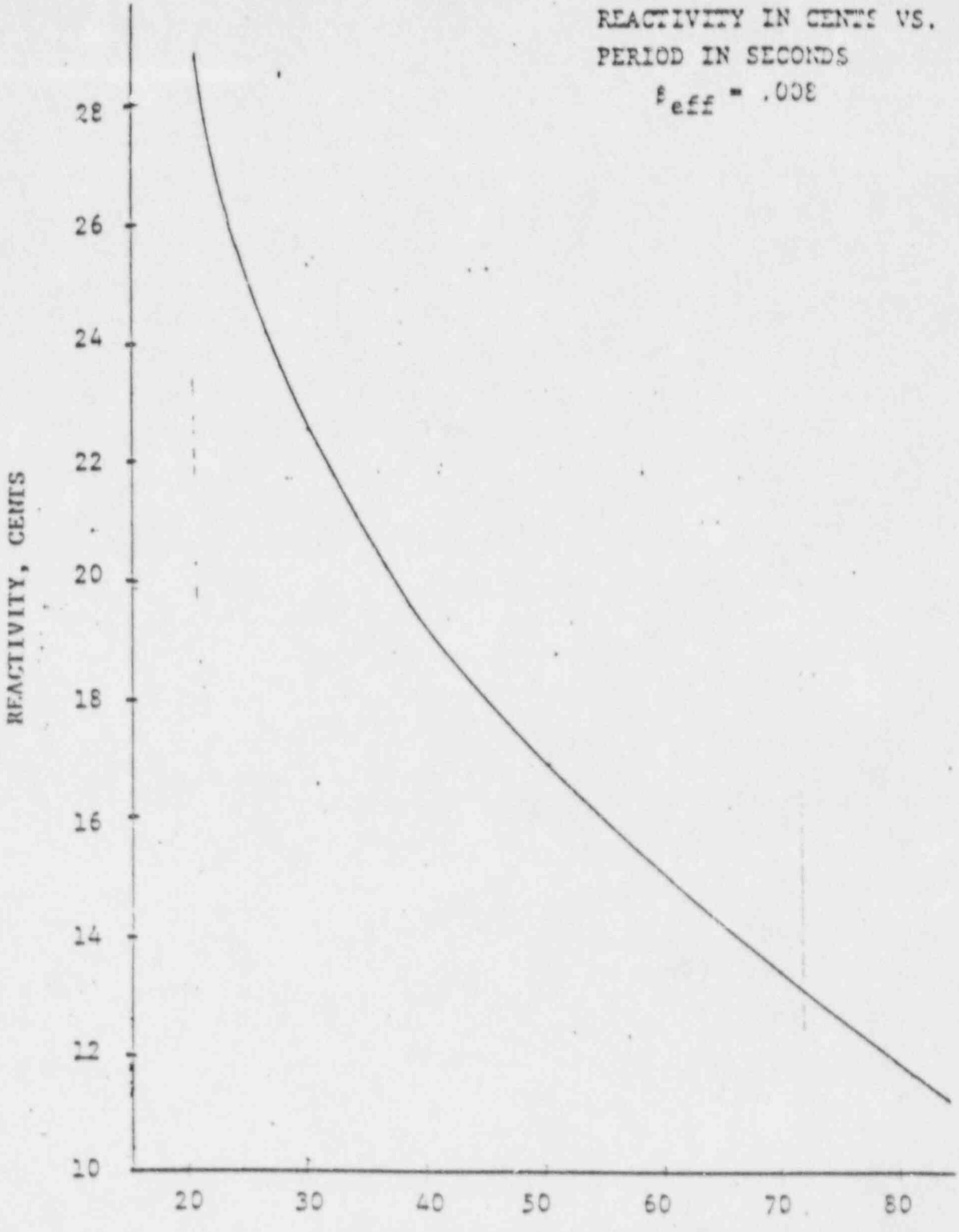

REACTIVITY IN CENTS VS.
PERIOD IN SECONDS
β_{eff} = .008
REACTIVITY, CENTS
28
26
24
22
20
18
16
14
12
10
20
30
40
50
60
70
80
REACTOR PERIOD, SECONDS

FIGURE H-1

QUESTION H.05 (2.00)

WHY is excess reactivity needed for routine operations? GIVE four (4) reasons. (2.0)

QUESTION H.06 (1.50)

In the process of calibrating the control rods, the technique of subcritical multiplication is typically used. To use the subcritical multiplication technique, the countrate from a detector due only to the source must be known.

From the following information, DETERMINE the value of the countrate due to the source alone. (1.5)

critical rod position = 19.0 in. withdrawn

differential rod worth at 19.0 in. = 30 c/in.

at 18.8 in. countrate = 2000 cps

QUESTION H.07 (2.00)

EXPLAIN the impact of increasing the temperature of the reactor core on the "resonance escape probability" factor, "p". That is, HOW and WHY does resonance escape probability p change with an increase in the temperature of the reactor core? (2.0)

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

QUESTION H.08 (1.00)

A moderator is necessary to slow neutrons down to thermal energies. WHICH of the following is the correct reason for a reactor operating with thermal instead of fast neutrons? (CHOOSE the correct statement below.) (1.0)

(a.) Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

(b.) Reactors operating primarily on fast neutrons are inherently unstable and cannot be safely controlled.

(c.) The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

(d.) Doppler and moderator temperature coefficients become positive as neutron energy increases.

QUESTION H.09 (1.50)

Specify TRUE or FALSE for each of the following.

a. Reactivity effects of placing samples of boron in the core are used to calibrate the core in order to determine the neutron absorption cross sections of other 1/v materials. (0.5)

b. The primary impact on k-eff of placing boron samples in the core is on the "resonance escape probability" factor "p". (0.5)

c. The reactivity effects of the boron samples are measured by noting the difference in critical position of a calibrated control rod located as far away as possible from the test location. (0.5)

QUESTION H.10 (1.50)

If B-eff for the RPI Critical Facility reactor was reduced from the actual 0.0077 to 0.0055, HOW and WHY would the reactor respond to a small addition of positive reactivity? (1.5)

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

QUESTION H.11 (2.00)

Assume the reactor is operating at 270 watts power and a boron strip worth 60 cents falls out of the core. The reactor power takes a prompt jump to 675 watts followed by a subsequent power rise on a 6.7 period.

a. WHY is there a prompt jump and a period-type of response? (1.0)

b. If a scram were not initiated for 8.6 sec, WHAT power level would the reactor obtain? (1.0)

QUESTION H.12 (2.50)

Assume that the reactor power level changes linearly in time from 675 to 3000 watts.

a. HOW MUCH energy in Btu would be produced during the 3.6 second excursion? (1.5)

b. Assume that your answer to part "a." was 20 Btu, that there was no heat transfer from the fuel during the excursion, that the specific heat of the fuel was 0.12 Btu/lbm deg F, and that the weight of the fuel was 10 lbm. WHAT would be the rise in fuel temperature? (1.0)

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

QUESTION I.01 (2.50)

The RPI Critical Facility uses an Area Radiation Monitoring System to ensure radiological safety. LIST the locations of the four (4) detectors (channels) and INDICATE which channel has the highest trip setpoint. (2.5)

QUESTION I.02 (2.00)

LIST the two (2) classes of radiological emergencies as defined in the emergency procedures. (2.0)

QUESTION I.03 (1.00)

Water from the RPI Critical Facility may be intentionally released to the river directly via two (2) routes. WHAT are the two (2) sources/locations from which the water releases can occur? (1.0)

QUESTION I.04 (2.00)

The radiation level due to a known small radioactive deposit in a pipe fitting is 1 r/hr (gamma) measured 15 feet away. An operator must operate a valve located 5 feet from the pipe fitting.

a. WHAT is the dose rate at the valve? (1.0)

b. If it takes the operator 2 minutes to operate the valve, WHAT radiation dose (mrem) will the operator receive? (1.0)

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

QUESTION I.05 (1.00)

ANSWER TRUE or FALSE for each of the following statements.

a. If the vault were loaded with the total inventories of HEU fuel plates and LEU fuel pins for the new core, k-inf would be less than 0.90 under flooded conditions. (0.5)

b. Criticality in the fuel storage vault is monitored by radiation detector on the reactor deck. (0.5)

QUESTION I.06 (1.00)

In accordance with the Emergency Procedures, WHAT two (2) radiological conditions will require that the reactor be shutdown? (1.0)

QUESTION I.07 (1.00)

Whenever the reactor is operated, the particulate activity monitor is used. ANSWER the following questions with respect to the particulate monitor.

a. Air, for the sample, is drawn from WHAT location? (0.5)

b. WHAT type of radioactivity is measured (neutron, alpha, beta, or gamma)? (0.5)

QUESTION I.08 (1.50)

Two (2) identical samples are irradiated in the same flux; one for 20 minutes, and the other for 10 minutes. WILL the 20-minute sample contain exactly twice the activity of the 10-minute sample? EXPLAIN. (1.5)

QUESTION I.09 (1.50)

A radiation source emits 0.90 MeV gamma rays and produces a reading of 10 rad/h on a detector 3 feet away. What thickness of lead shielding is required to be placed between the source and the detector to reduce the reading to 5 mrad/h? Assume that the tenth value layer (TVL) for lead is one (1) inch. (SHOW your work.) (1.5)

QUESTION I.10 (3.00)

Based on 10 CFR 20, WHAT are the maximum allowable exposure quarterly limits for the whole body, extremities, and skin for a radiation worker who has an NRC Form 4 on file? (3.0)

QUESTION I.11 (2.00)

PROVIDE the definitions of the following two (2) terms that pertain to radiological protection. (2.0)

1. rad

2. rem

QUESTION I.12 (1.50)

EXPLAIN the operation of a thermoluminescent dosimeter, or TLD, i.e., what is measured and how? (1.5)

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

QUESTION J.01 (1.00)

DESCRIBE HOW the presence of a neutron is detected in a BF-3 detector. (1.0)

QUESTION J.02 (1.00)

When the reactor console switch is turned on:
(CHOOSE the correct statement below.) (1.0)

(a.) all scrams are cleared in the safety system, and power is supplied to the control rod magnets.

(b.) the scram circuits are activated, and power is supplied to the control rod magnets.

(c.) the scram circuits are activated, and any water dump bypass is removed.

(d.) all scrams are cleared, and any water dump bypass is removed.

QUESTION J.03 (1.00)

The solenoid current to the dump valve is:
(CHOOSE the correct statement below.) (1.0)

(a.) 90 to 110 mA DC to hold the valve closed and drops to zero to open the valve due to a scram signal.

(b.) zero mA when the valve is closed and changes to 90 to 110 mA DC to open the valve due to a scram signal.

(c.) 3 A, 400 Hz to hold the valve closed and drops to zero to open the valve due to a scram signal.

(d.) zero A when the valve is closed and changes to 3 A, 400 Hz to open the valve due to a scram signal.

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

QUESTION J.04 (1.50)

According to the Operating Procedures, no more than four (4) control rods may be withdrawn simultaneously as a bank.

a. What operational limits are placed on withdrawing the four (4) rods as a bank? (1.0)

b. What is the steady rate of withdrawal for a control rod provided by the control rod drive mechanism? (0.5)

QUESTION J.05 (1.50)

There are three (3) scram functions that have the built-in capability of being placed in bypass. LIST these three (3) functions. (1.5)

QUESTION J.06 (2.00)

The following four (4) statements (a, b, c, and d) refer to the Solenoid Interrupt Circuit. Respond to each with TRUE or FALSE.

a. If one of the electrical leads in one of the instrument scrams' external contacts broke (open circuit), it would cause a scram. (0.5)

b. If one of the electrical leads in one of the manual scrams' external contacts broke (open circuit), it would cause a scram. (0.5)

c. The rectified DC current flows through two series instrument-scram relays, the opening of either of which would cause a scram. (0.5)

d. If one of the electrical leads in one of the control rod solenoid circuits broke (open circuit), it would cause all of the control rod to drop. (0.5)

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

QUESTION J.07 (1.50)

Shown in the upper half of Figure J-1 is an outline of one quadrant of core A. On the lower half of the figure is an empty graph drawn to the same radial scale as the core outline. On the lower-half graph, SKETCH the relative neutron flux variations for the fast neutron flux AND the thermal neutron flux. (1.5)

QUESTION J.08 (1.50)

WHAT are the three (3) steps required to determine the overall temperature coefficient of reactivity. (1.5)

QUESTION J.09 (1.00)

The Limiting Conditions for Operation include the specification that: (CHOOSE the correct statement below.) (1.0)

(a.) the excess reactivity of the reactor core above cold, clean critical shall not exceed $0.60.

(b.) the maximum control rod reactivity rate shall be less than $0.05/sec up to 10 times the source level and less than $0.12/sec at all higher flux levels.

(c.) the normal moderator/reflector water level shall be established such that the auxiliary reactor scram shall add negative reactivity within one minute of its activation.

(d.) the reactor shall be subcritical by at least $5.50 with the most reactive control rod fully withdrawn.

QUESTION J.10 (1.00)

The excess reactivity at 68 deg F is calculated for the LEU Core B to be about: (CHOOSE the correct statement below.) (1.0)

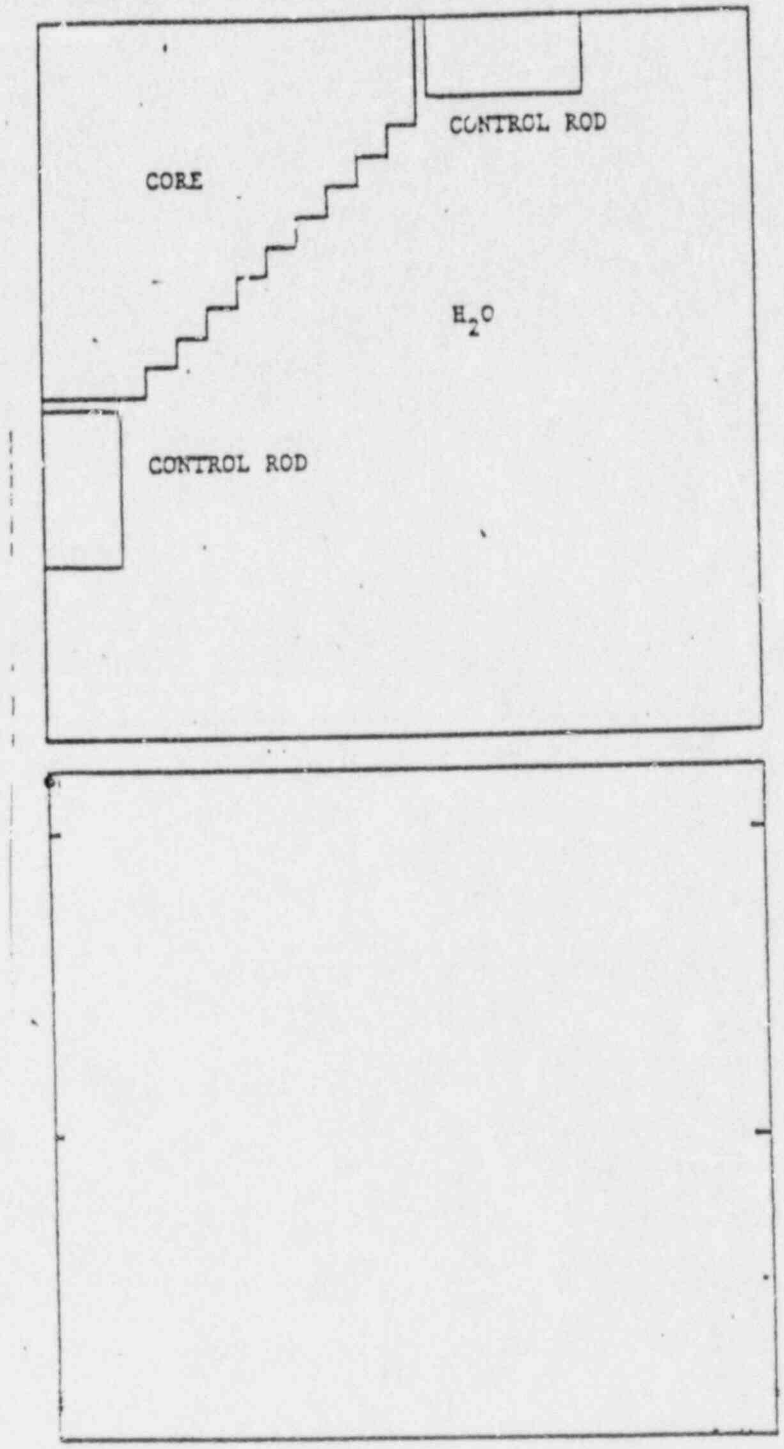
(a.) 0.00053

(b.) 0.0046

(c.) 0.018

(d.) 0.023

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



CORE A CONFIGURATION AND FLUX MAP

FIGURE J-1

QUESTION J.11 (1.00)

The shutdown margin is calculated for the LEU Core B1 to be: (CHOOSE the correct statement below.) (1.0)

(a.) 0.00053

(b.) 0.0046

(c.) 0.018

(d.) 0.023

QUESTION J.12 (1.50)

For the new LEU core

a. HOW many control rods are used? (0.5)

b. WHAT is the worth of each control rod? (0.5)

c. WHAT is the drive length of each control rod? (0.5)

QUESTION J.13 (2.50)

The following parts of this question pertain to the reactivity worth of the control rods.

a. SKETCH a control rod differential worth curve, and EXPLAIN the reason for the shape. (1.5)

b. If, near the end of its withdrawal range, a control rod had a rod worth reversal. (Rod worth reversal means that a control rod withdrawal would result in a decrease in reactivity.) WHAT could cause this rod reversal? (1.0)

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

QUESTION J.14 (1.00)

According to the Limiting Conditions for Operation with respect to reactor parameters, the minimum operating temperature shall be such as to ensure that above that temperature: (CHOOSE the correct statement below.) (1.0)

(a.) the core has a negative isothermal temperature coefficient.

(b.) the core has a negative void coefficient.

(c.) the core would require the addition of no more than $0.15 in reactivity to reach a negative isothermal temperature coefficient condition.

(d.) three (3) control rods inserted (assuming the minimum number of 4 rods with 1 stuck out) into the core would be sufficient to shutdown the reactor.

QUESTION J.15 (1.00)

If a previously-untested type of control rod were inserted into the core, several parameters shall be determined in order to comply with the Technical Specifications. One such parameter shall be the control rod and control rod bank reactivity worths. LIST two (2) other parameters that must be determined. (1.0)

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

QUESTION K.01 (1.00)

Subcritical multiplication, M, is defined as the ratio of neutron fluxes (or their corresponding countrates). SPECIFY the numerator and the denominator of this ratio. (1.0)

QUESTION K.02 (2.50)

Figure K-1 shows several 1/M plots for fuel loading.

a. WHICH of the three curves is considered to be the LEAST conservative when predicting criticality? (0.5)

b. EXPLAIN the conditions that would produce the shape of curve No. 3 instead of that of curve No. 2. (1.0)

c. Assume that curve No. 2 was obtained with all control rods inserted into the core. Using the same source size and location and the same detector sensitivity and location, DRAW on Figure K-1 the 1/M curve for the condition of all-rods-out. (1.0)

QUESTION K.03 (1.50)

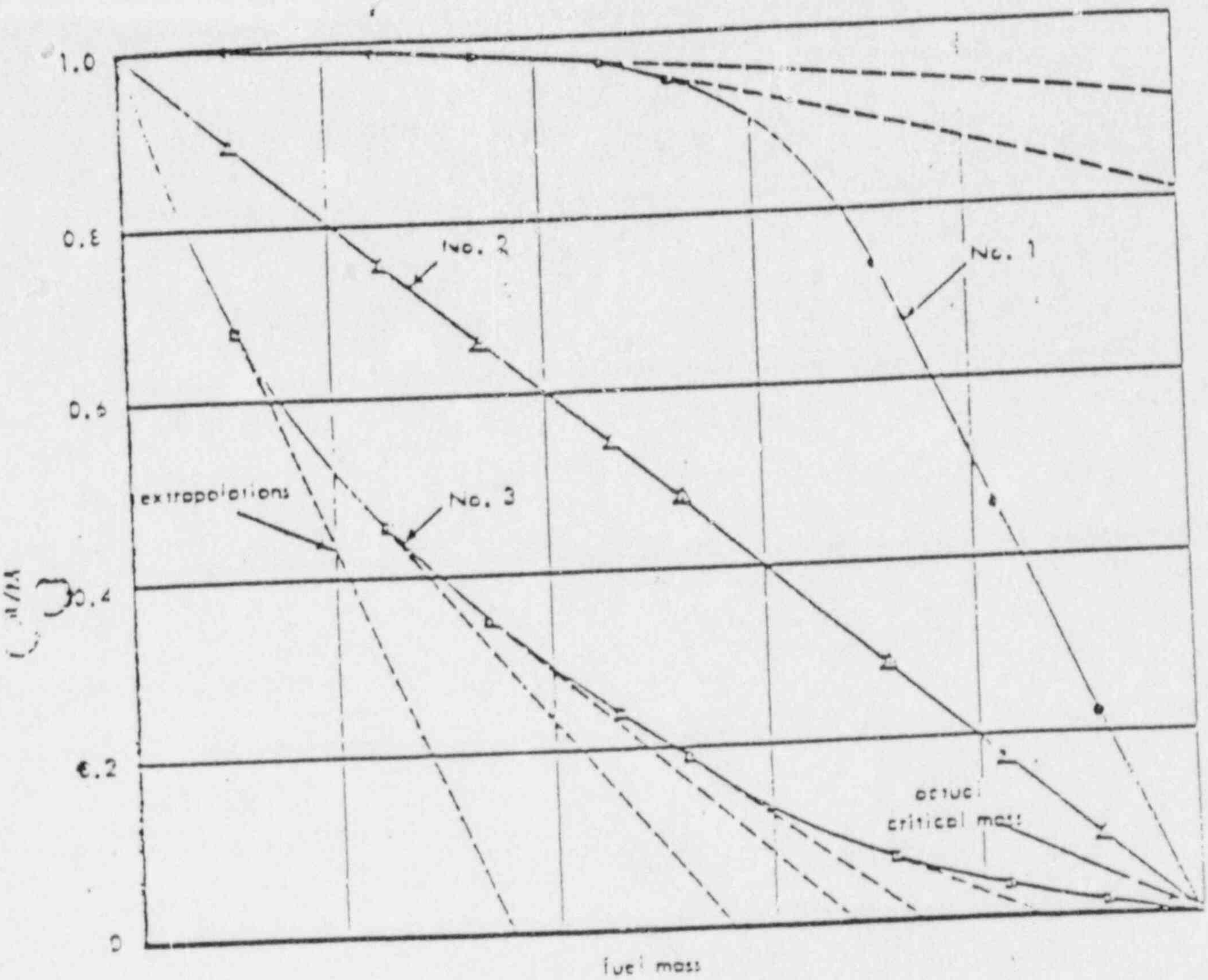
One of the guidelines of the fuel loading procedure states:

Fuel additions will be limited to one-half the difference between the loaded mass and the extrapolated critical mass or to four (4) stationary elements, whichever is lowest.

a. WHY is this fuel load criteria used? (1.0)

b. WHY is the other criterion set on the addition of 4 fuel elements? Why not 3 or 5? (0.5)

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



1.0
0.8
0.6
0.4
0.2
0
No. 2
No. 1
extrapolations
No. 3
actual critical mass
fuel mass

FIGURE K-1

QUESTION K.04 (1.00)

CHOOSE from the list below the one item that is NOT in accordance with fuel load procedures. (1.0)

(a.) After the minimum critical mass is attained, fuel additions will be limited to one (1) fuel element.

(b.) Each fuel element will be added in a lattice position such that the minimum surface to volume ratio is achieved.

(c.) The number of elements to be added at any given step should not exceed that of the previous step.

(d.) The control rod assemblies are loaded after the fuel elements have been loaded to obtain the minimum critical mass.

QUESTION K.05 (2.00)

For the following material and worth restrictions on placing experiments in the RPI Critical Facility fill-in-the-blanks.

a. For movable experiments with an absolute worth greater than $0.35, the maximum reactivity change for withdrawal and insertion shall be $____/sec. Moving parts worth less than $0.35 may be oscillated at higher frequencie in the core. (0.5)

b. The maximum positive step insertion of reactivity which can be caused by an experimental accident or experimental equipment failure of a movable or unsecured experiment shall not exceed $______. (0.5)

c. Experiments shall not contain a material which may produce a ____________ chemical reaction and/or ________________ radioactivity. (0.5)

d. Experiments containing known ____________ or highly flammable materials shall not be installed in the reactor. (0.5)

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

QUESTION K.06 (1.00)

The RPI facility was informed of the accident at the Argentine Critical Facility (RA-2) that occurred on September 23, 1983. The report of the accident stated that:
(CHOOSE the correct statement below.) (1.0)

(a.) one operator received a lethal, absorbed dose of about 100 rad of neutrons and 40 rad of gamma.

(b.) the moderator was not completely removed from the core before the core configuration was modified.

(c.) the excursion occurred when a control rod was removed.

(d.) the operating procedures were correctly followed but poorly written.

QUESTION K.07 (2.00)

A 5-curie neutron source is used at the RPI Critical Facility. ANSWER the following parts of this question concerning that source.

a. DESCRIBE the nuclear processes by which the source produces neutrons. (1.0)

b. Over what period of time would the activity of the neutron source be reduced to 2.5 curies? For your answer, CHOOSE from 1 month, 1 year, 10 years, or 100 years. (0.5)

c. HOW MANY neutrons/sec are emitted by this source? For your answer, choose from 10**2, 10**7, 10**11, or 10**15. (0.5)

QUESTION K.08 (1.00)

LIST the two (2) separate ways that fuel should be controlled by the fuel handler. (1.0)

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

QUESTION K.09 (1.00)

Respond to each with TRUE or FALSE.

a. The core structure consists of a thick top plate which is drilled through with 1/2-inch diameter holes on the prescribed pitch for the fuel pins. (0.5)

b. The core structure consists of a fuel pin support plate drilled with 1/4-inch diameter holes to accept the tips of the fuel pins. (0.5)

QUESTION K.10 (3.00)

SPECIFY the following core parameters for a Spert fuel pin or rod. (3.0)

1. rod overall length
2. cladding outside diameter
3. active fuel length
4. fuel pellet chemical form (name or formula)
5. fuel pellet enrichment
6. cladding material

QUESTION K.11 (2.00)

FILL-in-the-blanks.

Housed in each of the control rod "baskets" is the "absorber."

Number of absorber sections in each control rod ________ (0.5)

Absorber material ________ (0.5)

Absorber contained in ___________ (0.5)

Cladding material ________ (0.5)

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

QUESTION K.12 (2.00)

a. For a reactor that is over moderated the introduction of a void into the core will cause (POSITIVE or NEGATIVE) reactivity change. (0.5)

b. Voids introduced into the core of the RPI critical facility will cause a (POSITIVE or NEGATIVE) in reactivity. (0.5)

c. HOW are voids introduced into the core of the RPI critical facility during an experiment to determine the void coefficient? (1.0)

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

QUESTION L.01 (2.00)

Assume during operation of the Critical Facility, water is observed leaking from the moderator tank. WHAT are your four (4) immediate actions? (2.0)

QUESTION L.02 (1.00)

According to the Technical Specifications as approved by the NRC on July 1987, the thermal power and the integrated thermal power for any given 365 days are limited. WHAT are these two limits? (1.0)

QUESTION L.03 (1.50)

The Technical Specifications itemize three conditions that must be satisfied in order to consider that the reactor is "secured." LIST these three (3) conditions. (1.5)

QUESTION L.04 (1.00)

According to the Technical Specifications, the reactor meets the definition of "shutdown" if:
(CHOOSE the correct statement below.) (1.0)

(a.) the Licensed Senior Operator (LSO) on duty is within 15 miles of the facility, and all control rods are inserted into the reactor.

(b.) the Licensed Senior Operator (LSO) on duty is within 30 minutes travel time of the facility, and the excess reactivity is less than $1.00.

(c.) the control rods are inserted, and the moderator dump valve is open.

(d.) the reactor is subcritical by at least $1.00, and the control rods are inserted.

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

QUESTION L.05 (1.00)

A certain calibration has been conducted on November 15th and December 1st. This calibration has a Surveillance Frequency requirement that is "weekly;" the Surveillance Interval is 10 days. By WHAT date must the next calibration be conducted? (1.0)

QUESTION L.06 (1.50)

SPECIFY the limiting safety system settings required by the Technical Specifications for: (1.5)

a. maximum power level

b. minimum flux level

c. minimum period

QUESTION L.07 (2.00)

According to the Limiting Conditions for Operation, four "channels" of scram shall be operating during reactor operation (neglecting any bypasses authorized for maintenance checks and radiation surveys). SPECIFY these four (4) channels of scram. (2.0)

QUESTION L.08 (2.00)

According to the Limiting Conditions for Operation, certain interlocks shall be operable during reactor operations. Five (5) of these interlocks prevent control rod withdrawal but do not cause a reactor scram. LIST four (4) of these interlocks. (2.0)

QUESTION L.09 (1.00)

WHAT types of fires can a CO2 fire extinguisher in the reactor room be used to extinguish? (1.0)

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

QUESTION L.10 (1.50)

In the Code of Federal Regulations, 10 CFR 50, the terms "safety limit" and "limiting safety system setting" are defined. Based on those definitions, specify if each of the statements below is TRUE or FALSE. (1.5)

a. If a safety limit had been exceeded, the licensee shall notify the Commission. Operation shall not be resumed until authorized by the Commission.

b. If a limiting safety system setting has been exceeded, the licensee shall notify the Commission.

c. For each limiting safety system setting for a process variable, there is a corresponding safety limit for that variable.

QUESTION L.11 (.50)

ANSWER TRUE or FALSE.

According to the RPI emergency procedures, in case of a bonafide accident involving risk of life or limb or destruction of valuable property an adult can be given a one time exposure of up to 25 rems. (0.5)

QUESTION L.12 (1.00)

According to the Technical Specifications, there is a minimal staffing requirement when the reactor is not shutdown. Specify this staffing requirement. (1.0)

QUESTION L.13 (1.50)

According to the emergency procedures "any radiological emergency shall include immediate notification of ________." LIST these three (3) persons that must be notified (by position). (1.5)

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

QUESTION L.14 (1.00)

According to the Operating Procedures, chhhhanges to the core configuration that involve the movement (insertion or removal) of control rods will be under the direct control of: (CHOOSE the correct statement below.) (1.0)

(a.) the licensed operator in the control room.

(b.) the senior operator on duty.

(c.) the reactor facility supervisor.

(d.) the Director, Office of Radiation and Nuclear Safety.

QUESTION L.15 (1.00)

The following step/action is part of the Pre-startup Procedures and Checklist. WHY is this step performed? (1.0)

Adjust the fine voltage setting on the startup channels +/- 50 volts.

QUESTION L.16 (.50)

According to the Operating Procedures, WHAT is the acceptable range of positive period for increasing reactor power level? (0.5)

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

EQUATION SHEET

Where $\dot{m}_1 = \dot{m}_2$

$(density)_1(velocity)_1(area)_1 = (density)_2(velocity)_2(area)_2$

$KE = \frac{mv^2}{2}$ $PE = mgh$ $PE_1 + KE_1 + P_1V_1 = PE_2 + KE_2 + P_2V_2$ where V = specific volume, P = Pressure

---

$Q = \dot{m}c_p(T_{out} - T_{in})$ $Q = UA\ (T_{ave} - T_{stm})$ $Q = \dot{m}(h_1 - h_2)$

$P = P_o 10^{(SUR)(t)}$ $P = P_o e^{t/T}$ $SUR = \frac{26.06}{T}$ $T = \frac{(B-p)t}{p}$

---

delta $K = (K_{eff} - 1)$ $CR_1(1-K_{eff1}) = CR_2(1-K_{eff2})$ $CR = S/(1-K_{eff})$

$M = \frac{(1-K_{eff1})}{(1-K_{eff2})}$ $SDM = \frac{(1-K_{eff}) \times 100\%}{K_{eff}}$

---

decay constant $= \frac{\ln(2)}{t_{1/2}} = \frac{0.693}{t_{1/2}}$ $A_1 = A_o e^{-(\text{decay constant}) \times (t)}$

Water Parameters

1 gallon = 8.345 lbs
1 gallon = 3.78 liters

1 ft^3 = 7.48 gallons

Density = 62.4 lbm/ft^3
Density = 1 gm/cm^3

Heat of Vaporization = 970 Btu/lbm
Heat of Fusion = 144 Btu/lbm
1 Atm = 14.7 psia = 29.9 in Hg

Miscellaneous Conversions

1 Curie = ?.7 x 10^{10} dps
1 kg = 2.21 lbs

1 hp = 2.54 x 10^3 Btu/hr

1 MW = 3.41 x 10^6 Btu/hr
1 Btu = 778 ft-lbf

Degrees F = (1.8 x Degrees C) + 32
1 inch = 2.54 centimeters
g = 32.174 ft-lbm/lbf-sec^2

ANSWER H.01 (1.00)

(d.) [+1.0]

REFERENCE

1. Generic: "Academic Program for Nuclear Power Plant Personnel," Volume II, Physics, General Physics Corporation, pp. 3-62 to 3-66.

ANSWER H.02 (1.00)

$T = t/\{\ln(p\text{-}2/p\text{-}1)\}$

$= 60/\{\ln(5)\}$

$= 60/1.61$

$= 37.3$ sec (0.621 min) [+1.0]

REFERENCE

RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May 1975, p. 37.

ANSWER H.03 (2.50)

a. l-* = prompt neutron generation time

beta-i = average fraction of neutrons per fission due to the i-th group of delayed neutrons

lambda-i = decay constant for the i-th group of delayed neutrons

[+0.5 each]

b. There are six predominant groups of delayed neutrons, i.e., the fission process can be adequately described by assuming six radioactive decay chains that generate all of the delayed neutrons. [+1.0]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 37,38.

2. Generic: "Nuclear Reactor Engineering," Samuel Glasstone and Alexander Sesonske, 1963, pp. 93, 233-251.

ANSWER H.04 (1.50)

using Figure H-1, 30 sec = 22.5 c [+0.5 for 22 to 23 c]

rho = $ (beta-eff)

(0.225)(0.008)

0.00180 (0.002 or 0.0018) [+0.5, using the value of c from above]

k-eff = 1/(1 - rho)

1/(1 - 0.00180)

1.00180 (1.002 or 1.0018) [+0.5, using value for rho from above]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, p. 40.

ANSWER H.05 (2.00)

1. to overcome negative power coefficients

2. to overcome neutron losses (poisons/leakage)

3. to give operating flexibility rate; (i.e., permit power increases at a reasonable rate)

4. to compensate for fuel burn-up

5. to accommodate negative reactivity of experiments

Any four (4) [+0.5] each, +2.0 maximum.

REFERENCE

1. RPI: Manual of Experiments for Rensselaer Reactor Facility, p. 35.

ANSWER H.06 (1.50)

delta-k = (0.2 in.)(30 c/in.)

= 0.06 $

= (0.06)(0.008) = 0.00048 [+0.75]

(0.008 beta was used in calculation. A reasonable beta 0.0075 to 0.008 is acceptable.)

C-s = C-t (delta-k)

= (2000 cps)(0.00048)

= 0.96 cps [+0.75]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 44-46.

ANSWER H.07 (2.00)

As the temperature of the core (including the fuel pins) increases, the value of p decreases [+0.5]. This occurs because of the Doppler effect in U-238 [+0.5]. The Doppler effect is the term applied to the effective broadening and lowering of the microscopic cross section for neutron absorption [+0.5] because of the higher average neutron energy [+0.5].

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 59, 60.

ANSWER H.08 (1.00)

(c.) [+1.0]

REFERENCE

1. RPI: Principles of Nuclear Reactor Engineering, Glasstone, Section 1.68.

ANSWER H.09 (1.50)

a. TRUE [+0.5]

b. FALSE (An absorber primarily affects the thermal utilization factor.) [+0.5]

c. TRUE [+0.5]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 6-1 to 6-6.

ANSWER H.10 (1.50)

The reactor would respond faster [+0.5], because of the shorter average neutron lifetimes [+1.0].

REFERENCE

1. RPI: Manual of Experiments for Rensselaer Reactor Facility, pp. 38 and 39.

ANSWER H.11 (2.00)

a. The prompt jump is the change in the power level due to the prompt neutrons only [+0.5]. The period type response is determined largely by the properties of the delayed neutrons [+0.5].

b. p-2 = (p-1)exp(t/T) [+0.5]
= (675)exp(8.6/6.7)
= 2436 W [+0.5]

REFERENCE

1. RPI: Attachment 2 to letter, Harris and Wicks (RPI) to Thomas (NRC), September 21, 1983, no page numbers in Attachment 2.

ANSWER H.12 (2.50)

a. E = (3000 + 675/2)(8.6)
= 15,800 watt sec [+1.0]
= 15 Btu [+0.5]

b. 20 Btu = (0.12 Btu/lbm deg F)(delta deg F)(10 lbm) [+0.5]

delta deg F = (20)/(10)(0.12)
= 16.7 deg F [+0.5]

REFERENCE

1. RPI: Attachment 2 to letter, Harris and Wicks (RPI) to Thomas (NRC), September 21, 1983, no page numbers in Attachment 2.

ANSWER I.01 (2.50)

1. control room
2. reactor window
3. reactor room
4. reactor deck

[+0.5 each]

No. 5. (reactor deck) has the highest setpoint [+0.5]

REFERENCE

1. RPI: "Startup Procedures for Critical Facility," Donald R. Harris, March 1985, p. 3.

ANSWER I.02 (2.00)

An emergency that involves either

1. excessive exposure of personnel to ionizing radiation OR
2. release of radioactive materials

[+1.0 each]

REFERENCE

1. RPI: Emergency Procedures for the RPI Critical Facility, p. 9. (7.0).

ANSWER I.03 (1.00)

1. from the storage tank

2. from the storage pit

[+1.0 each]

REFERENCE

1. RPI: "Operating Procedures for the RPI Critical Facility," Donald R. Harris, March 1985, pp. 5 and 6.

ANSWER I.04 (2.00)

a. dose rate (dr) = 1000 mrem/hr x 152/52 [+1.0]
(at 5 feet)
= 9000 mrem/hr

b. dose = dr x time
= 9000 mrem/hr x 2/60 hr/min [+1.0]
= 300 mrem

REFERENCE

1. RPI: "Personal Safety and Radiation Monitoring for the RPI Critical Facility," F. Rodriguez-Vera, April 1985, p. 2.

ANSWER I.05 (1.00)

a. TRUE

b. FALSE

[+0.5 each]

REFERENCE

1. RPI: Technical Specifications, 5.6.

ANSWER I.06 (1.00)

1. contaminated moderator [+0.5]

2. clad rupture [+0.5]
release of radionuclides to building [+0.5]

+1.0 maximum

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute, Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, June 1986, p. 11.

ANSWER I.07 (1.00)

a. ~~from stack duct~~ [+0.5] ~~(actual~~ wire cage around reactor top side - deck~~)~~

b. beta [+0.5]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute, Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, June 1986, pp. 3, 40.

ANSWER I.08 (1.50)

No [+0.5]. Radioactive decay and activation are related to the half-life or decay constant of the material. The exponential nature of that buildup means that the activation during the second half-life will be less than during the first [+1.0].

REFERENCE

1. Generic: Introduction to Nuclear Reactor Operations, Burn, p. 2-54.

ANSWER I.09 (1.50)

(10 rad/h)(1/10)(1/10)(1/10) = 10 mrad/h [+0.5]
half value layer = (0.3)(TVL) = 0.3 in. [+0.5]
Therefore, 3.3 in. of lead is required [+0.5]

REFERENCE

1. Generic: "Reactor Operator Study Handbook, ORNL-TM-2034, 1968, Volume 2, p. 108.

ANSWER I.10 (3.00)

1. whole body: 3 rem/quarter [+0.75]
   not to exceed 5(N-18) [+0.75]

2. extremities: 18.75 rem/quarter [+0.75]

3. skin: 7.5 rem/quarter [+0.75]

REFERENCE

1. Generic: "Code of Federal Regulations, Title 10," 10 CFR 20, Section 20.101, p. 239, January 1985.

ANSWER I.11 (2.00)

1. The unit of rad is defined as an absorbed radiation dose of 100 ergs per gram of tissue. [+1.0]

2. The unit of rem is a biological dose unit defined by the relation: (dose in rems) = (dose in rads) x (RBE). [+1.0] (RBE is the relative biological effectiveness and compares a dose's effectiveness to that of 200 keV X-rays).

REFERENCE

1. RPI: "Personal Safety and Radiation Monitoring for the RPI Critical Facility," F. Rodriguez-Vera, April 1985, pp. 3, 5.

ANSWER I.12 (1.50)

TLDs measure the integrated (over time) exposure to beta, gamma, and neutron radiations. When certain substances such as LiF or CaF-3 containing Mn as an impurity are exposed to such radiation, the absorption of the energy will excite the atoms of the crystal. By heating the crystal, the captured energy will be released in the form of pulses of light. [+1.5]

REFERENCE

1. RPI: "Personal Safety and Radiation Monitoring for the RPI Critical Facility," F. Rodriguez-Vera, April 1985, pp. 3, 5.

ANSWER J.01 (1.00)

The neutron undergoes an (n, alpha) reaction with a B-10 nucleus [+0.5]. The alpha particle travel causes ionization of the BF-3 gas [+0.25]. The ionized charges move under the pull of the electric field resulting in an electrical pulse in the detector circuitry [+0.25].

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, p. 18.

ANSWER J.02 (1.00)

(b.) [+1.0]

REFERENCE

1. RPI: "Startup Procedures for Critical Facility," Donald R. Harris, March 1985, p. 4.

ANSWER J.03 (1.00)

(a.) [+1.0]

REFERENCE

1. RPI: "Startup Procedures for Critical Facility," Donald R. Harris, March 1985, p. 4, 5.

ANSWER J.04 (1.50)

(a.) This is permitted only when the source channel has increased by less than one decade from the shutdown condition [+1.0].

(b.) 3 in./min [+0.5]

REFERENCE

1. RPI: "Operating Procedures for the RPI Critical Facility," Donald R. Harris, March 1985, p. 1.

ANSWER J.05 (1.50)

1. door scram
2. period scram
3. water dump valve scram

[+0.5 each]

REFERENCE

1. RPI: "Operating Procedures for the RPI Critical Facility," Donald R. Harris, March, 1985, p. 4.

ANSWER J.06 (2.00)

a. FALSE (The contacts are in parallel and normally OPEN)

b. TRUE (The contacts are in series and normally CLOSED)

c. TRUE

d. FALSE (only one will drop)

[+0.5 each]

REFERENCE

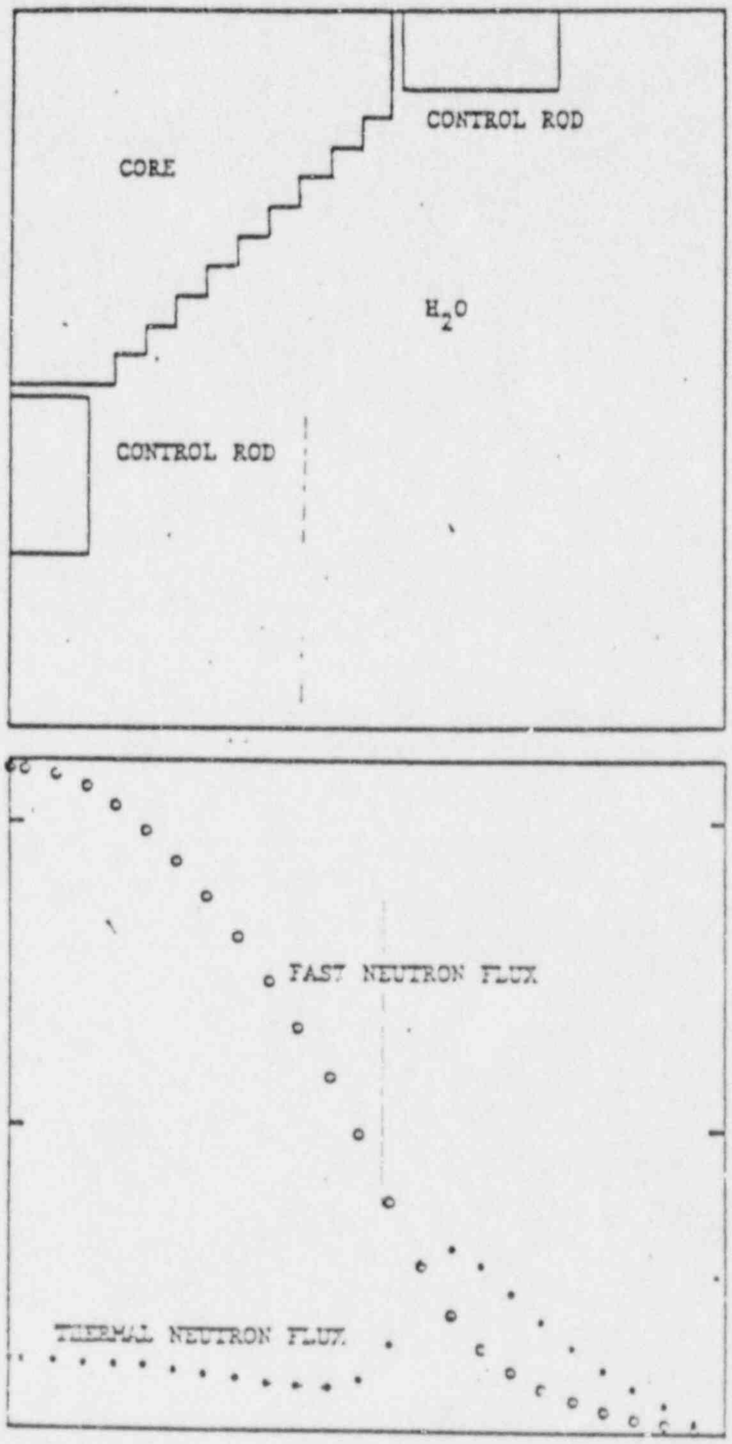
1. RPI: "Solenoid Interrupt Circuit for the RPI Critical Facility," Appendix to Question 6, pp. 2, 3, 4.

ANSWER J.07 (1.50)

See Figure J-1-ANSWER.
[+0.75 for each curve]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, June 1986, Figure 4.3.



CORE A CONFIGURATION AND FLUX MAP

FIGURE J-1-ANSWER

ANSWER J.08 (1.50)

1. bring reactor critical at uniform temperature
2. heat the reactor water with the immersion heaters
3. measure reactivity change by movement of calibrated control rod

[+0.5 each]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute Critical Facility, Safety Analysis Report," June 1986, 7.10, p. 22.

ANSWER J.09 (1.00)

(c.) [+1.0]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 3-1.
2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 3-1.

ANSWER J.10 (1.00)

(b.) [+1.0]

REFERENCE

RPI: "Rensselaer Polytechnic Institute, Responses to Questions Sent by January 6, 1987 Letter from Mr. John J. Dosa to Dr. Donald R. Harris Concerning HEU/LEU Core Conversion Proposal," March 3, 1987, Figure 5.2.

ANSWER J.11 (1.00)

(d.) [+1.0]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute, Responses to Questions Sent by January 6, 1987 Letter from Mr. John J. Dosa to Dr. Donald R. Harris Concerning HEU/LEU Core Conversion Proposal," March 3, 1987, Figure 5.2.

ANSWER J.12 (1.50)

a. 4
b. 0.007 (no dimension ($ x beta)
c. 36 inches

[+0.5 each]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute, Responses to Questions Sent by January 6, 1987 Letter from Mr. John J. Dosa to Dr. Donald R. Harris Concerning HEU/LEU Core Conversion Proposal," March 3, 1987, p. 7.

ANSWER J.13 (2.50)

a. See Figure J-2-ANSWER. [+0.5]

   The reason for the bell-shaped curve is that the impact on reactivity of a small change in control rod position is dependent on the magnitude of the neutron flux level in the vicinity of the change in poison concentration [+0.5]. The neutron flux is at a axial maximum near the axial center plane [+0.5].

b. The rod reversal is caused by a length of fuel that is placed below the control rod [+0.5]. As the rod is withdrawn additional fuel is inserted in the core [+0.5].

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 41-44.

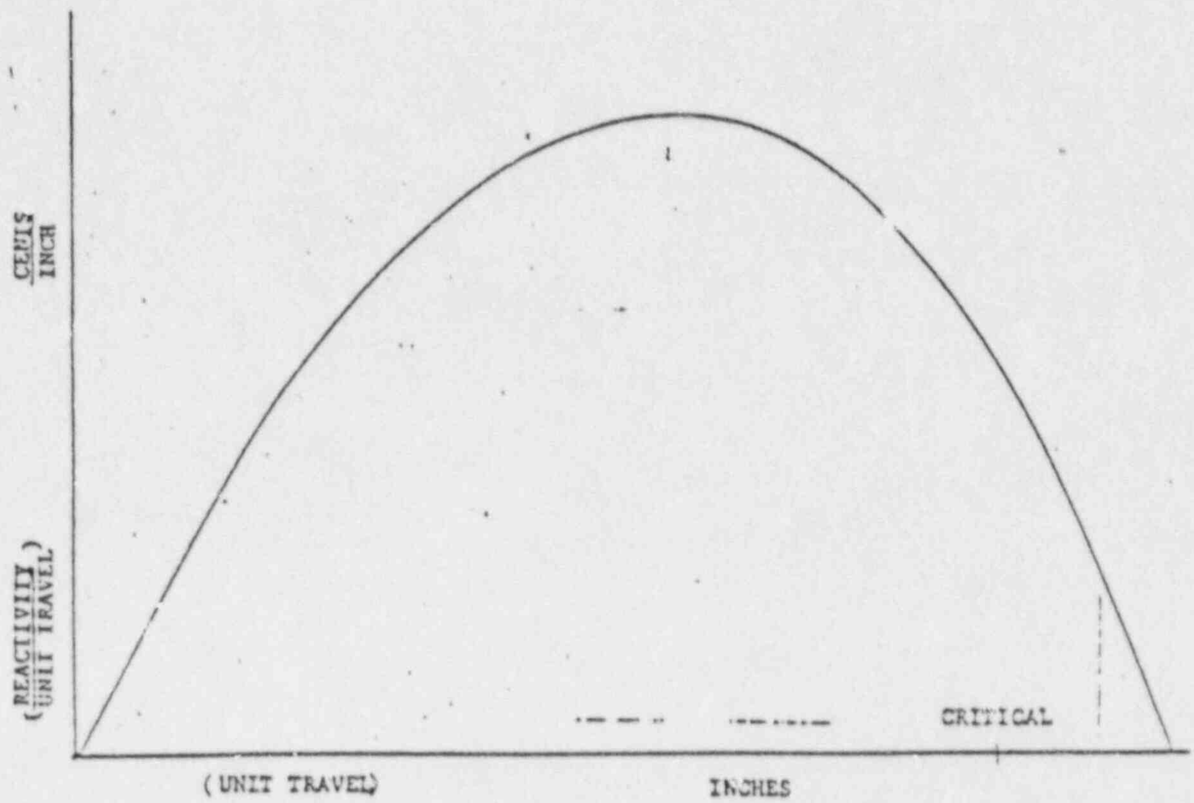


Figure Differential Control Rod Worth Curve

FIGURE J-2-ANSWER

ANSWER J.14 (1.00)

(c.) [+1.0]

REFERENCE

1. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 3-5.

ANSWER J.15 (1.00)

1. temperature coefficient of reactivity

2. void coefficient of reactivity

3. reactor power measurement

4. shutdown margin

[+0.5 each, +1.0 maximum]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 4-2.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 4-2.

ANSWER K.01 (1.00)

M = countrate due to the source and core fissions/
countrate due to the source only

[+1.0]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, p. 25.

ANSWER K.02 (2.50)

a. curve No. 1 [+0.5]

b. For curve No. 3, the detector/source geometry (too great a distance) is such that the detector does not "see" the source to the same degree as that corresponding to curve No. 2; hence, 1/M is lower in curve No. 3. [+1.0]

c. See Figure K-2-ANSWER. [+1.0]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, pp. 24-28

ANSWER K.03 (1.50)

a. this provides a reasonable rate for loading fuel without going critical before it is desired [+1.0]

b. to maintain symmetry [+0.5]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, p. 30, 31.

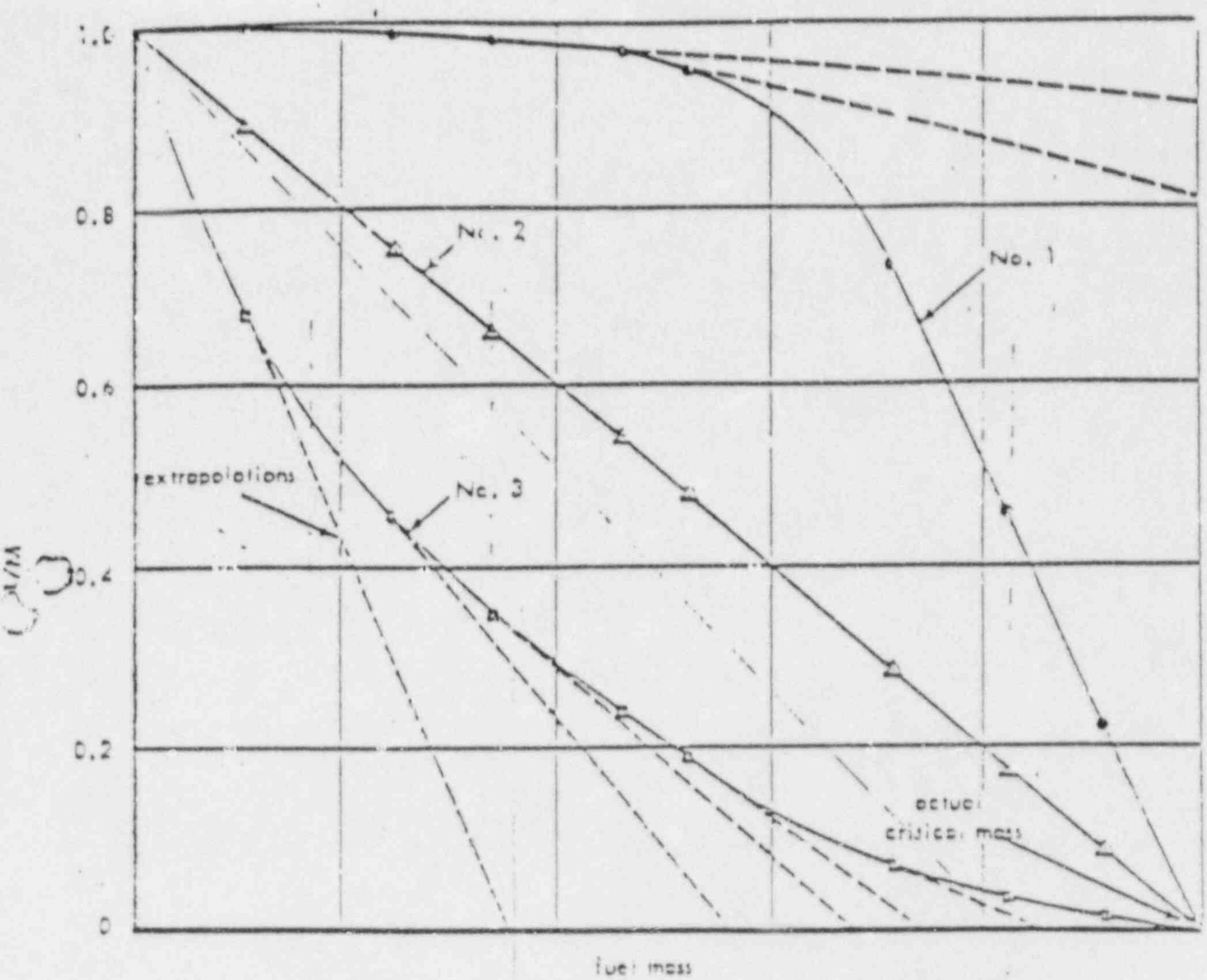


FIGURE K-2-ANSWER

ANSWER K.04 (1.00)

(d.) [+1.0]

REFERENCE

1. RPI: "A Manual of Experiments for the Rensselaer Reactor Facility," Richard M. Kacich, May, 1975, p. 30, 31.

ANSWER K.05 (2.00)

a. $0.20/sec [+0.5]
b. $0.60 [+0.5]
c. violent [+0.25], significant airborne [+0.25]
d. explosives [+0.5]

REFERENCE

1. RPI: Technical Specifications 3.4, p. 3-7.

ANSWER K.06 (1.00)

(b.) [+1.0]

REFERENCE

1. RPI: "IE Information Notice No. 83-66, Supplement 1: Fatality at Argentine Critical Facility, May 25, 1984, pp. 1-3.

ANSWER K.07 (2.00)

a. Pu-238 = U-234 + alpha
Pu-239 = U-235 + alpha
alpha + Be-9 = C-12 + n

[+0.5 each, +1.0 maximum]

b. 100 years [+0.5]

c. 10**7 neutrons/sec [+0.5]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute, Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, January 1983, p. 25.

2. Generic: "Academic Program for Nuclear Power Plant Personnel," Volume II, Physics, General Physics Corporation, pp. 5-2 and 5-3.

ANSWER K.08 (1.00)

1. fuel load hook
2. hand

[+0.5 each]

REFERENCE

1. RPI: Operating Procedures, p. 4.

ANSWER K.09 (1.00)

a. FALSE (An upper fuel pin lattice plate contains the holes and rests on the thick top plate.) [+0.5]

b. TRUE [+0.5]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute Critical Facility, Safety Analysis Report, Docket No. 50-225, License No. CX-22, June 1986, pp. 5, 6.

ANSWER K.10 (3.00)

1. 41.75 in. [+0.5 for 40 to 42 in.]

2. 0.466 in. [+0.5 for 0.43 to 0.50 in.]

3. 36.00 in. [+0.5 for 35 to 37 in.]

4. UO-2 [+0.5 for UO-2 or uranium oxide]

5. 4.81 w/o [+0.5 for 4.7 to 4.9 w/o]

6. stainless steel [+0.5]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, June 1986, pp. 6, 7, and Figure 4.7.

ANSWER K.11 (2.00)

1. 2 [+0.5]

2. Boron enriched in B-10 [+0.5]

3. stainless steel cermet [+0.5]

4. stainless steel [+0.5]

REFERENCE

1. RPI: "Rensselaer Polytechnic Institute Critical Facility, Safety Analysis Report," Docket No. 50-225, License No. CX-22, June 1986, p. 7.

ANSWER K.12 (2.00)

a. positive [+0.5]

b. negative [+0.5]

c. using a stainless steel chamber [+0.5] filled with polystyrene [+0.5]

REFERENCE

1. RPI: Manual of experiments, Chapter VII, p. 7-3.

2. RPI: SAR, Proposed Modification, October 1986, p. 15, Table 5.2.

ANSWER L.01 (2.00)

1. shutdown and secure the reactor
2. isolate the leak
3. de-energize equipment as needed for personnel safety and prevention of equipment damage
4. notify Operations Supervisor

[+0.5 each]

REFERENCE

1. RPI: Emergency Procedures for RPI Critical Facility, p. 8.

ANSWER L.02 (1.00)

100 W thermal and 200 kWh integrated power [+0.5 each]

REFERENCE

1. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 3-1.

ANSWER L.03 (1.50)

1. The full insertion of all control rods has been verifi
2. The console key has been removed.
3. There is no operation in progress that involves the moving of fuel pins in the reactor vessel, the insertion or removal of experiments from the reactor vessel, or control rod maintenance.

[+0.5 each]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 1-2.
2. RPI: "Replacement Pages for Technical Specifications Approved

by NRC (July 1987)," p. 1-2.

ANSWER L.04 (1.00)

(d.) [+1.0]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 1-2.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 1-2.

ANSWER L.05 (1.00)

December 5th (20 days after November 15th) [+1.0]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 1-3 and 1-4.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 1-3.

ANSWER L.06 (1.50)

a. 135 watts [+0.5]

b. 2.0 cps [+0.5]

c. 5 seconds [+0.5]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 2-2.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 2-2.

ANSWER L.07 (2.00)

1. regular manual scram (red button)

2. reactor console key

3. loss of building power

4. reactor door scram

[+0.5 each]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 3-2.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 3-2.

ANSWER L.08 (2.00)

1. reactor period < 15 sec

2. neutron flux < 2 cps

3. failure of 400 Hz power supply to synchro

4. failure of line voltage to the recorders

5. moderator-reflector water fill ON

[+0.5 each, +2.0 maximum]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 3-3.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 3-3.

ANSWER L.09 (1.00)

Type B electrical [+0.5] and Type C flammable liquids [+0.5]

REFERENCE

1. RPI: Fire extinguisher.

ANSWER L.10 (1.50)

a. TRUE

b. FALSE (It is necessary for the automatic protective action to fail in order to be required to report to the Commission. See the note in Reference 2.)

c. FALSE (There is no one-for-one correspondence between a safety limit and a limiting safety system setting.)

[+0.5 each]

REFERENCE

1. Generic: "Code of Federal Regulations, Title 10," 10 CFR 50.36, pp. 418, 419.

2. RPI: "Replacement Pages for Technical Specifications Approved by NRC (July 1987)," p. 1-2, 2-2, 6-5, 6-6. There appears to be an error in the Tech Specs at this point. The Tech Specs seem to imply that by simply exceeding the limiting safety system setting the 24 h report to the Commission is required. This is not required by 10 CFR 50.36; 10 CFR 50.36 is

ANSWER L.11 (.50)

False (up to 12.5 rems) [+0.5]

REFERENCE

1. RPI: Emergency Procedures for RPI Critical Facility, p. 14.

ANSWER L.12 (1.00)

1. An RO or an SRO shall be at the controls.

2. An SRO shall be present or readily available (on call).

[+0.5 each]

REFERENCE

1. RPI: "Technical Specifications and Bases for the Rensselaer Polytechnic Institute Critical Experiments Facility," p. 6-5.

ANSWER L.13 (1.50)

1. Radiation Safety Officer [+0.5]
2. Director of the Critical Facility [+0.5]
3. Critical Facility Supervisor [+0.5]

REFERENCE

1. RPI: Emergency Procedures, Section 7.2.

ANSWER L.14 (1.00)

(c.) [+1.0]

REFERENCE

1. RPI: "Operating Procedures for the RPI Critical Facility," Donald R. Harris, March 1985, p. 5.

ANSWER L.15 (1.00)

to check the high voltage plateau [+0.5] and to compare the countrate to previous readings [+0.5]

REFERENCE

1. RPI: "Startup Procedures for Critical Facility," Donald R. Harris, March, 1985, pp. 1 to 4.

ANSWER L.16 (.50)

30 to 50 sec. [+0.5 for 20 to 50 sec.]

REFERENCE

1. RPI: "Operating Procedures for the RPI Critical Facility," Donald R. Harris, March 1985, p. 1.

Attachment 2

FACILITY COMMENTS AND NRC RESOLUTION

Question H.05

Comment:

Answer 4, Burnup, is not a factor in the RPI reactor since operation is limited to 200 kW per year.

Resolution:

Comment not accepted. Facility reference material cites burnup as a factor.

Question H.06

Comment:

Beta of 0.008 was used in answer calculation, Beta for RPI is 0.0078.

Resolution:

Comment accepted. Reasonable values of Beta will be accepted, and arithmetic will be checked. Answer key modified accordingly.

Question H.12

An error in the answer key calculation was found during the grading of the examinations, answer key corrected.

Question I.01

Comment:

RPI presently uses only four area monitors (as required by Tech Specs).

Resolution:

Comment accepted. Deleted Answer #3 ("pit"). Question and answer modified accordingly.

Question I.03

Comment:

RPI uses a swimming pool filter to clean up water in the storage pit and can return the water to the storage tank instead of the river.

Resolution:

Comment not accepted. The question asked for the two sources/locations that water may be released from the facility directly to the river. Your comment states that the water in one of the locations may, by choice, be routed elsewhere; that did not answer the question.

Question I.06

During grading, an additional correct answer was noted and added to the answer key.

Question I.07

Comment:

The air sample is presently being drawn from the wire cage around the reactor deck.

Resolution:

Comment accepted, the was observed by the examiner. Answer key changed.

Question J.12

Comment:

Part b has no dimensions (Dollar x Beta)

Resolution:

Comment noted. Answer key modified accordingly.

Question K.03

Comment:

Question related to th? old core but was part of the material supplied for the examination and is therefore acceptable.

Resolution:

Commert noted.

Question L.06

Comment:

Minimum flux level has been increased from 2 cps to 5 cps, but it is not in the manuals.

Resolution:

Comment not accepted. The question asked for the minimum flux level in accordance with the Technical Specifications.