June 17, 2004

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-225/OL-04-01, RENSSELAER POLYTECHNIC INSTITUTE

Dear Mr. Winters:

During the week of May 24, 2004, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Rensselaer Polytechnic Institute reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.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 Mr. Warren Eresian at 301-415-1833 or internet e-mail wje@nrc.gov.

Sincerely,

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-225

Enclosures: 1. Initial Examination Report No. 50-225/OL-04-01
2. Examination and answer key

cc w/encls:
Please see next page

cc:

Mayor of the City of Schenectady
Schenectady, NY 12305

Barbara Youngberg
Chief, Radiation Section
NYS Dept. of Environmental Conservation
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Mr. Thomas McGiff, RSO
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Director
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Please see next page

<u>DISTRIBUTION w/encls.</u>:
PUBLIC
DHughes, PM
Facility File (EBarnhill)

<u>DISTRIBUTION w/o encls.</u>:
RNRP\R&TR r/f
WEresian
PMadden

ADAMS ACCESSION #: ML041550693 **TEMPLATE #: NRR-074**

OFFICE	**RNRP:CE**		**IROB:LA**		**RNRP:SC**	
NAME	**WEresian**		**EBarnhill**		**PMadden**	
DATE	**06/ 3 /2004**		**06/ 9 /2004**		**06/ 16 /2004**	

C = COVER **E = COVER & ENCLOSURE** **N = NO COPY**

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

REPORT NO.:	50-225/OL-04-01
FACILITY DOCKET NO.:	50-225
FACILITY LICENSE NO.:	CX-22
FACILITY:	Rensselaer Polytechnic Institute
EXAMINATION DATES:	May 25, 2004
EXAMINERS:	Warren Eresian, Chief Examiner

SUBMITTED BY: **/RA/** 06/ 17 /2004
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of May 24, 2004, the NRC administered operator licensing examinations to two Senior Reactor Operator (Instant) candidates. Both candidates passed the examinations.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**0/0**	**2/0**	**2/0**
Operating Tests	**0/0**	**2/0**	**2/0**
Overall	**0/0**	**2/0**	**2/0**

3. Exit Meeting:
   Mr. Jonathan Stephens, Reactor Supervisor
   Warren Eresian, NRC Chief Examiner

The NRC thanked the facility staff for their cooperation during the examinations. No generic deficiencies were noted. The Reactor Supervisor provided comments on two questions, resulting in changes to the answer key.

U. S. NUCLEAR REGULATORY COMMISSION
RESEARCH AND TEST REACTOR LICENSE EXAMINATION

FACILITY: Rensselaer Polytechnic Institute

REACTOR TYPE: Critical Facility

DATE ADMINISTERED: 05/25/2004

REGION: 1

CANDIDATE:___________________________

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers one side ONLY. Attach any answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each category 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
20	36	______	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	36	______	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
15	28	______	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
55		______	_____% FINAL GRADE	

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

____
Candidate's Signature

ENCLOSURE 2

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 in the upper right-hand corner of the examination cover sheet.

6. Print your name in the upper right-hand corner of the answer sheets.

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

8. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK. NOTE: partial credit will NOT be given on multiple choice questions.

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

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

11. When you are done and have turned in your examination, leave the examination area as defined by the examiner. If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001 (1.00)

Of the approximately 200 Mev of energy released per fission event, the largest amount appears in the form of:

a. beta and gamma radiation

b. prompt and delayed neutrons

c. fission fragments

d. alpha radiation

QUESTION: 002 (1.00)

A reactor is operating at a steady-state power level of 1.000 kW. Reactor power is increased to a new steady-state power level of 1.004 kW. At the higher power level, K_{eff} is:

a. 1.004

b. 1.000

c. 0.004

d. 0.000

QUESTION: 003 (1.00)

A factor in the six-factor formula which is most affected by control rod position is:

a. Resonance escape probability

b. Fast fission factor

c. Neutron reproduction factor

d. Thermal utilization factor

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

QUESTION: 004 (1.00)

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 beta-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: 005 (1.00)

In a subcritical reactor, K_{eff} is increased from 0.861 to 0.946. Which ONE of the following is the amount of reactivity that was added to the reactor core?

a. 0.085 delta k/k ($10.90)

b. 0.104 delta k/k ($13.33)

c. 0.161 delta k/k ($20.64)

d. 0.218 delta k/k ($27.95)

QUESTION: 006 (1.00)

For U-235, the thermal fission cross-section is 582 barns, and the capture cross-section is 99 barns. When a thermal neutron is absorbed by U-235, the probability that a fission will occur is:

a. 0.146

b. 0.170

c. 0.830

d. 0.855

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

QUESTION: 007 (1.00)

A negative fuel temperature coefficient means that:

a. when fuel temperature decreases, negative reactivity is added.

b. when fuel temperature increases, positive reactivity is added.

c. when fuel temperature decreases, reactor power increases.

d. when fuel temperature decreases, positive reactivity is added.

QUESTION: 008 (1.00)

Which ONE of the following elements will slow down fast neutrons most quickly, i.e. produces the greatest energy loss per collision?

a. Oxygen-16

b. Uranium-238

c. Hydrogen-1

d. Boron-10

QUESTION: 009 (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.

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

QUESTION: 010 (1.00)

The major source of heat generated in the fuel from the decay of fission products is from:

a. beta and gamma radiation.

b. prompt and delayed neutrons.

c. fission fragment kinetic energy.

d. alpha radiation.

QUESTION: 011 (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: 012 (1.00)

The effective neutron multiplication factor, K_{eff}, is defined as:

a. absorption/(production + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. production/(absorption + leakage)

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

QUESTION: 013 (1.00)

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

a. Neutron economy is increased since thermal neutrons are less likely to leak out of the core 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. The fission cross section of the fuel is much higher for thermal neutrons than fast neutrons.

QUESTION: 014 (1.00)

Delayed neutrons are considered to be "more effective" than prompt neutrons because delayed neutrons have a:

a. higher reproduction factor.

b. higher resonance escape probability.

c. higher fast fission factor.

d. higher thermal utilization factor.

QUESTION: 015 (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.

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

QUESTION: 016 (1.00)

Delayed neutron precursors decay by beta decay. Which ONE reaction below is an example of beta decay?

a. ${}_{35}Br^{87} \text{->} {}_{36}Kr^{87}$

b. ${}_{35}Br^{87} \text{->} {}_{35}Kr^{86}$

c. ${}_{35}Br^{87} \text{->} {}_{34}Kr^{86}$

d. ${}_{35}Br^{87} \text{->} {}_{33}Kr^{83}$

QUESTION: 017 (1.00)

Which ONE of the following describes the term *prompt jump*?

a. The instantaneous change in power level due to withdrawing a control rod.

b. A reactor which has attained criticality on prompt neutrons alone.

c. A reactor which is critical using both prompt and delayed neutrons.

d. A positive reactivity insertion which is less than β_{eff}.

QUESTION: 018 (1.00)

Which ONE of the following conditions will DECREASE shutdown margin?

a. Addition of uranium fuel.

b. Adding an experiment which inserts negative reactivity.

c. Xenon buildup following shutdown.

d. Increasing pool water temperature, if temperature coefficient is negative.

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

QUESTION: 019 (1.00)

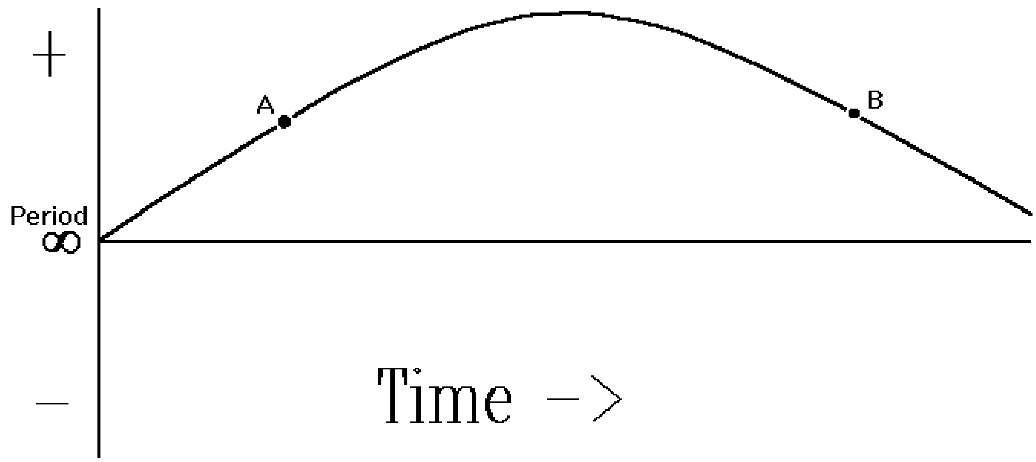
Shown below is a trace of reactor period as a function of time. Between points A and B **REACTOR POWER** is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



QUESTION: 020 (1.00)

Which ONE of the following describes the response of the subcritical reactor to <u>equal</u> 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 CATEGORY A *****)

QUESTION: 001 (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: 002 (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: 003 (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

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

QUESTION: 004 (1.00)

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

a. Control room area gamma monitoring system bypassed.

b. Positive isothermal temperature coefficient of reactivity.

c. A movable experiment with a reactivity worth of $0.65.

d. Three operable control rods

QUESTION: 005 (1.00)

In accordance with the Technical Specifications, a SAFETY LIMIT is:

a. the actuating level for an automatic protective device related to those variables having significant safety functions.

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

c. a limit on an important process variable which is found to be necessary to reasonably protect the integrity of physical barriers which guard against the uncontrolled release of radioactivity.

d. a system which is designed to initiate automatic reactor protection or to provide information for initiation of manual protective action.

QUESTION: 006 (1.00)

The maximum reactivity change allowed for withdrawal and insertion of an experiment with an absolute worth of $.50 is:

a. $0.40/second.

b. $0.35/second.

c. $0.20/second.

d. $0.15/second.

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

QUESTION: 007 (1.00)

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

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

b. notify the Operations Supervisor.

c. shutdown and secure the reactor.

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

QUESTION: 008 (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: 009 (1.00)

Emergency Action Levels are:

a. specific instrument readings, observations, dose rates, etc which provide thresholds for establishing emergency classes.

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.

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

QUESTION: 010 (1.00)

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

a. A power level trip setting of 120 watts.

b. Coolant temperature of 45 degrees F.

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

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

QUESTION: 011 (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 through loss of the reflector above the core following a scram.

QUESTION: 012 (1.00)

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.

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

QUESTION: 013 (1.00)

"Experiments containing known explosives or highly flammable materials shall not be installed in the reactor." This is an example of a:

a. safety limit.

b. surveillance requirement.

c. limiting safety system setting.

d. limiting condition for operation.

QUESTION: 014 (1.00)

Which ONE of the following materials could be used in a reactor experiment?

a. Those that may produce violent chemical reactions.

b. Those which contain explosives.

c. Those that are highly flammable.

d. Those which contain corrosives.

QUESTION: 015 (1.00)

In accordance with the Emergency Plan, an "Emergency Planning Zone" is:

a. an area for which offsite emergency planning is performed.

b. the area beyond the site boundary.

c. the area within the site boundary.

d. the area within the site boundary where the licensee may directly initiate emergency activities.

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

QUESTION: 016 (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: 017 (1.00)

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: 018 (1.00)

Which ONE of the following defines an "Instrument 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.

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

QUESTION: 019 (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. neutron flux = 60 counts per minute.

d. fill pump running.

QUESTION: 020 (1.00)

Which ONE of the following Non-Radiological Emergencies does NOT require that the reactor be shut down and secured?

a. Human injury.

b. Smoke or fire.

c. Bomb threat.

d. Act of civil disorder.

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

QUESTION: 001 (1.00)

Period information is supplied from the:

a. BF_3 detector.

b. Linear Channel 1.

c. Linear Channel 2.

d. Log Amplifier.

QUESTION: 002 (1.00)

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

QUESTION: 003 (1.00)

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

a. 30 minutes

b. 40 minutes

c. 60 minutes

d. 80 minutes

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

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.	Reactor window	2. 100 mr/hour
c.	Reactor room	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 enriched boron in iron in a stainless steel cement.

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.

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

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 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: 009 (1.00)

Which ONE of the following descriptions of interlock features will allow control rod motion?

a. fill pump on, period greater than 15 seconds.

b. fill pump off, period less than 15 seconds.

c. fill pump off, period greater than 15 seconds.

d. fill pump on, period greater than 15 seconds.

QUESTION: 010 (1.00)

The reactor is operating at 100% power when the 400 cycle MG set fails. As a result:

a. control rods cannot be moved.

b. the dump valve automatically opens.

c. the reactor scrams.

d. control rods cannot be withdrawn.

QUESTION: 011 (1.00)

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.

QUESTION: 012 (1.00)

The purpose of the 400 Hz output from the MG set is to:

a. furnish the drive power for the recorders.

b. provide power to the control rod position indicators.

c. supply input power to the Solenoid Interrupt Circuit.

d. develop the required magnetic flux to couple the control rods to the drives.

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

QUESTION: 013 (1.00)

The SPERT fuel elements consist of:

a. 4.8% enriched uranium with stainless steel clad.

b. 35.2% enriched uranium with stainless steel clad.

c. 4.8% enriched uranium with aluminum clad.

d. 35.2% enriched uranium with aluminum clad.

QUESTION: 014 (1.00)

The poison section of a control rod is constructed of:

a. boron in iron, clad in stainless steel.

b. graphite, clad in aluminum.

c. beryllium in iron, clad in stainless steel.

d. boron in iron, clad in aluminum.

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

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
C.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 65.

ANSWER: 002 (1.00)
B.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2^{nd} Edition, page 287.

ANSWER: 003 (1.00)
D.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 85.

ANSWER: 004 (1.00)
B.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2^{nd} Edition, page 289.

ANSWER: 005 (1.00)
B.
REFERENCE:
From Equation Sheet, $\rho = (K - 1)/K$. When K = 0.861, ρ = -0.161 delta K/K. When K = 0.946, ρ = -0.057 delta K/K.
$\Delta\rho$ = -0.057 - (-0.161) = +0.104 delta K/K.

ANSWER: 006 (1.00)
D.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 18.

ANSWER: 007 (1.00)
D.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2^{nd} Edition, page 307.

ANSWER: 008 (1.00)
C.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2^{nd} Edition, page 59.

ANSWER: 009 (1.00)
C.
REFERENCE:
From Equation Sheet, $P = P_o e^{t/\tau}$; $P = 1xe^{(60/29)} = e^{2.069}$ = 7.91 watts.

ANSWER: 010 (1.00)
C.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 60.

ANSWER: 011 (1.00)
C.
REFERENCE:
A supercritical reactor cannot indicate a steady neutron level.

ANSWER: 012 (1.00)
D.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 195.

ANSWER: 013 (1.00)
D.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 81.

ANSWER: 014 (1.00)
B.
REFERENCE:
Duderstadt and Hamilton, Nuclear Reactor Analysis, page 239.

ANSWER: 015 (1.00)
D.
REFERENCE:
Since time is not a factor, any amount of positive reactivity will cause the power to rise.

ANSWER: 016 (1.00)
A.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 71.

ANSWER: 017 (1.00)
A.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 287.

ANSWER: 018 (1.00)
A.
REFERENCE:
Anything which adds positive reactivity will increase the shutdown margin.

ANSWER: 019 (1.00)
A.
REFERENCE:
Since the period is always positive, reactor power is increasing, but at a lower rate.

ANSWER: 020 (1.00)
B.
REFERENCE:
RPI Laboratory 2.

B. NORMAL/EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
A.
REFERENCE:
10 CFR 20.

ANSWER: 002 (1.00)
B.
REFERENCE:
RPI Requalification Program

ANSWER: 003 (1.00)
B.
REFERENCE:
From Equation Sheet, $DR_1D_1^2 = DR_2D_2^2$
$(10)(1) = DR_2\ (64)$; $DR_2 = 10/64 = 0.156$ R/hour = 156 mR/hour.

ANSWER: 004 (1.00)
B.
REFERENCE:
RPI Technical Specifications, Section 3.2.

ANSWER: 005 (1.00)
C.
REFERENCE:
RPI Technical Specifications, Definitions.

ANSWER: 006 (1.00)
C.
REFERENCE:
RPI Technical Specifications, Section 3.4.

ANSWER: 007 (1.00)
C.
REFERENCE:
RPI Emergency Plan, Section 6.2.

ANSWER: 008 (1.00)
A.
REFERENCE:
RPI Technical Specifications, Section 4.1.

ANSWER: 009 (1.00)
A.
REFERENCE:
RPI Emergency Plan, Definitions.

ANSWER: 010 (1.00)
B.
REFERENCE:
RPI Technical Specifications, Section 3.2.

ANSWER: 011 (1.00)
D.
REFERENCE:
RPI Technical Specifications, Section 3.1.

ANSWER: 012 (1.00)
B.
REFERENCE:
RPI Emergency Plan, Section 7.

ANSWER: 013 (1.00)
D.
REFERENCE:
RPI Technical Specifications, Section 3.4.

ANSWER: 014 (1.00)
D.
REFERENCE:
RPI Technical Specifications, Section 3.4.

ANSWER: 015 (1.00)
A.
REFERENCE:
RPI Emergency Plan, Definitions.

ANSWER: 016 (1.00)
D.
REFERENCE:
10 CFR 20.

ANSWER: 017 (1.00)
C.
REFERENCE:
RPI Emergency Plan, Section 2.

ANSWER: 018 (1.00)
C.
REFERENCE:
RPI Technical Specifications, Definitions.

ANSWER: 019 (1.00)
B.
REFERENCE:
RPI Technical Specifications, Table 2.

ANSWER: 020 (1.00)
A.
REFERENCE:
RPI Emergency Plan, Section 6.6.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
D.
REFERENCE:
SAR, Figure 7.1

ANSWER: 002 (1.00)
B.
REFERENCE:
Operating Procedures, Section A.

ANSWER: 003 (1.00)
B.
REFERENCE:
Operating Procedures, Section J.

ANSWER: 004 (1.00)
A,4; B,3; C,1; D,2.
REFERENCE:
SAR, Section 7.7.

ANSWER: 005 (1.00)
D.
REFERENCE:
SAR, Section 4.2.2.

ANSWER: 006 (1.00)
D.
REFERENCE:
Technical Specifications, Table 1.

ANSWER: 007 (1.00)
A.
REFERENCE:
SAR, Section 9.1.

ANSWER: 008 (1.00)
A.
REFERENCE:
SAR, Section 4.2.5.

ANSWER: 009 (1.00)
C.
REFERENCE:
SAR, Figure 7.2.

ANSWER: 010 (1.00)
D.
REFERENCE:
SAR, Figure 7.2.

ANSWER: 011 (1.00)
D.
REFERENCE:
Pre-Startup Procedures, Section D.

ANSWER: 012 (1.00)
B.
REFERENCE:
SAR

ANSWER: 013 (1.00)
A.
REFERENCE:
SAR, Section 4.2.1.

ANSWER: 014 (1.00)
A.
REFERENCE:
SAR, Section 4.2.2.

ANSWER: 015 (1.00)
B.
REFERENCE:
SAR, Section 4.2.2.

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

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 _____
019	a	b	c	d _____
020	a	b	c	d _____

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

B. NORMAL/EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS

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 ______
019	a	b	c	d ______
020	a	b	c	d ______

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

C. FACILITY AND RADIATION 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 ______

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

EQUATION SHEET

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

°C = 5/9 (°F - 32)