July 28, 2008

Mr. Glenn C. Winters, Director
Reactor Critical Facility
Nuclear Engineering and Science Building, 2nd floor
Rensselaer Polytechnic Institute
Troy, NY 12181

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-225/OL-08-01, RENSSELAER POLYTECHNIC INSTITUTE

Dear Mr. Winters:

During the week of July 7, 2008, the U.S. Nuclear Regulatory Commission (NRC) administered 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 Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-225

Enclosures:
1. Examination Report No. 50-225/OL-08-01
2. Facility Comments with NRC Resolution
3. Corrected Written Examination

cc: Mr. Jeffrey Geuther, Rensselaer Polytechnic Institute
cc w/o enclosure: See next page

July 28, 2008

Mr. Glenn C. Winters, Director
Reactor Critical Facility
Nuclear Engineering and Science Building, 2nd floor
Rensselaer Polytechnic Institute
Troy, NY 12181

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-225/OL-08-01, RENSSELAER POLYTECHNIC INSTITUTE

Dear Mr. Winters:

During the week of April 14, 2008, the U.S. Nuclear Regulatory Commission (NRC) administered 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 Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-225

Enclosures: 1. Examination Report No. 50-225/OL-08-01
2. Corrected Written Examination

cc: Mr. Jeffrey Geuther, Rensselaer Polytechnic Institute
cc: w/o enclosures: See next page

DISTRIBUTION w/ encls.:
PUBLIC PRTB r/f JEads Facility File CHart (O12-D19)

ADAMS ACCESSION #: ML082070060

OFFICE	**PRTB:CE**	**IOLB:LA**	**PRTB:BC**
NAME	**PIsaac pi**	**CHart cah**	**JEads jhe**
DATE	**7/25/08**	**7/25/08**	**7/28/08**

OFFICIAL RECORD COPY

cc:

Mayor of the City of Schenectady
Schenectady, NY 12305

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Test, Research, and Training
  Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

EXAMINATION REPORT NO: 50-225/OL-08-01

FACILITY: Rensselaer Polytechnic Institute

FACILITY DOCKET NO.: 50-225

FACILITY LICENSE NO.: CX-22

SUBMITTED BY: **/RA/** July 28, 2008
Patrick J. Isaac, Chief Examiner Date

SUMMARY:

During the week of July 07, 2008, the NRC administered operator licensing examinations to one Senior Reactor Operator (SRO) candidate. The candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick J. 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:

Glenn Winters, Director, Rensselaer Polytechnic Institute
Patrick Isaac, NRC, Examiner

The NRC Examiner thanked the facility for their support in the administration of the examinations and agreed to make the following changes to the written examination:

Question A.14 - Deleted. Due to the low level of power at which the reactor operates, the effects of xenon are not observed at the Rensselaer reactor.

Question B.4 - Deleted. Due to a typographical error, two of the four choices were labeled “a”.

Question C.11 - Change the correct answer to “c”.

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

FACILITY: RPI

REACTOR TYPE: Critical Experimental

DATE ADMINISTERED: 07/08/2008

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
19.00	34.5	________	____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
19.00	34.5	________	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
18.00	31.0	________	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
56.00		________ FINAL GRADE	____%	TOTALS

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

Candidate's Signature

ENCLOSURE 2

A N S W E R   S H E E T

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

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

019 a b c d ___

020 a b c d ___

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

A N S W E R S H E E T

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

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 1 ___ 2 ___ 3 ___ 4 ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

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

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER SHEET

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

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

(***** END OF CATEGORY 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 neither received nor given assistance in completing the examination. This must be done after you complete the examination.

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

4. Use black ink or dark pencil <u>only</u> to facilitate legible reproductions.

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

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

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

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

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

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

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

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

EQUATION SHEET

$Q = m\ c_p\ \Delta T$

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

$SUR = 26.06/\tau$

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

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

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

$\lambda_{eff} = 0.1$ 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 eV = 1.6×10^{-19} watt-sec.

1 Curie = 3.7×10^{10} dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

°F = 9/5°C + 32

1 Mw = 3.41×10^6 BTU/hr

°C = 5/9 (°F - 32)

Question: A.1 [1.0 point]

A reactor scram has resulted in the instantaneous insertion of .006 ΔK/K of negative reactivity. Which one of the following is the stable negative reactor period resulting from the scram?

a. 45 seconds

b. 56 seconds

c. 80 seconds

d. 112 seconds

Question: A.2 [1.0 point]

The count rate is 50 cps.   An experimenter inserts an experiment into the core, and the count rate decreases to 25 cps. Given the initial K_{eff} of the reactor was 0.8, what is the worth of the experiment?

a. $\Delta\rho$ = - 0.42

b. $\Delta\rho$ = + 0.42

c. $\Delta\rho$ = - 0.21

d. $\Delta\rho$ = + 0.21

Question: A.3 [1.0 point]

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%

Question: A.4 [1.0 point]

Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

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

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

Question: A.5 [1.0 point]

Which one of the following is the MAJOR source of energy recovered from the fission process?

a. Kinetic energy of the fission neutrons

b. Kinetic energy of the fission fragments

c. Decay of the fission fragments

d. Prompt gamma rays

Question: A.6 [1.0 point]

Which statement illustrates a characteristic of Subcritical Multiplication?

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

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

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

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

Question: A.7 [1.0 point]

If reactor power is increasing by a decade every minute, it has a period of:

a. 13 sec

b. 26 sec

c. 52 sec

d. 65 sec

Question: A.8 [1.0 point]

Which one of the following statements describes Count Rate characteristics after a control rod withdrawal with the reactor subcritical? (Assume the Rx remains subcritical.)

a. Count Rate will rapidly increase (prompt jump) then gradually increase to a stable value.

b. Count Rate will rapidly increase (prompt jump) then gradually decrease to the previous value.

c. Count Rate will rapidly increase (prompt jump) to a stable value.

d. There will be no change in Count Rate until criticality is achieved.

Question: A.9 [1.0 point]

Most nuclear text books list U-235 delayed neutron fraction (β_i) as being 0.0065Δρ. Most research reactors however have an effective delayed neutron fraction ($\beta_{effective}$) of 0.0070 Δρ. Which one of the following is the reason for this difference?

a. Delayed neutrons are born at higher energies than prompt neutrons resulting in a greater worth for the neutrons.

b. Delayed neutrons are born at lower energies than prompt neutrons resulting in a greater worth for the neutrons.

c. The fuel includes U^{238} which has a relatively large β for fast fission.

d. The fuel includes U^{238} which via neutron absorption becomes Pu^{239} which has a larger β for fission.

Question: A.10 [1.0 point]

Which ONE of the following conditions will DECREASE shutdown margin?

a. The highest worth control rod is fully withdrawn.

b. Adding new uranium fuel.

c. Xenon buildup following shutdown.

d. Adding an experiment which inserts negative reactivity.

Question: A.11 [1.0 point]

You perform two initial startups a week apart. Each of the startups has the same starting conditions, (core burnup, pool and fuel temperature, and count rate are the same). The only difference between the two startups is that during the **SECOND** one you stop for 10 minutes to answer the phone. For the second startup compare the critical rod height and count rate to the first startup.

	Rod Height	Count Rate
a.	Higher	Same
b.	Lower	Same
c.	Same	Lower
d.	Same	Higher

Question: A.12 [1.0 point]

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

a. 3 hr.

b. 75 hr.

c. 108 hr.

d. 158 hr.

Question: A.13 [1.0 point]

Which ONE of the following is the reason for the -80 second period following a reactor scram?

a. The negative reactivity added during a scram is greater than á-effective

b. The half-life of the longest-lived group of delayed neutron precursors is approximately 55 seconds

c. The fuel temperature coefficient adds positive reactivity as the fuel cools down, thus retarding the rate at which power drops

d. The amount of negative reactivity added is greater than the Shutdown Margin

~~Question: A.14 [1.0 point]~~ DELETED

~~Which One of the following is the time period in which the maximum amount of XE^{135} will be present in the core?~~

~~a. 8 to 10 hours after a startup to 100% power.~~

~~b. 4 to 6 hours after a power increase from 50% to 100%.~~

~~c. 4 to 6 hours after a power decrease from 100% to 50%.~~

~~d. 8 to 10 hours after a scram from 100%~~.

Question: A.15 [1.0 point]

Which ONE of the following describes the difference between reflectors and moderators?

a. Reflectors decrease core leakage while moderators thermalize neutrons

b. Reflectors shield against neutrons while moderators decrease core leakage

c. Reflectors decrease thermal leakage while moderators decrease fast leakage

d. Reflectors thermalize neutrons while moderators decrease core leakage

Question: A.16 [1.0 point]

Experimenters are attempting to determine the critical mass of a new fuel material. As more fuel was added the following fuel to count rate data was taken:

Fuel	Counts/Sec
1.00 kg	500
1.50 kg	800
2.00 kg	1142
2.25 kg	1330
2.50 kg	4000
2.75 kg	15875

Which one of the following is the amount of fuel needed for a critical mass?

a. 2.60 kg

b. 2.75 kg

c. 2.80 kg

d. 2.95 kg

Question: A.17 [1.0 point]

With the reactor on a constant period, which transient requires the LONGEST time to occur?

A reactor power change of:

a. 5% power going from 1% to 6% power

b. 10% power going from 10% to 20% power

c. 15% power going from 20% to 35% power

d. 20% power going from 40% to 60% power

Question: A.18 [1.0 point]

Which one of the following is NOT a reason for or benefit of operating with a flat neutron flux profile?

a. A higher average power density is possible.

b. More even burn up of fuel results.

c. Moderator temperature is equalized throughout the core.

d. Control rod worth is made more uniform.

Question: A.19 [1.0 point]

The reactor has scrammed following an extended period of operation at full power.
Which one of the following accounts for generation of a majority of the heat one (1) hour after the scram?

a. Spontaneous fissions

b. Delayed neutron fissions

c. Alpha fission product decay

d. Beta fission product decay

Question: A.20 [1.0 point]

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.

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

d. The maximum reactivity insertion with the reactor shutdown with control rods fully inserted under peak Xenon conditions.

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

Question: B.1 [1.0 point]

In order to ensure the health and safety of the public, in an emergency, 10CFR50 allows the operator to deviate from Technical Specifications. What is the minimum level of authorization needed to deviate from Tech. Specs?

a. USNRC

b. Reactor Supervisor

c. Licensed Senior Reactor Operator.

d. Licensed Reactor Operator.

Question: B.2 [1.0 point]

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

a. Control room area gamma monitoring system bypassed.

b. A reactivity change of $0.35 from withdrawing a movable experiment with a reactivity worth of $0.50.

c. A negative temperature coefficient of reactivity above 100ºF.

d. One inoperable control rod.

Question: B.3 [1.0 point]

Which one of the following statements defines the Technical Specifications term "Channel Test?"

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

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

c. The introduction of a simulated signal into the instrument primary sensor for verification of proper instrument response alarm and/or initiating action.

d. The combination of sensors, electronic circuits and output devices connected to measure and display the value of a parameter

~~Question: B.4 [1.0 point]~~ DELETED

~~Which one of the following instruments should you use to survey a gamma source?~~

~~a. Thin window ion chamber.~~

~~a. GM tube.~~

~~b. Ion chamber (open window).~~

~~c. Neutron ball.~~

Question: B.5 [2.0 points, 0.5 each]

Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

Question: B.6 [2.0 points, 0.5 each]

Match the radiation reading from column A with its corresponding radiation area classification (per 10 CFR 20) listed in column B.

COLUMN A	COLUMN B
a. 10 mRem/hr	1. Unrestricted Area
b. 150 mRem/hr	2. Radiation Area
c. 10 Rem/hr	3. High Radiation Area
d. 550 Rem/hr	4. Very High Radiation Area

Question: B.7 [1.0 point]

A radioactive source generates a dose of 100 mr/hr at a distance of 10 feet. Using a two inch thick sheet of lead for shielding the reading drops to 50 mr/hr at a distance of 10 feet. What is the minimum number of sheets of the same lead shielding needed to drop the reading to less than 5 mr/hr at a distance of 10 ft?

a. 1

b. 3

c. 5

d. 7

Question: B.8 [1.0 point]

Which one of the following is the 10 CFR 20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)**?

a. The sum of the deep dose equivalent and the committed effective dose equivalent.

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

c. The sum of the external deep dose and the organ dose.

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

Question: B.9 [1.0 point]

A room contains a source which, when exposed, results in a general area dose rate of 175 millirem per hour. This source is scheduled to be exposed continuously for 25 days. Select an acceptable method for controlling radiation exposure from the source within this room.

a. Post the area with words “Danger-Radiation Area”.

b. Equip the room with a device to visually display the current dose rate within the room.

c. Equip the room with a motion detector that will alarm in the control room.

d. Lock the room to prevent inadvertent entry into the room.

Question: B.10 [2.0 points, 0.5 each]

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

Question: B.11 [1.0 point]

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. projected radiological dose or dose commitment values to individuals that warrant protective action following a release of radioactive material.

Question: B.12 [1.0 point]

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

a. in the control room.

b. in the counting room.

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

d. near the facility gate near the site boundary.

Question: B.13 [1.0 point]

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.

Question: B.14 [1.0 point]

Which one of the following does NOT require NRC approval for changes?

a. Facility License

b. Requalification plan

c. Emergency Implementation Procedures

d. Emergency Plan

Question: B.15 [1.0 point]

In the event of a civil disturbance involving the RCF the operator must immediately:

a. Evacuate the Critical Facility taking the Log Book.

b. Notify the NRC.

c. Notify the Operations Supervisor.

d. Verify all fans are turned off.

Question: B.16 [1.0 point]

Assuming that no channels are bypassed, the safety system channels which are required by the Technical Specifications to be operating in all modes of operation are:

a. log N power level, reactor period, pool water level

b. linear power level, manual scram, criticality detector

c. reactor period, water dump valve scram, manual scram

d. log N power level, reactor door scram, manual scram

Question: B.17 [1.0 point]

It is April 1, 2008. You have stood watch for the following hours during the last quarter:

Jan. 11, 2008	0.5 hours
Feb. 24, 2008	1.5 hours
Mar. 16, 2008	1.0 hours

What requirements must you meet in order to stand an RO watch today?

a. None. You've met the minimum requirements of 10 CFR 55.

b. You must perform 4 hours of shift functions under the direction of a licensed operator or licensed senior operator as appropriate.

c. You must perform 6 hours of shift functions under the direction of a licensed operator or licensed senior operator as appropriate.

d. You must submit a new application form to the NRC requesting a waiver to reactivate your license.

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

Question: C.1 [1.0 point]

A linear power channel (LP1 or LP2) uses a (an):

a. uncompensated ion chamber

b. compensated ion chamber

c. fission chamber

d. boron-trifluoride detector

Question: C.2 [1.0 point]

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 enriched boron in iron in a stainless steel cement.

Question: C.3 [1.0 point]

Which ONE of the following types of detector is utilized in the area gamma radiation monitoring system?

a. Geiger-Mueller tube

b. Scintillation detector

c. Ionization chamber

d. Proportional counter

Question: C.4 [1.0 point]

The reactor room ventilation system:

a. operates by natural circulation, with its own vent to the outside stack

b. shares a vent with the control room ventilation system

c. exhaust fan starts up in response to high radiation alarms

d. exhaust vent closes in response to high radiation alarms

Question: C.5 [1.0 point]

The temperature monitoring system monitors the temperature of the:

a. reactor coolant and control room air.

b. reactor coolant and fuel.

c. reactor coolant and reactor room air.

d. fuel and reactor room air.

Question: C.6 [1.0 point]

The Dump Valve Bypass control:

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

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

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

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

Question: C.7 [1.0 point]

The structure within the core that forms the base of the three-tiered core-support structure is the:

a. carrier plate.

b. plastic spacer plate.

c. fuel pin lattice plate.

d. unistrut support plate.

Question: C.8 [1.0 point]

The "worst case" single instrument malfunction for a reactivity insertion accident is a(n):

a. loss of voltage to the detector for linear power channel 1(LP1).

b. open circuit on the ion chamber for log power channel 2(PP2).

c. interrupt of output current to the Water Dump Valve solenoid.

d. grounded input signal to the short period module of the Solenoid Interrupt Circuit.

Question: C.9 [1.0 point]

The area gamma monitoring system has detectors located in the control room, in the reactor room:

a. on the reactor deck and outside the reactor room window.

b. in the counting room and outside the reactor room window.

c. on the reactor deck and in the fuel storage vault.

d. in the counting room and in the fuel storage vault.

Question: C.10 [1.0 point]

The water dump valve operation may be by-passed by:

a. locking closed the water dump valve operator locally.

b. depressing the bypass pushbutton on the main control panel.

c. placing key switch located on CP-2 to the "By-pass" position.

d. disconnecting the DC current output at the Solenoid Interrupt Circuit module.

Question: C.11 [1.0 point]

Under what condition is the moderator fill pump to be operated during startup?

a. When control rods are in motion.

b. When the dump valve is open and the scram is not bypassed.

c. When water level is less than 68 inches.

d. When the air compressor is secured.

Question: C.12 [1.0 point]

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

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

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

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

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

Question: C.13 [1.0 point]

Which ONE of the following describes the device used for calibrating the logarithmic power channel?

a. Gold-foil neutron flux pin.

b. Boron-impregnated neutron flux pin.

c. Stochastic thermal power temperature recorder.

d. Local gamma-flux power radiation level recorder.

Question: C.14 [1.0 point]

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

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

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

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

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

Question: C.15 [1.0 point]

Differentiation between gamma and neutron induced signals in the startup channel is accomplished by:

a. amplifying only neutron signals coming from the detector.

b. counting only signals at strengths greater than the gamma signals.

c. adjusting the amplifier gain.

d. adjusting the compensating voltage applied to the detector.

Question: C.16 [1.0 point]

When there is a loss of power, the reactor tank pump:

a. suction valve fails OPEN, and the discharge valve fails CLOSED.

b. suction valve fails OPEN, and the discharge valve fails OPEN.

c. suction valve fails CLOSED, and the discharge valve fails CLOSED.

d. suction valve fails CLOSED, while the discharge valve fails OPEN.

Question: C.17 [1.0 point]

There are three scram functions that may be BYPASSED. They are:

a. high water level scram, reactor door scram, dump valve scram.

b. linear power scram, dump valve scram, period scram.

c. linear power scram, high water level scram, reactor door scram.

d. reactor door scram, period scram, dump valve scram.

Question: C.18 [1.0 point]

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 stops.

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

d. the fill valve is completely opened.

(*** End of Examinatiuon ***)

A.1 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.6, p. 4-16.

A.2 a
REF: $CR_1 / CR_2 = (1 – Keff_2) / (1 – Keff_1) \rightarrow 50 / 25 = (1 – Keff_2) / (1 – 0.8)$
Therefore $Keff_2 = 0.6$
$\Delta\rho = Keff_2 – Keff_1 / Keff_2 \cdot Keff_1 = (0.6 – 0.8) / (0.6 \cdot 0.8) = - 0.41667$/CR2=(1-Keff2)/(1-Keff1)

A.3 a
REF: $P = P_0 e^{t/\tau}$ $P_o = 110\%$ $\tau = 20$ sec. t = 0.5 $P = 110 e^{0.5/20} = 112.78\%$

A.4 d
REF: Glasstone and Sesonske, *Nuclear Reactor Engineering*, Chapter 5, Section 5.114

A.5 b
REF: Standard NRC Reactor Theory Question

A.6 a
REF: Standard NRC Reactor Theory Question

A.7 b
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991,
$P = P_o e^{t/T}$ $10 = 1e^{60/T}$ ln 10 = 60/T 2.3 = 60/T T = 60/2.3 T = 26 seconds

A.8 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 5.7, pp. 5-28 — 5-38

A.9 b
REF: Standard NRC Reactor Theory Question

A.10 b
REF: Standard NRC Reactor Theory Question

A.11 d
REF: Burn, R. Introduction to Nuclear Reactor Operations, 1982, Sect. 5.7

A.12 b
REF: $A = A_o e^{-\lambda t}$ $\lambda = .693 / T2 \rightarrow \ln A/A_o = - .693\, t / T2$
$T2 = - .693 \cdot 24hr / \ln 0.8 = 75$ hr

A.13 b
REF: Introduction to Nuclear Reactor Operations, Reed Robert Burn, Section 3.2.2, Delayed Neutrons.

~~A.14 d~~ DELETED
~~REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988~~

A.15 a
REF: Introduction to Nuclear Reactor Operations, Reed Robert Burn, Section 5.4, Inverse Multiplication, p. 5-14.

A.16 c
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 3.161 — 3.163, pp. 190 & 191.

A.17 a
REF: Introduction to Nuclear Reactor Operations, Reed Robert Burn, Section 4.3, Reactor Period and Reactor Power

A.18 c
REF: MIT Reactor Physics Notes; Reactivity Feedback

A.19 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988 pg. 3-4.

A.20 b
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, § 5.198, p. 300.

B.1 c
REF: 10CFR50.54(y)

B.2 c
REF: TS 3.2

B.3 c
REF: TS 1.0

~~B.4 b~~ DELETED
~~REF: Nuclear Power Plant Health Physics and Radiation Protection, Ch. 10~~

B.5 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

B.6 a, 2; b, 3; c, 3; d, 4
REF: 10 CFR 20.1003, Definitions

B.7 c
REF: Two inches = one-half thickness ($T_{1/2}$). Using 5 half-thickness will drop the dose by a factor of $(\frac{1}{2})^5 = 1/32$ □ $100/32 = 3.13$

B.8 a
REF: 10 CFR 20.1003 *Definitions*

B.9 d
REF: 10 CFR 20.1601

B.10 1 d 2 c 3 b 4 c
REF: 10CFR55

B.11 a
REF: RCF Emergency Plan Definitions

B.12 b
REF: RCF Emergency Plan §7.0

B.13 c
REF: RCF Emergency Plan §6.0 & Emergency Procedures §2.0

B.14 c
REF: 10 CFR 50.54q; 10 CFR 50.59; 10 CFR 55.59

B.15 c
REF: Emergency Procedures §6.4

B.16 d
REF: T.S. Table 1

B.17 c
REF: 10CFR55.53e & f

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

C.1 a
REF: Laboratory 1.

C.2 d
REF: SAR § 4.2.2.

C.3 a
REF: SAR page 7-7.

C.4 a
REF: SAR page 9-1

C.5 c
REF: SER pg. 7-4

C.6 a
REF: Prestart Procedures.

C.7 a
REF: SAR page 4-14

C.8 b
REF: SAR page 13-1

C.9 a
REF: SAR page 7-7

C.10 c
REF: Prestart Procedures.

C.11 c
REF: Pre-Start Procedures.

C.12 c
REF: Laboratory 1.

C.13 a
REF: Surveillance Procedure “Power Calibration.”

C.14 b
REF: Emergency Procedures, page 3

C.15 b
REF: Laboratory 1.

C.16 a
REF: SAR Figure 5.1.

C.17 d
REF: Technical Specifications, Section 3.2

C.18 d
REF: Pre-start Procedures.

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