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

REPORT NO.: 50-225/OL-96-01

FACILITY DOCKET NO.: 50-225

FACILITY LICENSE NO.: CX-22

FACILITY: Rensselaer Polytechnic Institute

EXAMINATION DATES: January 18, 1996

EXAMINER: Warren J. Eresian, Chief Examiner

SUBMITTED BY: Warren J. Eresian 1/30/96
Warren J. Eresian, Chief Examiner Date

SUMMARY:

The NRC administered initial license examinations to two Senior Reactor Operator (Instant) applicants, and retake examinations (written only) to two Senior Reactor Operator (Instant) applicants.

ATTACHMENT 1

REPORT DETAILS

1. Examiners:

   Warren J. Eresian, Chief Examiner

2. Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	Total (Pass/Fail)
NRC Grading:	0/0	3/1	3/1

3. Written Examination:

   Both initial Senior Reactor Operator (Instant) applicants passed the written examination. One Senior Reactor Operator (Instant) applicant passed the retake examination, Category A. One Senior Reactor Operator (Instant) applicant failed the retake examination, Category B.

4. Operating Test:

   Both initial Senior Reactor Operator (Instant) applicants passed the operating test. Retake applicants were not required to take the operating test.

5. Exit Meeting:

   An exit meeting was held on January 18, 1996. Present were:

   Warren J. Eresian, NRC Chief Examiner
   Mr. Michael Galayda, Supervisor, Critical Facility

   The NRC thanked the RPI staff for their assistance during the examination. No generic problems were noted.

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

FACILITY: Rensselaer

REACTOR TYPE: Critical Facility

DATE ADMINISTERED: 01/18/96

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	35	______	______	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	35	______	______	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
17	30	______	______	C. PLANT AND RADIATION MONITORING SYSTEMS
57		______ FINAL GRADE	______%	

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 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)

A reactor is subcritical with a K_{eff} of 0.955. Five dollars ($5.00) of positive reactivity is inserted into the core (ß = 0.007). At this point, the reactor is:

a. supercritical.

b. exactly critical.

c. subcritical.

d. prompt critical.

QUESTION: 002 (1.00)

During the time when reactor power increases, the delayed neutron fraction, ß:

a. increases because delayed neutron precursors are being produced at a faster rate.

b. decreases because delayed neutrons are being produced from precursors that were formed at a lower power level.

c. increases because prompt neutrons are being produced at a faster rate.

d. remains unchanged.

QUESTION: 003 (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}.

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

QUESTION: 004 (1.00)

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

a. 0.004 delta k/k.

b. 0.4% delta k/k.

c. 1.004% delta k/k.

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

QUESTION: 005 (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: 006 (1.00)

Fuel is being loaded into a core. The operator is using a 1/M plot to monitor core loading. Which ONE of the following conditions would result in a non-conservative prediction of core critical mass (i.e. the core would go critical with fewer elements loaded than predicted)?

a. The detector is too far away from the source.

b. The detector is too close to the source.

c. Excessive time is allowed between fuel element addition.

d. A fuel element is placed between the source and the detector.

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

QUESTION: 007 (1.00)

If equal amounts of positive or negative reactivity are added to an exactly critical reactor, which of the following describes the result on the absolute value of reactor period?

a. Positive and negative period will be of equal value.

b. The positive period value will be longer than the negative period value.

c. The negative period value will be longer than the positive period value.

d. Positive and negative periods will only be of equal value until the reactivity added exceeds ONE dollar.

QUESTION: 008 (1.00)

Because most fission fragments have neutron-to-proton ratios that are high and above the stability range (greater than 1.0), they generally decay by:

a. negative-beta emission.

b. positive-beta emission.

c. spontaneous fission.

d. alpha emission.

QUESTION: 009 (1.00)

Which ONE of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.

b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.

c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay process.

d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

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

QUESTION: 010 (1.00)

A thermal neutron is a neutron which:

a. experiences no net change in its energy after several collisions with atoms of the diffusing medium.

b. has been produced several seconds after its initiating fission occurred.

c. is produced as a result of thermal fission.

d. possesses thermal rather than kinetic energy.

QUESTION: 011 (1.00)

A beam of thermal neutrons is aimed at a thin foil target made of 10% copper and 90% aluminum (10% of the foil are copper atoms, 90% are aluminum atoms.) From the following data, which reaction below has the HIGHEST probability of occurrence?

Element	σ_a	σ_s
Copper	3.79 barns	7.90 barns
Aluminum	0.23 barns	1.49 barns

a. A neutron absorption in aluminum.

b. A neutron scattering reaction with aluminum.

c. A neutron scattering reaction with copper.

d. A neutron absorption in copper.

QUESTION: 012 (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: 013 (1.00)

Which factor in the six-factor formula is described by the ratio:

$$\frac{\text{number of neutrons produced by thermal fission}}{\text{number of thermal neutrons absorbed in the fuel}}$$

a. fast fission factor.

b. resonance escape probability.

c. reproduction factor.

d. thermal utilization factor.

QUESTION: 014 (1.00)

A reactor is critical at 18.1 inches on the controlling rod. The controlling rod is withdrawn to 18.4 inches. The reactivity inserted is 14.4 cents. What is the differential rod worth?

a. 14.4 cents/inch at 18.25 inches.

b. 14.4 cents/inch only between 18.1 and 18.4 inches.

c. 48 cents/inch at 18.4 inches.

d. 48 cents/inch at 18.25 inches.

QUESTION: 015 (1.00)

Two different neutron sources were used during two reactor startups. One neutron source, which emits ten times as many neutrons as the second, was used in the first startup. Assuming all other factors remain the same, which ONE of the following is the expected result at criticality?

a. Power level will be higher for the first startup.

b. Power level will be higher for the second startup.

c. The first startup will result in a higher rod position (rods further out of the core.)

d. The second startup will result in a higher rod position (rods further out of the core.)

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

QUESTION: 016 (1.00)

Given:	ρ_{excess}	0.50% delta k/k
	Control Rod 1	0.25% delta k/k
	Control Rod 2	0.45% delta k/k
	Control Rod 3	0.55% delta k/k

What is the actual (NOT Tech. Spec. minimum) shutdown margin for this core?

a. 0.20% delta k/k

b. 0.75% delta k/k

c. 1.25% delta k/k

d. 1.75% delta k/k

QUESTION: 017 (1.00)

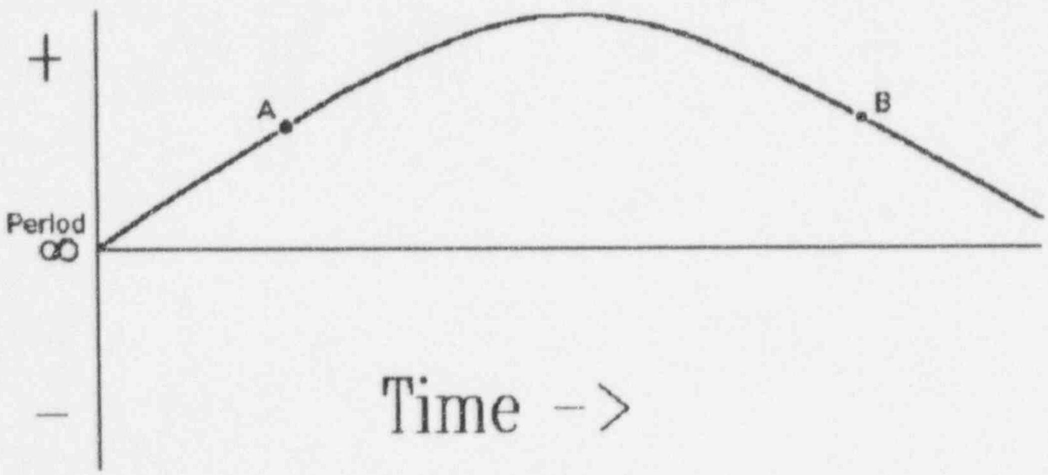
Shown below is a trace of reactor period as a function of time. Between points A and B **REACTOR POWER** is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



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

QUESTION: 018 (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: 019 (1.00)

The fuel temperature coefficient of reactivity is -1.25E-4 delta K/K/deg.C. When a control rod with an average rod worth of 0.1 % delta K/K/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, the fuel temperature has:

a. increased by 80 deg C.

b. decreased by 80 deg C.

c. increased by 8 deg C.

d. decreased by 8 deg C.

QUESTION: 020 (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)

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

QUESTION: 001 (1.00)

In accordance with the Power Calibration Procedure, if the absolute power level of the log power chamber does not agree within 10% of the log power recorder:

a. the log power recorder scale must be recalibrated.

b. the compensating voltage of the chamber must be adjusted to give the proper indication.

c. the high voltage to the chamber must be adjusted to give the proper indication.

d. the position of the chamber must be adjusted to give the proper indication.

QUESTION: 002 (1.00)

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

a. A clean fuel pin with a reactivity worth of $0.20.

b. A total control rod drop time (full out to full in) of 0.80 second.

c. A water level of 12 inches above the top grid of the core.

d. A moderator temperature of 50 deg. F.

QUESTION: 003 (1.00)

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

a. Control room area gamma monitoring system removed from service.

b. Period channel bypassed.

c. An experiment which contacts reactor coolant and which may corrode.

d. Three operable control rods.

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

QUESTION: 004 (1.00)

Prior to the disposal of water from the reactor tank, storage tank or sump, it must be tested to ensure that:

a. the pH is between 4.7 and 7.0.

b. the temperature is less than 70 deg. F.

c. the activity is within limits.

d. the particulate concentration is within limits.

QUESTION: 005 (1.00)

A KNOWN CORE is one for which:

a. the core has been critical and the critical bank position has been measured

b. the addition, movement or removal of fuel is limited to $0.30 of reactivity or four fuel pins, whichever is smaller

c. the inverse multiplication method is used for fuel addition in the initial approach to criticality

d. fuel movement may occur with only three control rods and rod drives operational

QUESTION: 006 (1.00)

To ensure that there is adequate shutdown capability even with a stuck rod, requirements are established for the:

a. insertion time for each control rod.

b. minimum number of operable control rods.

c. maximum moderator-reflector water level.

d. actuation time for the auxiliary reactor scram.

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

QUESTION: 007 (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: 008 (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.

QUESTION: 009 (1.00)

Following an unintentional scram, the reactor may be prepared for startup only after the cause of the scram has been determined by the:

a. Facility Director.

b. Operations Supervisor.

c. Senior Reactor Operator.

d. Reactor Operator.

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

QUESTION: 010 (1.00)

During a reactor startup in which the rod sensitivity is known from previous measurements, withdrawal of control rods as a bank is permitted:

a. as long as the reactivity addition does not exceed 12 cents per second up to 10 times the source level.

b. only until the source channel has increased by ONE decade and then they may only be withdrawn ONE at a time.

c. as long as the control rod withdrawal rate does not exceed 3 inches per minute.

d. as long as the reactivity addition does not exceed 5 cents per second.

QUESTION: 011 (1.00)

During performance of a power calibration, the reactor is scrammed after activation and the operator enters the high bay area to take readings. Prior to entering the high bay area the operator should verify that:

a. the neutron source has been removed to its shielded container.

b. all control rods are fully inserted and water drained from the tank.

c. the "Reactor On" key is removed and returned to the office safe.

d. 10 minutes have elapsed to allow for short lived isotopes to decay.

QUESTION: 012 (1.00)

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

a. Control rod drop time determination.

b. Criticality detector system calibration.

c. Moderator-reflector water height verification.

d. Shutdown margin determination.

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

QUESTION: 013 (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.

QUESTION: 014 (1.00)

The limit for maximum water level 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: 015 (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.

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

QUESTION: 016 (1.00)

The reactor parameter which is protected by Safety Limits is:

a. steady state power level.

b. fuel pellet temperature.

c. moderator level.

d. fuel clad temperature.

QUESTION: 017 (2.00)

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

a. The sum of Internal Dose and External Dose.

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

c. The sum of External Dose and Organ Dose.

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

QUESTION: 018 (1.00)

"The excess reactivity of the reactor core above cold, clean critical shall not be greater than $0.60." This is an example of a(n):

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

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

QUESTION: 019 (1.00)

A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. There is, however, a small section of pipe (point source) which reads 10 mrem/hr at one (1) meter. Which ONE of the following defines the posting requirements for the area in accordance with 10CFR20?

a. "CAUTION RADIATION AREA."

b. "CAUTION RADIOACTIVE MATERIAL."

c. "GRAVE DANGER, VERY HIGH RADIATION AREA."

d. "CAUTION HIGH RADIATION AREA."

QUESTION: 020 (1.00)

A licensed operator who fails to actively perform the functions of an operator for a minimum of four hours per calendar quarter:

a. cannot operate the reactor unless he/she has performed a minimum of six (6) hours of licensed functions under the direction of an operator or senior operator.

b. cannot operate the reactor until he/she has successfully completed an oral or written examination on console operation.

c. can continue to operate the reactor only under the direction of an operator or senior operator until five (5) startups are completed.

d. must operate the reactor for a sufficient number of hours in the next calendar quarter so that at least eight (8) hours of operation have occurred in the two quarters.

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

QUESTION: 001 (1.00)

For a control rod, the Full-out light is ON, the Full-in light is OFF, and there is no power to the rod magnets. This indicates that:

a. the rod and drive are not in contact, the rod is full up and the drive is full down.

b. the rod and drive are both full up.

c. the rod and drive are both full down.

d. the rod and drive are not in contact, the drive is full up and the rod is full down.

QUESTION: 002 (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: 003 (1.00)

Electrical power for building lighting and equipment is:

a. 120/208 volt, three phase, 400 Hz

b. 120/208 volt, three phase, 60 Hz

c. 120/240 volt, single phase, 60 Hz

d. 120/240 volt, three phase, 400 Hz

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

QUESTION: 004 (1.00)

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: 005 (1.00)

The current required to hold the rod drives to the magnetic clutch is approximately:

a. 6 mA

b. 60 mA

c. 600 mA

d. 6 A

QUESTION: 006 (2.00)

For the area radiation monitoring system, match the trip 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

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

QUESTION: 007 (1.00)

For a control rod, the Full-out light is OFF, the Full-in light is OFF, and there is power to the rod magnets. This indicates that:

a. the rod and drive are in contact, and are both full in

b. the rod and drive are in contact, and are both full out

c. the rod and drive are not in contact, and the rod and drive are somewhere between full in and full out

d. the rod and drive are in contact, and are somewhere between full in and full out

QUESTION: 008 (1.00)

For the LEU core design, MAXIMUM control rod motion is limited to:

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

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

c. 42 inches, the nominal length of the control rods.

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

QUESTION: 009 (1.00)

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.

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

QUESTION: 010 (1.00)

There are three scram functions which 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: 011 (1.00)

The temperature monitoring system monitors the temperatures of the:

a. reactor coolant and fuel.

b. reactor coolant and reactor room air.

c. fuel and reactor room air.

d. reactor coolant and control room air.

QUESTION: 012 (1.00)

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

a. control rod position indication is lost.

b. the dump valve automatically opens.

c. the reactor scrams.

d. the control rod gang switch drives all rods in.

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

QUESTION: 013 (1.00)

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: 014 (1.00)

There are five (5) interlocks which are required to be met in order to permit rod withdrawal. Three of these are:

a. 400 cycle power on, reactor room area monitor on, fill pump off.

b. fill pump on, reactor period < 15 seconds, startup channel > 2 cps.

c. reactor room area monitor on, chart recorder on, startup channel > 2 cps.

d. 400 cycle power on, fill pump off, chart recorder on.

QUESTION: 015 (1.00)

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

a. amplifying only neutron signals coming from the detector.

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

c. securing detector high voltage at power levels above source strength.

d. compensating voltage applied to the detector.

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

QUESTION: 016 (1.00)

The GANG/SINGLE switch for rod #3 fails CLOSED. As a result:

a. rod #3 cannot be moved.

b. rod #3 moves with the ganged bank.

c. rod #3 inserts.

d. rod #3 withdraws.

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

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

QUESTION: 001 (1.00)
C.
REFERENCE:
When k_{eff} = 0.955, ρ = -0.047 delta k/k; $5.00 = 5(0.0070) = + 0.035 delta k/k
- 0.047 + 0.035 delta k/k = - 0.012 delta k/k

QUESTION: 002 (1.00)
B.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 4-8.

QUESTION: 003 (1.00)
A.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 287.

QUESTION: 004 (1.00)
D.
REFERENCE:
Since time is not a factor, any amount of positive reactivity will cause the power to rise.

QUESTION: 005 (1.00)
C.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 59.

QUESTION: 006 (1.00)
A.
REFERENCE:
Manual of Experiments, Core Loading by Subcritical Multiplication.

QUESTION: 007 (1.00)
C.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 285.

QUESTION: 008 (1.00)
A.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 18.

QUESTION: 009 (1.00)
C.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 3-7.

QUESTION: 010 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, Section 1.39.

QUESTION: 011 (1.00)
B.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 2-43.
Probability proportional to (Number of atoms)x(microscopic cross-section)

QUESTION: 012 (1.00)
A.
REFERENCE:
Anything which adds positive reactivity decreases shutdown margin.

QUESTION: 013 (1.00)
C.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 3-16.

QUESTION: 014 (1.00)
D.
REFERENCE:
$\Delta\rho$ = \$0.144; Δx = 18.4 - 18.1 = 0.3 inch; $\Delta\rho/\Delta x$ = \$0.48/inch.

QUESTION: 015 (1.00)
A.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 5-14.

QUESTION: 016 (1.00)
B.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, pages 6-2 thru 6-4.
SDM = Total Rod Worth - ρ_{excess} = 1.25% - 0.50% = 0.75% delta k/k

QUESTION: 017 (1.00)
A.
REFERENCE:
Burn, Introduction to Nuclear Reactor Operations, page 4-3.

QUESTION: 018 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, Section 2.177.

QUESTION: 019 (1.00)
A.
REFERENCE:
Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, page 307.
Since power increases, fuel temperature increases, adding negative reactivity to stop the power increase.
ΔT = (-0.01 delta k/k)/(-1.25x10^{-4} delta k/k/deg.C) = + 80 deg.C.

QUESTION: 020 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, Section 3.44.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
A.
REFERENCE:
Surveillance Procedures, Power Calibration.

ANSWER: 002 (1.00)
C.
REFERENCE:
Technical Specifications, Section 3.1

ANSWER: 003 (1.00)
D.
REFERENCE:
Technical Specifications, Section 3.1

ANSWER: 004 (1.00)
C.
REFERENCE:
Operating Procedures, Water Disposal.

ANSWER: 005 (1.00)
A.
REFERENCE:
Operating Procedures, Fuel Handling.

ANSWER: 006 (1.00)
B.
REFERENCE:
Technical Specifications, Section 3.1 Bases.

ANSWER: 007 (1.00)
D.
REFERENCE:
Technical Specifications, Section 3.4.

ANSWER: 008 (1.00)
A.
REFERENCE:
Emergency Plan, Definitions, Section 2

ANSWER: 009 (1.00)
C.
REFERENCE:
Emergency Procedures For The RPI Critical Facility, Section 7.3.1.

ANSWER: 010 (1.00)
A, D.
REFERENCE:
Operating Procedures, Reactor Startup.

ANSWER: 011 (1.00)
D.
REFERENCE:
Surveillance Procedures, Power Calibration.

ANSWER: 012 (1.00)
C.
REFERENCE:
Technical Specifications, Section 4.1.

ANSWER: 013 (1.00)
A.
REFERENCE:
Emergency Plan, Definitions, Section 2

ANSWER: 014 (1.00)
D.
REFERENCE:
Technical Specifications, Section 3.1 Bases.

ANSWER: 015 (1.00)
C.
REFERENCE:
Emergency Procedures, Section 2.0.

ANSWER: 016 (1.00)
B.
REFERENCE:
Technical Specifications, Section 2.1

ANSWER: 017 (1.00)
A.
REFERENCE:
10 CFR 20

ANSWER: 018 (1.00)
C.
REFERENCE:
Technical Specifications, Section 3.1

ANSWER: 019 (1.00)
D.
REFERENCE:
10 CFR 20

For a point source, 10 mR/hr at 1 meter = 111 mR/hr at 30 centimeters.

ANSWER: 020 (1.00)
A.
REFERENCE:
10 CFR 55

C. PLANT AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
D.
REFERENCE:
Safety Evaluation Report, Section 4.7.2.

ANSWER: 002 (1.00)
A.
REFERENCE:
Safety Analysis Report, Figure 4.7.

ANSWER: 003 (1.00)
B.
REFERENCE:
Safety Evaluation Report, Section 8

ANSWER: 004 (1.00)
A.
REFERENCE:
Instrumentation and Interlock Diagrams.

ANSWER: 005 (1.00)
B.
REFERENCE:
Pre-Startup Procedure, page 5.

ANSWER: 006 (2.00)
A,4; B,3; C,1; D,2
REFERENCE:
Pre-Startup Procedure, Page 13.

ANSWER: 007 (1.00)
D.
REFERENCE:
Safety Evaluation Report, Section 4.7.2

ANSWER: 008 (1.00)
B.
REFERENCE:
Safety Analysis Report, Section 4.1.

ANSWER: 009 (1.00)
B.
REFERENCE:
Safety Analysis Report, Section 5.2.

ANSWER: 010 (1.00)
D.
REFERENCE:
Technical Specifications, Section 3.1.

ANSWER: 011 (1.00)
B.
REFERENCE:
Safety Evaluation Report, Section 7.2.2.

ANSWER: 012 (1.00)
A.
REFERENCE:
Safety Evaluation Report, Section 8.0.

ANSWER: 013 (1.00)
A.
REFERENCE:
Operating Procedures, Surveillance Procedures, Power Calibration.

ANSWER: 014 (1.00)
D.
REFERENCE:
Technical Specifications, Table 2.

ANSWER: 015 (1.00)
B.
REFERENCE:
RPI Manual of Experiments, Chapter II, Startup Channel Calibration.

ANSWER: 016 (1.00)
B.
REFERENCE:
Safety Analysis Report for the Ganged Control Rod Operating System, page 3.

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 PROCEDURES & 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. PLANT 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 ____

016 a b c d ____

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

EQUATION SHEET

$Q = m\ c_p\ \Delta T$

$CR_1\ (1\text{-Keff})_1 = CR_2\ (1\text{-Keff})_2$

$SUR = 26.06/\tau$

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

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

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

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

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = 6CiE/D^2$

$\rho = (\text{Keff}-1)/\text{Keff}$

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)

cc:

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