March 17, 2017

Dr. Peter Caracappa, Director
Rensselaer Polytechnic Institute
Building JEC – Room 2032
110 8th Street
Troy, NY 12180-3590

SUBJECT: EXAMINATION REPORT NO. 50-225/OL-17-01, RENSSELAER POLYTECHNIC INSTITUTE

Dear Dr. Caracappa:

During the week of February 27, 2017, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Rensselaer Polytechnic Institute (RPI) critical assembly. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the *Code of Federal Regulations,* Section 2.390, a copy of this letter and the enclosure 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 NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Ms. Michele DeSouza at (301) 415-0747 or via at Michele.DeSouza@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, 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-17-01
2. Written Examination

cc: w/o enclosures: See next page

EXAMINATION REPORT NO. 50-225/OL-17-01, RENSSELAER POLYTECHNIC INSTITUTE
DATED MARCH 17, 2017.

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OFFICE	NRR/DPR/PROB/CE	NRR/DPR/PROB/OLA	NRR/DPR/PROB/BC
NAME	MDeSouza	ABaxter	AMendiola
DATE	03/08/2017	03/13/17	03/17/2017

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Rensselaer Polytechnic Institute **Docket No. 50-225**

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

REPORT NO.: 50-225/OL-17-01

FACILITY DOCKET NO.: 50-225

FACILITY LICENSE NO.: CX-22

FACILITY: RPI

EXAMINATION DATES: February 27, 2017

SUBMITTED BY: /RA/ 3/7/17
Michele DeSouza, Chief Examiner Date

SUMMARY:
During the week of February 27, 2017, the NRC administered an operator licensing examination to one Senior Reactor Operator (SRO) candidate. The Senior Reactor Operator candidate passed all applicable portions of the examination.

REPORT DETAILS

1. Examiner: Michele DeSouza, Chief Examiner, NRC

2. Results:

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

3. Exit Meeting:
Michele C. DeSouza, Chief Examiner, NRC
Mr. Glenn Winters, RPI Operations Supervisor

Per discussion with the facility, prior to administration of the examination, adjustments were accepted. Upon completion of the examination, the NRC Examiner met with facility staff representatives to discuss the results. At the conclusion of the meeting, the NRC examiner thanked the facility for their support in the administration of the examination.

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

FACILITY: RPI

REACTOR TYPE: Critical Experimental

DATE ADMINISTERED: 02/28/2017

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% in each section 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
15.00	33.3	_____	____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
15.00	33.3	_____	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
15.00	33.3	_____	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
45.00		_____ 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. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

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

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

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

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

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

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

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

EQUATION SHEET

$Q = m\, c_p\, \Delta T$

$CR_1 (1-K_{eff})_1 = CR_2 (1-K_{eff})_2$

$SUR = 26.06/\tau$

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

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

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

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

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = 6CiE/D^2$

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

$1 \text{ eV} = 1.6\text{x}10^{-19}$ watt-sec.

$1 \text{ Curie} = 3.7\text{x}10^{10}$ dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$°F = 9/5\,°C + 32$

$1 \text{ Mw} = 3.41\text{x}10^6$ BTU/hr

$°C = 5/9\,(°F - 32)$

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

$1 \text{ Curie} = 3.7 \times 10^{10}$ dis/sec

1 kg = 2.21 lbm

$1 \text{ Horsepower} = 2.54 \times 10^3$ BTU/hr

$1 \text{ Mw} = 3.41 \times 10^6$ BTU/hr

1 BTU = 778 ft-lbf

$°F = 9/5\,°C + 32$

1 gal (H_2O) . 8 lbm

$°C = 5/9\,(°F - 32)$

$c_P = 1.0$ BTU/hr/lbm/°F

$c_p = 1$ cal/sec/gm/°C

Section A – Reactor Theory, Thermo & Facility Operating Characteristics

Question A.01 (1 point) {1.0}

Every fission of Uranium-235 by a thermal neutron produces an average of:

a. 2.00 neutrons

b. 2.07 neutrons

c. 2.42 neutrons

d. 2.93 neutrons

Answer: A.01 c.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, Section 3.7, Table 3.4.

Question A.02 (1 point) {2.0}

Which factor in the six-factor formula is represented by the following ratio:

$$\frac{\text{number of neutrons that reach thermal energy}}{\text{number of neutrons that start to slow down}}$$

a. fast fission factor

b. resonance escape probability

c. reproduction factor

d. thermal utilization factor

Answer: A.02 b.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, Section 6.5, page 287.

Question A.03 (1 point) {3.0}

About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5} % full power at this time, what will the power be in three minutes.

a. 5×10^{-6} % full power

b. 2×10^{-6} % full power

c. 10^{-6} % full power

d. 5×10^{-7} % full power

Answer: A.03 c.
Reference: Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 289.
$P = P_0 e^{-T/\tau} = 10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

Question A.04 (1 point) {4.0}

During the neutron cycle from one generation to the next, several processes occur that may increase or decrease the available number of neutrons. Which ONE of the following factors describes an INCREASE in the number of neutrons during the cycle?

a. Thermal utilization factor.

b. Resonance escape probability.

c. Thermal non-leakage probability.

d. Fast fission factor.

Answer: A.04 d.
Reference: Burn, Introduction to Nuclear Reactor Operations, page 3-15.

Question A.05 (1 point) {5.0}

Which ONE of the following is the reason for operating with thermal neutrons instead of fast neutrons?

a. The fission cross section of the fuel is much higher for thermal neutrons than fast neutrons.

b. Neutron absorption in non-fuel material increases exponentially as neutron energy increases.

c. Doppler and moderator temperature coefficients become positive as neutron energy increases.

d. Neutron economy is increased since thermal neutrons are less likely to leak out of the core than fast neutrons.

Answer: A.05 a.
Reference: Duderstadt and Hamilton, Nuclear Reactor Analysis, page 81.

Question A.06 (1 point) {6.0}

During a reactor startup, the count rate is increasing linearly with time, with no rod motion. This means that:

a. the reactor is critical and the count rate increase is due to source neutrons.

b. the reactor is subcritical and the count rate increase is due to source neutrons.

c. the reactor is subcritical and the count rate increase is due to the buildup of delayed neutron precursors.

d. the reactor is critical and the count rate increase is due to the buildup of delayed neutron precursors.

Answer: A.06 a.
Reference: Burn, Introduction to Nuclear Reactor Operations, page 5-25.

Question A.07 (1 point) {7.0}

A reactor is critical at 0.1 mW and you are proceeding to raise reactor power. If it is estimated that the doubling time is 30 seconds, what would be reactor power 1 minute later?

a. 0.2 mW

b. 0.4 mW

c. 0.8 mW

d. 1.6 mW

Answer: A.07 b.

Reference: $P(t) = P_0 e^{T}$.

Question A.08 (1 point) {8.0}

Given a high power scram set at 110%, and a scram delay time of 0.5 sec, if the reactor is operating at 100% power prior to the scram, approximately how high will reactor power get with a positive 20 second period?

a. 113%

b. 116%

c. 124%

d. 225%

Answer: A.08 a.

Reference: $P = P_0\ e^{t/\tau}$ $P_O = 110\%$ $\tau = 20$ sec. $t = 0.5$ $P = 110\ e^{0.5/20} = 112.78\%$

Question A.09 (1 point) {9.0}

Which statement illustrates a characteristic of Subcritical Multiplication?

a. The number of source neutrons decreases for each generation.

b. The number of fission neutrons remains constant for each generation.

c. The number of neutrons gained per generation gets larger for each succeeding generation.

d. As Keff approaches unity (1), for the same increase in Keff, a greater increase in neutron population occurs.

Answer: A.09 d.

Reference: Standard NRC Reactor Theory Question

Question A.10 (1 point) {10.0}

K_{eff} is K_∞ times _____?

a. the reproduction factor (η)

b. the resonance escape probability (p)

c. the fast fission factor (ε)

d. the total non-leakage probability (L_f and L_{th})

Answer: A.10 d.
Reference: DOE Handbook Vol 2, L Theory (Nuclear Parameters), E.O. 1.1 a&b, pg. 9

Question A.11 (1 point) {11.0}

Prompt neutrons are produced by:

a. an installed source

b. directly from the fission

c. decayed fission fragments

d. Pair Production of high energy photon

Answer: A.11 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, Sec 3.2.

Question A.12 (1 point) {12.0}

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.

Answer: A.12 c.
Reference: RPI Technical Specifications Definitions

Question A.13 (1 point) {13.0}

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

Answer: A.13 c.

Reference: $SDM = 1-K_{eff}/K_{eff} \rightarrow K_{eff} = 1/SDM + 1$

$K_{eff} = 1/0.0526 + 1 \rightarrow K_{eff} = .95$

$CR_1/CR_2 = (1 - K_{eff2}) / (1 - K_{eff1}) \rightarrow 10/20 = (1 - K_{eff2}) / (1 - 0.95)$

$(0.5) \times (0.05) = (1 - K_{eff2}) \rightarrow K_{eff2} = 1 - (0.5)(0.05) = 0.975$

Question A.14 (1 point) {14.0}

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

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

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

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

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

Answer: A.14 d.

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

Question A.15 (1 point) {15.0}

A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur with the same number of elements loaded as if there were no change in the initial count rate.

b. criticality will occur earlier (i.e., with fewer elements loaded.)

c. criticality will occur later (i.e., with more elements loaded.)

d. criticality will be completely unpredictable.

Answer: A.15 a.
Reference: Laboratory 2 Experiment.

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

Section B – Normal/Emergency Operating Procedures & Radiological Controls

Question B.01 (1 point, 0.25 each) {1.0}

Match each of the following actions in Column A with the correct term from the Technical Specifications in Column B. Only one term from Column B may be used for each action in Column A.

	Column A	Column B
a.	Immersing a thermometer in an ice bath, then in boiling water and noting the readings.	1. Channel Check
b.	Placing a source next to a radiation detector and observing meter movement.	2. Channel Test
c.	Performing a determination of reactor power with irradiated foils, then adjusting neutron instrumentation to correspond to measured power.	3. Channel Calibration
d.	Observing the overlap between two different neutron detectors as power increases.	

Answer: B.01 a. = 2; b. = 2; c. = 3; d. = 1.
Reference: Technical Specifications, Definitions.

Question B.02 (1 point) {2.0}

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

a. A power level trip setting of 95 watts.

b. Operating coolant temperature of 45 degrees F.

c. excess reactivity of the reactor less than 0.50 $.

d. Criticality detector system removed from service, but replaced by an equivalent portable system.

Answer: B.02 b.
Reference: Technical Specifications, Section 3.1.4

Question B.03 (1 point) {3.0}

The reactivity worth of a planned moveable experiment is determined to be $0.80. Which ONE of the statements below is correct concerning this experiment?

a. The experiment is allowed in the core but must be secured.

b. The experiment is allowed in the core but must be doubly encapsulated.

c. The experiment cannot be allowed in the core due to an excessive reactivity value.

d. The experiment is allowed in the core provided that analysis indicates the worth is such that its removal will not exceed the safety limit.

Answer: B.03 c.
Reference: Technical Specifications, 3.4(4).

Question B.04 (1 point) {4.0}

Which one of the following at the RPI Critical Facility DOES NOT require the presence of a Senior Reactor Operator (SRO)?

a. The relocation of an in-core experiment with worth equivalent to $1.00

b. The manipulation of reactor console controls by a student in training

c. Removal of the control rods for maintenance

d. The rearrangement of two fuel assemblies

Answer: B.04 b
Reference: Under 10 CFR Part 55, The regulations in this part do not require a license for an individual who- "Under the direction and in the presence of a licensed operator or senior operator, manipulates the controls of a research or training reactor as part of the individual's training as a student" 10 CFR Part 55.13

Question B.05 (1 point) {5.0}

An example of Byproduct Material would be….

a. Pu-239

b. U-233

c. U-235

d. Au-198

Answer: B.05 d.
Reference: 10 CFR Part 20.1003 Byproduct material is radioactive material made radioactive by the process of using special nuclear material.

Question B.06 (1 point) {6.0}

As an employee at the reactor facility, if you worked continuously in an area of radiation which read 250 mrem/hr, how long could you stay before you exceeded your yearly limit for exposure?

a. 24 minutes

b. 2 hours

c. 8 hours

d. 20 hours

Answer: B.06 d.
Reference: 5000 mrem/250 mr/hr= 20 hours

Question B.07 (1 point) {7.0}

Match the requirements (10 CFR 55) for maintaining an active operator license in column A with the correct time period from column B.

	Column A	Column B
a.	Renewal of license	4 months
b.	Medical examination	1 year
c.	Console manipulation evaluation	2 years
d.	Requalification exam (written)	6 years

Answer: B.07 a. = 6yr; b. = 1yr; c. = 2yr ; d. = 1yr
Reference: 10CFR55

Question B.08 (1 point) {8.0}

In accordance with the Emergency Plan, the person or group responsible for setting any emergency action into motion is:

a. the Facility Director.

b. the Operations Supervisor.

c. the first staff member who becomes aware of the emergency.

d. the RPI Public Safety Force.

Answer: B.08 c.
Reference: Emergency Plan, 7. Emergency Response & Emergency Procedures §2.0

Question B.09 (1 point) {9.0}

Per RCF Technical Specifications, for movable experiments with an absolute worth greater than _____, the maximum reactivity change for withdrawal and insertion shall be _____.

a. $0.60, 0.50 $/sec

b. $0.35, 0.20 $/sec

c. $0.60, 0.10 $/sec

d. $0.35, 0.50 $/sec

Answer: B.09 b.
Reference: TS 2.8

Question B.10 (1 point) {10.0}

Reactor Operator works a standard forty (40) hour work week. His duties require him to work in a high radiation area for (4) hours a day. The dose rate in the area is 100 mR/hour. Which ONE of the following is the MAXIMUM number of days Reactor Operator may perform his duties WITHOUT exceeding 10 CFR 20 limits?

a. 5 days

b. 10 days

c. 12 days

d. 13 days

Answer: B.10 c.
Reference: 10CFR20.1201(a)(1); 5000 mr x 1 hr x day = 12.5 days 100 mr 4 hr

Question B.11 (1 point) {11.0}

According to emergency classification guide, the event associated with the contaminated moderator is defined as:

a. Operational Event

b. Personnel Emergency

c. Emergency Alert

d. Site Area Emergency

Answer: B.11 c.
Reference: Emergency Plan, Section 4.2

Question B.12 (1 point) {12.0}

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.

Answer: B.12 c.
Reference: Operating Procedures, Section A.

Question B.13 (1 point) {13.0}

You are transferring fuel to the storage vault from the core. The maximum number of the SPERT fuel pins that you allow to handle at one time is:

a. 1

b. 2

c. 3

d. 4

Answer: B.13 b.
Reference: RCF Operating Procedures, G "Fuel Handling", Version 2.1, September 2011

Question B.14 (1 point) {14.0}

The RCF Emergency procedures state that in the reactor room there are two Metal-X fire extinguishers. Which of the following classes of fire would most likely be used with this type of fire extinguisher?

a. Class A: Fires in ordinary combustibles, such as wood, paper, plastic, etc.

b. Class B: Fires in flammable or combustible liquids, flammable gases, greases, etc.

c. Class C: Fires in live electrical equipment.

d. Class D: Fires involving combustible metals such as magnesium

Answer: B.14 d.
Reference: RPI Emergency Procedures 6.2.6
http://www.monroeextinguisher.com/catalog.asp?prodid=504347 and
http://www.bc.edu/offices/facilities/meta-elements/pdf/fireExtinguisherTraining.pdf

Question B.15 (1 point) {15.0}

Per RCF Emergency Plan, what is the maximum allowable dose which the RCF Emergency Management can authorize for a volunteer to receive to save a life of someone injured?

a. 5.0 Rem

b. 12.5 Rem

c. 25.0 Rem

d. 50.0 Rem

Answer: B.15 b.
Reference: RCF Emergency Plan 7

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

Section C – Plant and Rad Monitoring Systems

Question C.01 (1 point) {1.0}

Which one of the following systems has bypass provisions?

a. Linear Power High Neutron Level Scram

b. Water Dump Valve Scram

c. Air particulate monitoring system in the ventilation stack

d. Water fill interlock with water in reactor tank 10±1" above core top grid

Answer: C.01 b.
Reference: Technical Specification 3.2.8

Question C.02 (1 point) {2.0}

Period information is supplied from the:

a. BF3 detector.

b. Linear power channel LP1.

c. Linear power channel LP2.

d. Log power channel PP2.

Answer: C.02 d.
Reference: SAR, 7.2 Design of Instrumentation and Control Systems 7.3.2

Question C.03 (1 point, 0.25 each) {3.0}

Match the readings listed in column A with their respective responses listed in column B Assume the reactor is in operation. (Items in column B is to be used more than once or not at all.)

Column A		Column B	
a.	Linear Power # 1 = 210%	1.	Normal Operation
b.	Water Dump Bypass	2.	Control rod withdrawal prohibit
c.	Voltage to Recorders = 90 V	3.	Reactor scram
d.	Count rate < 2 cps		

Answer: C.03 a. = 3; b. = 1 c. = 2 d. = 2
Reference: Technical Specification 3.2

Question C.04 (1 point) {4.0}

Following a loss of building electrical power, the solenoid suppling air to the dump valve:

a. will **de-energize**, the dump valve fails **OPEN** and moderator drained from the reactor tank.

b. will **energize**, the dump valve fails **OPEN** and moderator drained from the reactor tank.

c. will **de-energize**, the dump valve fails **CLOSE** and moderator kept in the reactor tank.

d. will **energize**, the dump valve fails **CLOSE** and moderator kept in the reactor tank

Answer: C.04 a.
Reference: SAR, 8.1 Normal Electrical Power Systems

Question C.05 (1 point) {5.0}

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.

Answer: C.05 b.
Reference: Technical Specifications, Table 2: Interlocks

Question C.06 (1 point) {6.0}

During a normal operation, which ONE of the following conditions will scram the reactor?

a. Reactor period exceeds 15 seconds.

b. Neutron flux is less than 2 cps.

c. Reactor door is opened.

d. Line voltage to recorder is less than 100 V.

Answer: C.06 c.
Reference: Prestart Procedures J. SCRAM Circuit Checks and Tests

Question C.07 (1 point) {7.0}

If control rod sensitivity is known, 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 $0.20 per second

d. the source level channel has increased by less than one decade

Answer: C.07 b.
Reference: Operating Procedures, Section A.

Question C.08 (1 point) {8.0}

The reactor will scram if one of the following interlocks is not satisfied:

a. Reactor Period > 15 sec

b. Reactor Console keys(2) on

c. Line voltage to records > 110V

d. Moderator-Reflector water fill 'off'

Answer: C.08 b.
Reference: Technical Specification 3.2 Table 2 (interlock)

Question C.09 (1 point, 0.25 each) {9.0}

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

Answer: C.09 a. = 4; b. = 3; c. = 1; d. = 2.
Reference: SAR, 7.7 Radiation Monitoring System.

Question C.10 (1 point) {10.0}

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.

Answer: C.10 d.
Reference: SAR, 4.2.2 Control Rods

Question C.11 (1 point) {11.0}

If smoke or fire is detected, the operator must immediately:

a. stop all rod withdrawal and notify the Senior Reactor Operator.

b. determine the location, and close down all fans.

c. notify the Operations Supervisor.

d. shutdown and secure the reactor.

Answer: C.11 d.
Reference: Emergency Plan, Section 7

Question C.12 (1 point) {12.0}

Which ONE of the following describes the warning output of the criticality detector system (area monitor)?

a. An audible and visual alarm is provided in the control room.

b. An audible and visual alarm is provided in the reactor room.

c. Audible alarm is provided in the reactor room and a visual alarm is provided in the control room.

d. An audible alarm is provided in the control room and a visual alarm is provided outside the facility.

Answer: C.12 a.
Reference: Examiners previous experience at the facility.

Question C.13 (1 point) {13.0}

The “Reactor Tank Fill and Drain Control” switch is turned to “Fill.” When the “Fill” light next to the switch comes on:

a. the reactor tank is filled to 68 inches with water.

b. the fill pump is on.

c. the return valve to the fill pump suction is fully closed.

d. the fill valve is completely opened.

Answer: C.13 b.
Reference: Prestart Procedures I. Begin Water Fill, step 3

Question C.14 (1 point) {14.0}

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.

Answer: C.14 b.
Reference: SAR, Section 7.2.3 & Laboratory 1.

Question C.15 (1 point) {15.0}

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

Answer: C.15 d.
Reference: Technical Specifications, 3.2 Reactor Control and Safety Systems, Basis

(*** End of Examination ***)