January 28, 2014

Dr. Peter Caracappa, Director
Rensselaer Polytechnic Institute
Jonsson Engineering Center
110 8th Street
Troy, NY 12180-3590

SUBJECT: EXAMINATION REPORT NO. 50-225/OL-14-01, RENSSELAER POLYTECHNIC INSTITUTE

Dear Dr. Caracappa:

During the week of January 13, 2014, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Rensselaer Polytechnic Institute reactor. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10, Section 2.390 of the *Code of Federal Regulations*, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Mr. Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/

Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-225

Enclosures:
1. Examination Report No. 50-225/OL-14-01
2. Written Examination

cc w/o enclosures: See next page

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DISTRIBUTION:
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ADAMS ACCESSION #: ML14023A727 **NRR-079**

OFFICE	PROB:CE	IOLB:LA	PROB:BC
NAME	PIsaac	CRevelle	GBowman
DATE	01/23/14	01/24/14	01/28/14

OFFICIAL RECORD COPY

cc:

Mayor of the City of Schenectady
Schenectady, NY 12305

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EXAMINATION REPORT NO: 50-225/OL-14-01

FACILITY: Rensselaer Polytechnic Institute

FACILITY DOCKET NO.: 50-225

FACILITY LICENSE NO.: CX-22

SUBMITTED BY: ____/RA/__________ _01/23/2014__ _
Patrick Isaac, Examiner Date

SUMMARY:

During the week of January 13, 2014, the NRC administered licensing examinations to one Senior Reactor Operator (SRO) candidate. The candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick Isaac, Chief Examiner

2. Results:

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

3. Exit Meeting:

Dr. Peter Caracappa, Director, Reactor Critical Facility
Mr. Glen Winters, Operations Supervisor, Reactor Critical Facility
Patrick Isaac, NRC, Examiner

The facility presented comments on the written examination and the NRC Examiner agreed to make the following change to the written examination:

Question B. 8 - Accept both “b” and “c” as correct answers

ENCLOSURE 1

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

FACILITY: RENNSELAER POLYTECHNIC INSTITUTE

REACTOR TYPE: REACTOR CRITICAL FACILITY

DATE ADMINISTERED: 1/15/2014

CANDIDATE: ___________________________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% overall is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
15.0	33.3	_______	_______	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTISTICS
15.0	33.3	_______	_______	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
15.0	33.3	_______	_______	C. FACILITY AND RADIATION MONITORING SYSTEMS
45.00		_______ FINAL GRADE		TOTALS

ALL THE WORK DONE ON THIS EXAMINATION IS MY OWN. I HAVE NEITHER GIVEN NOR RECEIVED AID.

____
CANDIDATE'S SIGNATURE

ENCLOSURE 2

Section A: ReactorTheory, Thermodynamics & Facility Operating Characteristics

A N S W E R   S H E E T

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

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

(***** END OF SECTION A *****)

Section B Normal, Emergency and Radiological Control Procedures

A N S W E R   S H E E T

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

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

(***** END OF SECTION B *****)

Section C Facility and Radiation Monitoring Systems

A N S W E R   S H E E T

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

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

(***** END OF SECTION C *****)

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

NRC RULES AND GUIDELINES
FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

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

5. Print your name in the blank provided on the upper section of the examination cover sheet and on the upper right-hand corner of each section of your answer sheets.

6. Mark your answers on the Answer sheet provided. Ensure all information you wish to have evaluated as part of your Answer is on your Answer sheet. Scrap paper will be disposed of immediately following the examination.

7. The point value for each question is indicated in parentheses after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. There is a time limit of three (3) hours for completion of the examination.

EQUATION SHEET

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

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

$$\lambda_{eff} = 0.1 \sec^{-1}$$

$$P = P_0 \ e^{t/T}$$

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

$$\ell^* = 1 \times 10^{-4} \sec$$

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

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

$$CR_1 (-\rho_1) = CR_2 (-\rho_2)$$

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

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

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

$$M = \frac{1 - K_{eff_1}}{1 - K_{eff\,2}}$$

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

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

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

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

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

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

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

$$DR_1 \ d_1^{\ 2} = DR_2 d_2^{\ 2}$$

$$DR = \frac{6 \, Ci \, E(n)}{R^2}$$

$$A_f = A_o(1 - e^{-\lambda t})$$

$$I = I_{oe^{-\mu x}}$$

$$\mu_m = \frac{\mu}{\rho}$$

DR – Rem/hr, Ci – curies, E – Mev, R – feet

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

1 Horsepower = 2.54 x 10^3 BTU/hr

1 BTU = 778 ft-lbf

1 gal (H_2O) ≈ 8 lbm

c_P = 1.0 BTU/hr/lbm/°F

1 kg = 2.21 lbm

1 Mw = 3.41 x 10^6 BTU/hr

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

c_p = 1 cal/sec/gm/°C

QUESTION: 01 (1.00)

Which one of the following describes the Technical Specifications “Shutdown Margin” of the RPI reactor?

a. The amount of negative reactivity which would be inserted into the core if all the rods were within one inch of being bottomed.

b. The amount of reactivity the reactor is subcritical by given a specific set of conditions.

c. The minimum amount of reactivity needed to keep the reactor subcritical by means of the control rods and assuming the most reactive rod is in the most reactive position.

d. The amount of reactivity inserted if all the control rods are bottomed and the reactor is subcritical by at least $1.00.

QUESTION: 02 (1.00)

A reactor is subcritical with a shutdown margin of .0526 Δk. The addition of a reactor experiment increases the indicated count rate from 10 cps to 20 cps. Which ONE of the following is the new K_{eff} of the reactor?

a. 0.53

b. 0.90

c. 0.975

d. 1.02

QUESTION: 03 (1.00)

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

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

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

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

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

QUESTION: 04 (1.00)

Which one of the following describes "excess reactivity"?

a. Extra reactivity into the core due to the presence of the source neutrons.

b. A measure of the resultant reactivity if all of the control rods and other poisons were removed when the reactor is critical.

c. The combined reactivity worth of control rods and chemical poison needed to keep the reactor shutdown.

d. The minimum amount of reactivity needed to keep the reactor subcritical assuming the most reactive rod in the most reactive position.

QUESTION: 05 (1.00)

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

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

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

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

d. Infinity, since neutron production has been terminated.

QUESTION: 06 (1.00)

A short reactor period is a greater hazard when reactor power is:

a. Close to 100%

b. Above the point where power level is producing enough energy to make up for the energy lost to ambient

c. Above 15 watts

d. Close to source counts

QUESTION: 07 (1.00)

Which one of the following will be the resulting stable reactor period when a $0.25 reactivity insertion is made into an exactly critical reactor core? (Assume a β of 0.0070 and a λ of 0.1 sec^{-1})

a. 50 seconds

b. 38 seconds

c. 30 seconds

d. 18 seconds

QUESTION: 08 (1.00)

The reactor is operating at 10 Watts. The reactor operator withdraws one of the control rods allowing power to increase. The operator then inserts the same rod to its original position, decreasing power. In comparison to the rod withdrawal, the rod insertion will result in:

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

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

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

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

QUESTION: 09 (1.00)

If the reactor is supercritical at 1 watt with a stable positive period of 29 seconds, reactor power ONE minute later will be approximately:

a. 3 watts.

b. 6 watts.

c. 8 watts.

d. 25 watts.

QUESTION: 10 (1.00)

You enter the control room and observe that the neutron instrumentation indicates a steady neutron level with no rods in motion. Which ONE condition below CANNOT be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source is in the core.

QUESTION: 11 (1.00)

Why does the fuel temperature coefficient become less negative at higher fuel temperatures?

a. As reactor power increases, the rate of increase in the fuel temperature diminishes.

b. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

c. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

d. The broadening of the resonance peaks diminishes per degree change in fuel temperature.

QUESTION: 12 (1.00)

A control rod is withdrawn from the core. Which of the following explains the reactivity addition from the rod?

a. Reactivity added will be equal for each inch of withdrawal.

b. Reactivity addition per inch will be greatest from 40% to 60% withdrawn.

c. Reactivity addition per inch will be greatest in the bottom fourth of the core.

d. Reactivity addition per inch will be greatest in the top fourth of the core.

QUESTION: 13 (1.00)

A critical reactor is operating at a steady state power level of 1.000 watts. Reactor power is increased to a new steady-state power level of 1.004 watts. Neglecting any temperature effects, what reactivity insertion is required to accomplish this power change?

a. 0.004 delta k/k.

b. 0.4% delta k/k.

c. 1.004% delta k/k.

d. Indeterminate, since any amount of positive reactivity could be used.

QUESTION: 14 (1.00)

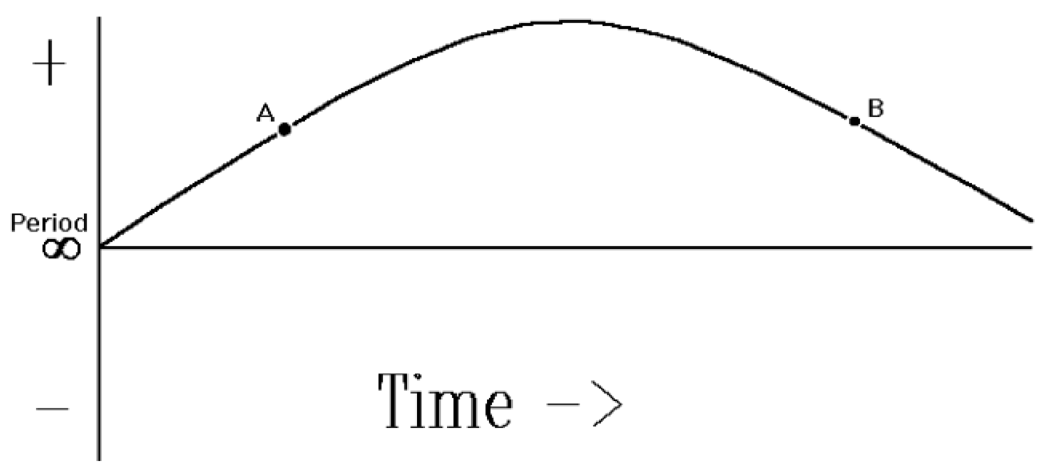
Shown below is a trace of reactor period as a function of time. Between points A and B **REACTOR POWER** is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



QUESTION: 15 (1.00)

Which one of the following describes the response of the subcritical reactor to equal insertions of positive reactivity as the reactor approaches critical? Each reactivity insertion causes:

a. a SMALLER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

b. a LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

c. a SMALLER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

d. a LARGER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

(***** END OF SECTION A *****)

QUESTION: 01 (1.00)

How would an accessible area be posted if the radiation level in the area is 65 mR/hr?

a. CAUTION- RADIATION AREA

b. CAUTION- HIGH RADIATION AREA

c. CAUTION- RADIOACTIVE MATERIALS AREA

d. CAUTION- RESTRICTED AREA

QUESTION: 02 (1.00)

To maintain an active Senior Reactor Operator license, the functions of a Senior Reactor Operator must be actively performed for at least:

a. four hours per month.

b. four hours per calendar quarter.

c. six hours per month.

d. six hours per calendar quarter.

QUESTION: 03 (1.00)

The gamma radiation level from a point source is 10 R/hour at a distance of 1 foot from the source. The radiation level 8 feet from the source is approximately:

a. 19 mR/hour

b. 156 mR/hour

c. 625 mR/hour

d. 1250 mR/hour

QUESTION: 04 (1.00)

In accordance with the Technical Specifications, which ONE condition below is permissible during reactor operations?

a. Control room area gamma monitoring system bypassed.

b. The shutdown reactivity with one control rod withdrawn is 0.60 $.

c. A movable experiment with a reactivity worth of 0.45 $.

d. The magnetic clutch release time for one of the control rods is 150 milliseconds.

QUESTION: 05 (1.00)

In accordance with the Technical Specifications, the Limiting Safety System Settings is:

a. the settings that initiate protective action for parameters associated with the reactor power limits and rate of power level changes.

b. an administratively established constraint on equipment and operational characteristics which shall be adhered to during operation of the reactor.

c. there to ensure that available shutdown reactivity is adequate and that positive reactivity insertion rates are within those analyzed in the SAR.

d. a specification that applies to the maximum temperature allowed in any in-core fuel pellet during normal operation or transients.

QUESTION: 06 (1.00)

Which one of the following surveillances are required to be performed before a reactor startup?

a. Moderator-reflector water height verification.

b. Criticality detector system calibration.

c. Control rod drop time determination.

d. Shutdown margin determination.

QUESTION: 07 (1.00)

Emergency Action Levels are:

a. specific instrument readings, observations, dose rates, etc which provide thresholds for initiating appropriate emergency measures.

b. accidents grouped by severity level for which predetermined emergency measures may be taken.

c. instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

d. immediate actions, beyond the scope of normal operating procedures, to mitigate the consequences of an accident.

QUESTION: 08 (1.00)

In accordance with the Technical Specifications, which ONE situation below is NOT permissible during reactor operation?

a. A power level trip setting of 90 watts.

b. The duty SRO bypassed the auxiliary reactor scram following core modification.

c. Operation with the Log N, Period channel bypassed.

d. Criticality detector system temporarily removed from service due to maintenance.

QUESTION: 09 (1.00)

The limit for maximum water level at no greater than 10 inches above the top grid of the core is based on:

a. providing adequate neutron shielding during operation.

b. limiting moderator mass to maximize negative temperature coefficient effects during transients.

c. avoiding hydraulic restrictions to control rod insertion during a scram.

d. ensuring that negative reactivity will be added within 1 minute of activation of the water dump.

QUESTION: 10 (1.00)

When the Critical Facility Emergency Alarm sounds, all personnel are to assemble:

a. in the control room.

b. in the shielded counting room.

c. at the edge of the inner zone within the operations boundary.

d. near the facility gate near the site boundary.

QUESTION: 11 (1.00)

In accordance with 10CFR20, which ONE of the following defines "Total Effective Dose Equivalent (TEDE)?"

a. The dose to a specific organ or tissue resulting from an intake of radioactive material.

b. The dose that the whole body receives from sources outside the body.

c. The sum of External Dose and Organ Dose.

d. The sum of Internal Dose and External Dose.

QUESTION: 12 (1.00)

During an accident or emergency, the person or group responsible to ascertain the nature of the problem and assume responsibility for appropriate actions is:

a. the Facility Director.

b. the Operations Supervisor.

c. the senior staff member present.

d. the RPI Public Safety Force.

QUESTION: 13 (1.00)

In accordance with the Technical Specifications, which one of the following defines a "Channel Check?"

a. The introduction of a signal into a channel for verification that it is operable.

b. A combination of sensors, electronic circuits and output devices which measure and display the value of a parameter.

c. The qualitative verification of acceptable performance by observation of channel behavior.

d. The adjustment of a channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures.

QUESTION: 14 (1.00)

While performing a reactor startup, the operator recorded the initial source channel at 13 cps. At 120 cps and assuming a known control rod sensitivity, withdrawal of the rods as a bank is permitted as long as:

a. reactor period is greater than 20 seconds

b. the reactivity addition does not exceed $0.05 per second

c. the reactivity addition does not exceed $0.12 per second

d. Withdrawal of the rods as a bank is not permitted.

QUESTION: 15 (1.00)
Which one of the following is NOT classified as an “Emergency Alert”?

a. Human injury.

b. Smoke or fire.

c. Bomb threat.

d. Act of civil disorder.

(***** END OF SECTION B *****)

QUESTION: 001 (1.00)

Period information is supplied from the:

a. BF3 detector.

b. Linear power channel LP1.

c. Linear power channel LP2.

d. Log power channel PP2.

QUESTION: 002 (1.00)

All of the following are interlocks that prevent control rod withdrawal during reactor operations EXCEPT:

a. failure of line voltage to recorders.

b. water level in reactor tank 12 inches above core top grid.

c. reactor period = 10 seconds.

d. fill pump running.

QUESTION: 003 (1.00)

The time required to fill the 2000 gallon reactor tank is approximately:

a. 30 minutes

b. 40 minutes

c. 1 hour

d. 1.5 hours

QUESTION: 004 (1.00)

For the area radiation monitoring system, match the alarm settings in Column B with the appropriate channel in Column A. Items in Column B may be used once, more than once, or not at all.

	Column A		Column B
a.	Control room.	1.	20 mr/hour
b.	Equipment hallway.	2.	100 mr/hour
c.	Vault criticality monitor.	3.	40 mr/hour
d.	Reactor deck.	4.	10 mr/hour

QUESTION: 005 (1.00)

Which one of the following describes the material used in the absorber section of the control rods?

a. Stainless steel with silver-indium inlay.

b. Hafnium in graphite clad with stainless steel.

c. Be-7 enriched beryllium in a silver-cadmium-indium alloy.

d. B-10 in iron cement clad with stainless steel.

QUESTION: 006 (1.00)

Which one of the following safety system scram conditions has a scram BYPASS associated with it?

a. Loss of power to the reactor building.

b. Magnet switch on control panel OFF.

c. Linear power scram.

d. Reactor door OPEN.

QUESTION: 007 (1.00)

Which one of the following describes the ventilation system for the reactor room?

a. It uses natural circulation with a single vent to the outside stack.

b. It uses natural circulation sharing a vent with the control room that is isolated on measured HIGH Ar-41.

c. It shares a forced fan vent with the control room with back draft dampers to prevent cross-contamination.

d. It uses a single vent with natural circulation during normal operation with a forced fan starting on measured HIGH Ar-41.

QUESTION: 008 (1.00)

The following reaction ($^{10}B + {}^{1}_{0}n \rightarrow {}^{7}_{3}Li + \alpha$) can best be found in the ____________

a. Control Room Radiation Monitor

b. The gas gap of a SPERT fuel pin

c. Linear Power channel LP2

d. Source Range Nuclear Instrumentation

QUESTION: 009 (1.00)

According to RPI RCF TS, why is the minimum number of control rods set at 4?

a. Controls thermal power from exceeding 100 W

b. Prevents conditions which would cause fuel element failure in SPERT fuel

c. Reduces the effect of flux tilting due to uneven power distribution

d. Ensures there is adequate shutdown margin, even for a stuck rod condition

QUESTION: 010 (1.00)

What is the Maximum Hypothetical Accident at the RPI CRF?

a. Fuel temperature exceeding 2000°F

b. The compromise of fuel cladding integrity resulting in fission product release > 10 CFR 20 limits

c. An unsecured experiment causing $0.60 of reactivity to be instantaneously inserted while the reactor is operating at maximum power

d. The loss of coolant from the reactor tank and leaking outside of confinement space

QUESTION: 011 (1.00)

The temperature monitoring system monitors the temperature of the:

a. reactor coolant and control room air.

b. reactor room air and the fuel.

c. reactor coolant and reactor room air.

d. reactor coolant and the fuel.

QUESTION: 012 (1.00)

On a loss of electrical power, the reactor tank pump:

a. drain valve fails CLOSED and the fill valve fails OPEN.

b. drain valve fails CLOSED and the fill valve fails CLOSED.

c. drain valve fails OPEN and the fill valve fails OPEN.

d. drain valve fails OPEN and the fill valve fails CLOSED.

QUESTION: 013 (1.00)

The startup channel detector provides indication of neutron flux by using:

a. current which is triggered by neutron fission event occurring in the detector.

b. pulses which are triggered by a neutron absorption event occurring in the detector .

c. current which is proportional to the number of neutron interactions in the detector.

d. pulses which are inversely proportional to the input energy of the neutron interaction in the detector.

QUESTION: 014 (1.00)

The Dump Valve Bypass control:

a. allows air to be admitted to the dump valve operator regardless of the scram condition.

b. locks air onto the dump valve operator if an automatic scram occurs but still allows response to manual scrams.

c. recloses the dump valve once it has opened if no scram signals exist.

d. bleeds air from the dump valve operator to ensure that the valve opens on a scram.

QUESTION: 015 (1.00)

Maximum control rod motion is limited to:

a. 22 inches, the length of the active absorber in the control rod.

b. 36 inches, the effective height of the core.

c. 42 inches, the nominal length of a fuel pin.

d. 64 inches, the height of water in the tank.

(***** END OF SECTION C *****)

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

ANSWER KEY

Section A: Reactor Theory, Thermodynamics, and Fac. Operating Characteristics

A.1
Answer: c
Reference: RPI Technical Specifications Definitions

A.2
Answer: c
Reference: SDM = 1-K_{eff}/K_{eff} → K_{eff} = 1/SDM + 1 → K_{eff} = 1/0.0526 + 1 → K_{eff} = .95
CR_1/CR_2 = (1 - K_{eff2}) / (1 - K_{eff1}) → 10/20 = (1 - K_{eff2}) / (1 - 0.95)
(0.5) x (0.05) = (1 - K_{eff2}) → K_{eff2} = 1 - (0.5)(0.05) = 0.975

A.3
Answer: d
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.20, p. 236.

A.4
Answer: b
Reference: RPI Tech. Specs

A.5
Answer: c
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.47, p. 246.

A.6
Answer: d
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.

A.7
Answer: c
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234.
T = (β-ρ)/λρ T = (.0070 - .00175)/.1 x .00175 = 30 seconds

A.8
Answer: c
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.18, p. 234

A.9
Answer: c
Reference: From Equation Sheet, $P = Poe^{t/T}$; P = 1xe(60/29) = e2.069 = 7.91 watts.

A.10
Answer: c
Reference: A supercritical reactor cannot indicate a steady neutron level.

A.11
Answer: d
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.98, p. 94.

A.12
Answer: b
Reference: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 5.224 — 5.229, pp. 306 — 307.
RPI – SAR Figure 4.8: Integral Control Rod Worth

A.13
Answer: d
Reference: Since time is not a factor, any amount of positive reactivity will cause the power to rise.

A.14
Answer: a
Reference: Since period is always positive, reactor power is increasing, but at different rates.

A.15
Answer: b
Reference: Burn, Introduction to Nuclear Reactor Operations, page 5-11.

Section B – Normal/Emergency Procedures and Radiological Controls

B.1
Answer: a
Reference: 10 CFR 20.

B.2
Answer: b
Reference: RPI Requalification Program

B.3
Answer: b
Reference: $DR_1d_1^2 = DR_2d_2^2$
$(10)(1) = DR_2 (64)$; $DR_2 = 10/64 = 0.156$ R/hour = 156 mR/hour.

B.4
Answer: c
Reference: RPI Technical Specifications, Section 3.8

B.5
Answer: a
Reference: RPI Technical Specifications, Section 2.2

B.6
Answer: a
Reference: RPI Technical Specifications, Section 4.2.

B.7
Answer: a
Reference: RPI Emergency Plan, Definitions.

B.8
Answer: b or c
Reference: RPI Technical Specifications, Section 3.2.

B.9
Answer: d
Reference: RPI Technical Specifications, Section 3.2.

B.10
Answer: b
Reference: RPI Emergency Plan, Section 7.

B.11
Answer: d
Reference: 10 CFR 20.

B.12
Answer: c
Reference: RPI Emergency Plan, Section 7.

B.13
Answer: c
Reference: RPI Technical Specifications, Definitions.

B.14
Answer: c
Reference: Operating Procedures, Section A.

B. 15
Answer: a
Reference: RPI Emergency Plan, Section 4

SECTION C. FACILITY AND RADIATION MONITORING SYSTEMS

C.1
Answer: d
Reference: SAR, Figure 7.1

C.2
Answer: b
Reference: RPI Technical Specifications, Table 2: Interlocks

C.3
Answer: c
Reference: Operating Procedures, Section J.

C.4
Answer: a, 4; b, 3; c, 1; d, 2.
Reference: SAR, Section 7.7.

C.5
Answer: d
Reference: SAR, Section 4.2.2.

C.6
Answer: d
Reference: Technical Specifications, Table 1.

C.7
Answer: a
Reference: SAR, Section 9.1.

C.8
Answer: d
Reference: SAR, Section 7.2 and 7.6.

C.9
Answer: d
Reference: RPI TS 3.2.

C.10
Answer: c
Reference: RPI SAR, Section 13.1.1.

C.11
Answer: c
Reference: Pre-Startup Procedures, Section A.

C.12
Answer: d
Reference: SAR, Figure 5.1: RCF Piping Diagram

C.13
Answer: b
Reference: SAR, Section 7.2.3 & Laboratory 1.

C.14
Answer: a
Reference: SAR, Section 4.3, Reactor Tank & Operating Procedures, Section E, Scram Recovery.

C.15
Answer: b
Reference: SAR, Section 4.2.2.