August 16, 2002

Dr. Gunter Kegel, Director
Nuclear Radiation Laboratory
University of Massachusetts - Lowell
One University Avenue
Lowell, Massachusetts 01854

SUBJECT: INITIAL EXAMINATION REPORT LETTER NO. 50-223/OL-02-02, UNIVERSITY OF MASSACHUSETTS - LOWELL, JULY 2002

Dear Dr. Kegel:

During the week of July 22, 2002, the NRC administered examinations to employees of your facility who had applied for a license to operate your University of Massachusetts Lowell Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1.

In accordance with 10 CFR 2.790 of the Commission's 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 document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/indesx.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 Patrick Isaac at 301-415-1019.

Sincerely,

/RA/

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

Docket No. 50-223

Enclosures: 1. Initial Examination Report No. 50-223/OL-02-02
2. Examination and answer key

cc w/enclosures:
Please see next page

cc:

Mayor of Lowell
City Hall
Lowell, MA 01852

Mr. Leo Bobek
Reactor Supervisor
University of Massachusetts - Lowell
One University Avenue
Lowell, MA 01854

Office of the Attorney General
Environmental Protection Division
19th Floor
One Ashburton Place
Boston, MA 02108

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

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ADAMS ACCESSION #: ML022250413 **TEMPLATE #: NRR-074**

OFFICE	**RORP:CE**		**IEHB:LA**		**RORP:SC**	
NAME	**PIsaac:rdr**		**EBarnhill**		**PMadden**	
DATE	**08/ 13 /2002**		**08/ 15 /2002**		**08/ 16 /2002**	

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

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

REPORT NO.:	50-223/OL-02-02
FACILITY DOCKET NO.:	50-223
FACILITY LICENSE NO.:	R-125
FACILITY:	University of Massachusetts - Lowell
EXAMINATION DATES:	07/24 - 25/2002
EXAMINER:	Patrick Isaac, Chief Examiner

SUBMITTED BY: ***/RA/*** 07/31/2002
Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of July 22, 2002, NRC administered Operator Licensing examinations to one (1) Reactor Operator (RO) and one (1) Senior Reactor Operator Upgrade (SROU) candidate. Both candidates passed their respective portions of the examinations.

ENCLOSURE 1

REPORT DETAILS

1. Examiner:

   Patrick Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**1/0**	**N/A**	**1/0**
Operating Tests	**1/0**	**1/0**	**2/0**
Overall	**1/0**	**1/0**	**2/0**

3. Exit Meeting:

   Personnel attending:

   Leo M. Bobek, Reactor Supervisor
   Patrick Isaac, Chief Examiner, USNRC

   Mr. Bobek recommended that the correct answer for question B. 012, of the written examination, should be changed from "a" to "b". The chief examiner agreed with Mr. Bobek's recommendation and the answer key was modified accordingly.

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

FACILITY:	Univ. of Mass. — Lowell
REACTOR TYPE:	POOL
DATE ADMINISTERED:	07/24/02
REGION:	1
CANDIDATE:	______________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach all answer sheets to the examination. Point values 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
20.00	33.3	________	_____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	33.3	________	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.3	________	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60.00		________ 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.

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 ___

(***** 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 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 RAD MONITORING SYSTEMS

A N S W E R   S H E E T

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

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 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

$\dot{Q} = \dot{m} c_p \Delta T$

$\dot{Q} = \dot{m} \Delta h$

$\dot{Q} = UA \Delta T$

$$SUR = \frac{26.06 (\lambda_{eff}\rho)}{(\beta - \rho)}$$

$SUR = 26.06/\tau$

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

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

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

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

$\rho = (Keff-1)/Keff$

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0075$

$DR_1D_1^2 = DR_2D_2^2$

$$Cp\ (H20) = 0.146 \frac{kw}{gpm \cdot {}^\circ F}$$

$SCR = S/(1-Keff)$

$CR_1 (1-Keff)_1 = CR_2 (1-Keff)_2$

$$M = \frac{(1-Keff)_0}{(1-Keff)_1}$$

$M = 1/(1-Keff) = CR_1/CR_0$

$SDM = (1-Keff)/Keff$

$I = I_o e^{-ux}$

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

$\tau = \ell^*/(\rho-\bar{\beta})$

$R = 6 C E n$

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

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

$P = S / (1 - Keff)$

---

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^{3} BTU/hr

1 Mw = 3.41×10^{6} BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5°C + 32

931 Mev = 1 amu

°C = 5/9 (°F - 32)

QUESTION: 001 (1.00)
Given a source strength of 100 neutrons per second (N/sec) and a multiplication factor of 0.8, the expected neutron count rate would be:

a. 125 N/sec

b. 250 N/sec

c. 400 N/sec

d. 500 N/sec

QUESTION: 002 (1.00)
With the reactor critical at 10 KW a blade is pulled to insert a positive reactivity of 0.00126 $\Delta K/K$. Which one of the following will be the stable reactor period as a result of this reactivity insertion?

a. 10 seconds

b. 50 seconds

c. 60 seconds

d. 70 seconds

QUESTION: 003 (1.00)
An initial count rate of 100 is doubled five times during a startup. Assuming an initial Keff of 0.950, which one of the following is the new Keff?

a. 0.957

b. 0.979

c. 0.985

d. 0.998

QUESTION: 004 (1.00)
Consider two identical critical reactors, with the exception that one has a beta of 0.0072 and the other has a beta of 0.0060. Each reactor is operating a 10 watts. Which one of the following compares the response of the reactors to a +0.1% delta k/k reactivity insertion?

a. The resulting period will be shorter for the reactor with the 0.0072 beta fraction

b. The resulting period will be shorter for the reactor with the 0.0060 beta fraction

c. The resulting power level will be higher for the reactor with the 0.0072 beta fraction

d. The resulting power level will be higher for the reactor with the 0.0060 beta fraction

QUESTION: 005 (2.00, 0.5 each)
Match the terms in column A with the correct definition in column B

Section A R Theory, Thermo & Fac. Operating Characteristics

Column A		Column B	
a.	Fast Neutrons	1.	Neutrons released promptly from fission.
b.	Prompt Neutrons	2.	High energy neutrons.
c.	Slow Neutrons	3.	Neutrons released from decay after fission.
d.	Delayed Neutrons	4.	Low energy neutrons.

QUESTION: 006 (1.00)
The reactor is critical and increasing in power. Power has increased from 20 watts to 80 watts in 60 seconds. How long will it take at this rate for power to increase from 0.080 KW to 160 KW?

a. 0.5 minute

b. 2.5 minutes

c. 5.5 minutes

d. 10.5 minutes

QUESTION: 007 (1.00)
A reactor with an initial population of 24000 neutrons is operating with Keff = 1.01. Of the CHANGE in population from the current generation to the next generation, how many are prompt neutrons?

a. 25

b. 238

c. 2500

d. 24240

QUESTION: 008 (1.00)
Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. Inserting an experiment adding positive reactivity.

b. Lowering moderator temperature if the moderator temperature coefficient is negative.

c. Depletion of a burnable poison.

d. Depletion of uranium fuel.

QUESTION: 009 (1.00)
Which one of the following is the PRIMARY reason that delayed neutrons are so effective at controlling reactor power?

a. Delayed neutrons make up a very large fraction of the fission neutrons in the core.

b. Delayed neutrons have a much longer mean lifetime than prompt neutrons.

c. Delayed neutrons are born at thermal energies.

d. Delayed neutrons are born at lower energies than prompt neutrons.

QUESTION: 010 (1.00)
Which one of the following is the principal source of heat in the reactor after a shutdown from extended operation at 1 MW?

a. Production of delayed neutrons

b. Kinetic energy of fission fragments

c. Spontaneous fission of U-238

d. Gamma interactions

QUESTION: 011 (1.00)
The following data was obtained during a reactor fuel load.

No. of Elements	Detector A (cps)
0	20
8	28
16	30
24	32
32	42
40	80

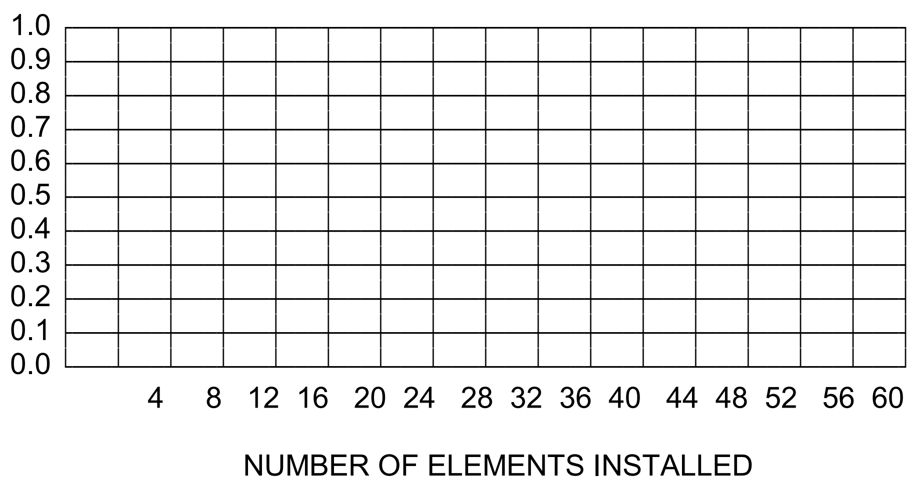
Which one of the following represents the number of fuel elements predicted to reach criticality?

a. 48

b. 52

c. 56

d. 60



QUESTION: 012 (1.00)
Following 8 hours at 1 MW, the reactor operator reduces reactor power to 50%. Rod control is placed in manual mode and all rod motion is stopped. Which one of the following describes the response of reactor power, without any further operator actions, and the PRIMARY reason for its response?

a. Power increases due to the burnout of xenon.

b. Power increases due to the burnout of samarium.

c. Power decreases due to the buildup of xenon.

d. Power decreases due to the buildup of samarium.

QUESTION: 013 (1.00)
Which one of the following is a correct statement concerning the factors affecting control rod worth?

a. Fuel burn up causes the rod worth for periphery rods to decrease.

b. Fuel burn up causes the rod worth to increase in the center of the core.

c. The withdrawal of a rod causes the rod worth of the remaining inserted rods to increase.

d. As Rx power increases rod worth increases.

QUESTION: 014 (1.00)
Pool temperature increases by 20°F. Given αTmoderator = -0.0005 ΔK/K/°F and an average regulating rod worth of 0.004 ΔK/K/inch. By how much and in what direction did the regulating rod move to compensate for the temperature change?

a. 0.25 inches in

b. 0.25 inches out

c. 2.5 inches in

d. 2.5 inches out

QUESTION: 015 (1.00)
Which ONE of the following statements describes the subcritical reactor response as Keff approaches unity?

d. A LARGER change in neutron level results from a given change in Keff and a SHORTER period of time is required to reach the equilibrium neutron level for a given change in Keff.

b. A LARGER change in neutron level results from a given change in Keff and a LONGER period of time is required to reach the equilibrium neutron level for a given change in Keff.

c. A SMALLER change in neutron level results from a given change in Keff and a SHORTER period of time is required to reach the equilibrium neutron level for a given change in Keff.

d. A SMALLER change in neutron level results from a given change in Keff and a LONGER period of time is required to reach the equilibrium neutron level for a given change in Keff.

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 016 (1.00)
An experiment to be placed in the central thimble has been wrapped in cadmium. Which one of the following types of radiation will be most effectively blocked by the cadmium wrapping?

a. Thermal neutrons

b. Fast neutrons

c. Gamma rays

d. X-rays

QUESTION: 017 (1.00)
A thin foil target of 10% copper atoms and 90% atoms aluminum is in a thermal neutron beam. Given σs Al = 3.79 barns, σs Cu = 0.23 barns, σa Al = 7.90 barns and σa Cu = 1.49 barns, which ONE of the following reactions has the highest probability of occurring? A neutron …

a. scattering reaction with aluminum.

b. scattering reaction with copper.

c. absorption in aluminum.

d. absorption in copper.

QUESTION: 018 (1.00)
The reactor is operating at 500 KW in steady-state and in manual mode. Which one of the following describes the stable reactor period if a control blade drops fully into the core and no operator action is taken?

a. -34 seconds due to the rapid decrease in prompt neutrons

b. -34 seconds due to the rapid decay of the short lived delayed neutron precursors

c. -80 seconds due to the slowing down length of prompt neutrons

d. -80 seconds due to the decay half life of the long lived delayed neutron precursors

QUESTION: 019 (1.00)
Which one of the following factors in the "six factor" formula is the most strongly affected by the Negative Temperature Coefficient ?

a. The fast fission factor

b. The thermal utilization factor

c. The resonance escape probability

d. The thermal non-leakage probability

QUESTION: 001 (1.00)

Section B Normal/Emergency Procedures and Radiological Controls

Following an irradiation of a specimen, the resulting radioisotope is expected to equal 12 curies. The radioisotope will decay by the emission of two gamma rays per disintegration with energies of 1.14 Mev and 1.36 Mev. Which one of the following is the radiation exposure rate (R/hr) at one 6 feet from the specimen with no shielding?

a. 180 R/hr

b. 30 R/hr

c. 5 R/hr

d. 2.72 R/hr

QUESTION: 002 (1.00)
A small radioactive source is to be stored in the reactor bay with no shielding. The source reads 2 R/hr at 1 foot. A “Radiation Area” barrier would have to be erected approximately ___ from the source.

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

QUESTION: 003 (1.00)
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 35 days. Select an acceptable method for controlling radiation exposure from the source within this room.

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

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. Post the area with the words "Danger-Radiation Area".

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 004 (1.00)
Consider two point sources, each having the same curie strength. Source A's gammas have an energy of 1 MEV whereas Source B's gamma have an energy of 2 MEV. You obtain a reading from the same Geiger counter 10 feet from each source. Concerning the two readings, which one of the following statements is correct?

a. Both readings are the same.

b. The reading from Source B is half that of Source A.

c. The reading from Source B is twice that of Source A.

d. The reading from Source B is four times that of Source A.

QUESTION: 005 (1.00)
Which one of the following is the definition for “Annual Limit on Intake” (ALI)?

a. 10 CFR 20 derived limit, based on a Committed Effective Dose Equivalent of 5 rems whole body or 50 rems to any individual organ, for the amount of radioactive material inhaled or ingested in a year by an adult worker.

b. The concentration of a radionuclide in air which, if inhaled by an adult worker for a year, results in a total effective dose equivalent of 100 millirem.

c. The effluent concentration of a radionuclide in air which, if inhaled continuously over a year, would result in a total effective dose equivalent of 50 millirem for noble gases.

d. Projected dose commitment values to individuals, that warrant protective action following a release of radioactive material.

QUESTION: 006 (1.00)
In order to ensure the health and safety of the public, 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: 007 (1.00)
Which one of the following statements describes the basis for the Safety Limit in the forced convection mode of operation?

a. Excessive gas pressure between the fuel-moderator and cladding may result in loss of fuel element cladding integrity.

b. The onset of nucleate boiling at the hot spot in the hot channel.

c. To prevent undesirable radiation levels on the surface of the pool.

d. The combination of reactor power and coolant flow rate will prevent the LSSS from being exceeded.

QUESTION: 008 (1.00)
"The reactor core is loaded so that the excess reactivity in the cold clean (xenon-free) critical condition does not exceed 4.7% delta K/K." This is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting conditions for operation.

d. surveillance requirement.

QUESTION: 009 (1.00)
At 8:00 am, prior to the start of reactor operation, a checkout procedure is performed in accordance with RO-9. The reactor is started up, operated, and then shutdown at 1:00 PM. Which one of the following describes the checkout requirement for a subsequent startup at 4:00 PM ?

a. a new checkout procedure must be performed.

b. the checkout procedure does not need to be performed.

c. only the power range monitor checks and tests, and fuel temperature 1 and 2 channel checks and tests must be performed.

d. only the manual scram channel test must be performed.

QUESTION: 010 (1.00)
Which one of the following statements describes the reason for the Technical Specifications limit on pool water conductivity?

a. maintain the coolant in a slightly basic condition.

b. restrict the concentration of coolant dissolved oxygen.

c. to ensure that leaking fuel are detected.

d. to minimize the rate of corrosion.

QUESTION: 011 (1.00)
During a reactor start-up the console operator is withdrawing a control blade and notices that the position indicator for the control blade is not changing. Select the operator action for these conditions.

a. Attempt to insert the control blade whose position indicator was not changing during blade withdrawal.

b. Continue the reactor start-up. Level power at 1 watt and investigate the cause.

c. Verify that source range counts are not changing.

d. Run the other unstuck blades and the Regulating Rod fully in.

QUESTION: 012 (1.00)
You are operating the reactor in natural convection mode at 250 Kilowatts when you note pool temperature is 100°F. Select the required operator action for the above condition.

a. Continue operations.

b. Shutdown the reactor.

c. Reduce reactor power to 1.33 Kilowatts.

d. Increase secondary cooling flow.

QUESTION: 013 (1.00)
Filling the pool via the clean-up demineralizer system is unavailable, whose permission is required to use an alternate method?

a. any licensed Reactor Operator

b. any licensed Senior Reactor Operator

c. Chief Reactor Operator

d. Reactor Supervisor

QUESTION: 014 (1.00)
An oral examination on facility and procedure changes must be administered to an operator who has not performed licensed duties as a Reactor Operator or as a Senior Reactor Operator:

a. at least once per month.

b. for four or more months.

c. six hours per calendar quarter.

d. at least once per calendar year.

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 015 (1.00)
The Emergency Planning Zone (EPZ) for the University of Massachusetts Lowell reactor is:

a. The reactor containment building.

b. The Pinanski Building.

c. The Pinanski Building and the area bounded by the chain-link fence around the containment building..

d. Site Boundary.

QUESTION: 016 (1.00)
An Emergency Action Level is:

a. a condition which calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

b. a class of accidents for which predetermined emergency measures should be taken or considered.

c. a procedure that details the implementation actions and methods required to achieve the objectives of the Emergency Plan.

d. a specific instrument reading or observation which may be used as a threshold for initiating appropriate emergency measures.

QUESTION: 017 (1.00)
At what power level during startup is the source normally withdrawn?

a. 500 milliwatts

b. 5 watts

c. 50 watts

d. 500 watts

QUESTION: 018 (1.00)
The source check of all radiation monitoring equipment is performed using a Co^{60} gamma emitting source or equivalent, with one exception, for which you use a Cf^{252} neutron emitting source or equivalent. The channel which is checked with the neutron emitting source is …

a. channel C (Continuous Air Monitor #1)

b. channel E (Fission Product Monitor)

c. channel Q (Gamma Cave)

d. channel L (Thermal Column)

Section C Facility and Radiation Monitoring Systems

QUESTION: 019 (1.00)
You are the reactor operator during operations at 90% power. Workers are preparing to secure the containment emergency exhaust system for maintenance. Which one of the following statements is applicable for this condition?

a. The reactor must be shutdown prior to taking out the emergency exhaust system.

b. The Reactor Supervisor may authorize reactor operation with the system out of service.

c. The reactor may continue running with all isolation valves closed.

d. The Radiation Safety Officer must approve reactor operation with the system out of service.

QUESTION: 020 (1.00)
You (a licensed Reactor Operator) and a Senior Reactor Operator (SRO) are operating the reactor on the weekend. No one else is available. In order to meet Technical Specifications requirements if you are on the console the SRO must be …

a. within the reactor containment

b. within the reactor containment or the Pinanski Building

c. within the confines of the North Campus

d. within 15 minutes walk of the reactor facility.

QUESTION: 001 (1.00)
You are operating the reactor at 1 Megawatt. Personnel are performing maintenance on the airlock doors and the truck door when a reactor scram occurs. Select the cause for the reactor scram.

a. The outer airlock door was opened and the inner airlock door was shut.

b. The outer airlock door was shut and the inner airlock door was open.

c. The outer airlock door has lost its pneumatic seal.

d. The truck door has lost its pneumatic seal.

QUESTION: 002 (1.00)
You are operating the reactor power at 1 Megawatt. A severe storm warning has been announced by the National Weather Service. A loss of electrical power has occurred (the emergency generator has NOT started). Select the condition of the ventilation system.

a. The ventilation fans have stopped and the ventilation valves, except valve F, have closed.

b. The ventilation fans continue to run and the ventilation valves, except valve F, have closed.

c. The ventilation fans have stopped and valve F has closed, the other ventilation valves remain open.

d. The ventilation fans continue to run and valve F has closed, the other ventilation valves remain open.

QUESTION: 003 (1.00)
You are preparing to raise reactor power to 1.5 Megawatt for the next experiment. You are instructed to place the core in the # 1 position and align the core for minimum flow induced vibration. Select the position and mode of cooling for the core.

a. Place the core in the bulk pool; Align the flow for the downcomer mode.

b. Place the core in the stall pool; Align the flow for the cross-stall mode.

c. Place the core in the bulk pool; Align the flow for the cross-stall mode.

d. Place the core in the stall pool; Align the flow for the downcomer mode.

QUESTION: 004 (1.00)
Which one of the following correctly describes the manual operation of Valve A in the ventilation system?

a. The valve is opened by air acting on a piston, against a spring. The valve is closed by opening a quick release valve which bleeds air off the piston opening the valve.

b. The valve is opened by air acting on a piston, against a spring. The valve is closed by opening a quick release valve which bleed air off an auxiliary piston which in turn opens a port bleeding air off the valve.

c. The valve is opened by spring pressure. The valve is closed by an explosive blast of high pressure air from an accumulator.

d. The valve is opened and closed via an air motor, using higher pressure air from an accumulator for quick closure

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QUESTION: 005 (1.00)
The console operator is maintaining reactor power at 100 Kilowatts with the regulating rod in automatic and at 50% withdrawn. The console operator notices an unexplained power excursion and manually scrams the reactor. Select the position and mode of operation for all control blades.

a. All blades are on the bottom and de-energized.

b. All control blades are on the bottom and de-energized; The Regulating Rod is in automatic at 50% withdrawn.

c. All control blades are on the bottom and de-energized; The Regulating Rod is in manual at 50% withdrawn.

d. All control blades are on the bottom and de-energized; The Regulating Rod is in automatic and automatically driven to 0%.

QUESTION: 006 (1.00)
Reactor Power is 500 Kilowatts when a large leak develops in the primary coolant piping. Select the device that ensures the reactor pool will not be completely drained.

a. The pool divider gate.

b. The pool wall liner.

c. The primary coolant pump.

d. The break valve.

QUESTION: 007 (1.00)
How does the facility assure that the 24 VDC wet cells used to provide flash current to the emergency generator will work?

a. 50% of the bank is replaced every 6 months.

b. 100% of the bank is replaced every two years.

c. House power feeds a charger which maintains a constant trickle charge.

d. House power feeds a charger for the Emergency lights which in turn provide a trickle charge to the Wet cells.

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QUESTION: 008 (1.00)
The reactor is operating at 100 kilowatts steady state power, when one of the beam tubes develops a small leak. Select the indication which alerts the console operator to the beam tube leak.

a. The stack monitor

b. The conduit lines connected to the beam tube

c. The water line in the beam tube

d. Bubbling in the pool

QUESTION: 009 (1.00)
The purpose of the thermal column is to:

a. enhance heat transfer characteristics of the core.

b. provide a thermal temperature rise for experiments.

c. enhance natural convection flow.

d. provide neutrons in the thermal energy range.

QUESTION: 010 (1.00)
The "Rabbit" is inserted and withdrawn from the core using:

a. a length of cable wire.

b. a blower and exhauster.

c. an exhauster and a wind gate cabinet.

d. two exhausters.

QUESTION: 011 (1.00)
The console operator is performing a reactor shutdown when the source range instrumentation comes on scale high AFTER the intermediate range instrumentation went off-scale low. Select the cause for the lack of instrumentation overlap.

a. Source range high voltage is off.

b. Source range high voltage is set too high.

c. Intermediate range compensating volts is set too low.

d. Intermediate range compensating volts is set too high.

QUESTION: 012 (1.00)
Given the following conditions:
- There is NO blade position indication.
- NO annunciators are in alarm.
- The picoammeters are in the tripped state.
- The scram magnets are de-energized.

Select the cause for the above conditions. A loss of the:

a. high voltage dc power supplies

b. unregulated control power supply

c. regulated instrumentation power supply

d. emergency generator

QUESTION: 013 (1.00)
When the scram magnet assemblies are energized, the control blades are:

a. coupled to the drive tube.

b. moving in the outward direction.

c. moving in the inward direction.

d. dropped into the core.

QUESTION: 014 (1.00)
Given the following conditions:
- Reactor power is 250 Kilowatts and increasing.
- Core inlet temperature is 104°F.
- Coolant flow is 1400 gpm.
- Reactor period is 15 seconds.

The Reactor scrams. Select the cause for the reactor scram.

a. High reactor flux

b. High core inlet temperature

c. Low coolant flow

d. Short period

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QUESTION: 015 (1.00)
During reactor operation, the console operator has noticed the pool temperature channel failed low (on the low end scale peg). Select the cause for this reading.

a. The thermocouple has shorted.

b. The thermocouple has opened.

c. The RTD has shorted.

d. The RTD has opened.

QUESTION: 016 (1.00)
Given the following conditions:
- An experiment requires the core flux to be as flat as possible both radially and axially.
- Core life is at MOL (Middle of Life)
- The experiment requires all fuel elements to be in the core.

Select the method for obtaining the required core flux.

a. Run with ALL control blades fully withdrawn.

b. Remove the graphite reflector elements.

c. Place the start-up source in the core during operation.

d. Invert or rotate the fuel elements to achieve the desired flux.

QUESTION: 017 (1.00)
Given the following conditions:
- Reactor power is 250 Kilowatts.
- The stack ventilation radiation monitor (gaseous/particulate) has indicated increasing counts over the past hour.
- A small leak has developed in the pneumatic tube.

Select a method to determine the LOCATION of the problem.

a. Operate the ventilation system in the manual mode.

b. Place a portable monitor in the area of the ventilation monitor.

c. Use a portable air monitor taking suction from the stack.

d. Shutdown the reactor and take a pool area air sample.

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QUESTION: 018 (1.00)
Which of the following describes how the cleanup system functions to minimize corrosion of the reactor components? The cleanup system:

a. maintains the coolant pH at a basic value.

b. maintains the coolant pH at a acidic value.

c. maintains primary coolant at a low conductivity.

d. filters suspended particles from the coolant.

QUESTION: 019 (1.00)
Which one of the following scrams is NOT disabled by placing the RANGE switch in the 0.10 MW position?

a. Coolant Gate Open

b. Bridge Position

c. Core Inlet High Temperature

d. Reactor Period Low

QUESTION: 020 (1.00)
Reactor power is 300 Kilowatts when the console operator selects "Rundown" on the console. Reactor power will:

a. decrease because the regulating blade is inserted into the core.

b. decrease because all four control blades are inserted into the core.

c. decrease because the regulating blade is inserted to the 50% withdrawn position.

d. decrease because all four control blades are inserted to the 50% withdrawn position.

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

ANSWER: 001 (1.00)
d.
REFERENCE:
C.R. = S/(1 - Keff) → C.R. = 100/(1 - 0.8) = 100/0.2 = 500

ANSWER: 002 (1.00)
b.
REFERENCE:
$\tau = (\beta-\rho)/\lambda_{eff}\rho = \dfrac{.0075 - .00126}{(.1)(.00126)} = 49.5$ seconds

ANSWER: 003 (1.00)
d.
REFERENCE:
CR1 (1-Keff1) = CR2 (1 - Keff2) or M1 (1-Keff1) = M2 (1 - Keff2)
CR2/CR1 = 32 → CR1 (1-Keff1)/CR2 = 1 - Keff2) → 100 (1-0.950)/3200 = 1 - Keff2
Keff2 = 1 - .0015625 = .998

ANSWER: 004 (1.00)
b.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1982, §§ 3.2.2 — 3.2.3

ANSWER: 005 (1.00)
a, 2; b, 1; c, 4; d, 3
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1988, § 3.2.2 Delayed Neutrons.

ANSWER: 006 (1.00)
c.
REFERENCE:
$P = Poe^{t/T}$ → $80 = 20e^{60\ sec/T}$ → T = 43.28 sec
1.6×10^5 watts = $80e^{t/43.28}$
t = 329 sec = 5.5 minutes

ANSWER: 007 (1.00)
b.
REFERENCE:
PSTR Training Manual, Section 2.9
24000 x 1.01 = 24240 neutrons in next generation
24240 - 24000 = 240 neutrons added
240 neutrons added - 0.7% delayed neutron fraction = 238 prompt neutrons added

ANSWER: 008 (1.00)
d.
REFERENCE:
Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.3, p. 6-4.

ANSWER: 009 (1.00)
b.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1982, §§ 3.2.2 — 3.2.3

ANSWER: 010 (1.00)

d.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 4.9, pp. 4-23 — 4-26.

ANSWER: 011 (1.00)
a.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.5, pp. 5-18 — 5-25.

ANSWER: 012 (1.00)
c.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §§ 8.1 —8.4, pp. 8-3 — 8-14.

ANSWER: 013 (1.00)
c.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 7.2 & 7.3, pp. 7-1 — 7-10.

ANSWER: 014 (1.00)
d.
REFERENCE:
+20°F × -0.0005 ΔK/K/°F = - 0.01 ΔK/K. To compensate the rod must add +0.01 ΔK/K. +0.01ΔK/K ÷ +0.004 ΔK/K/inch = +2.5 inches

ANSWER: 015 (1.00)
b.
REFERENCE:
Burn, R., Introduction to Nuclear Reactor Operations, © 1988, Chapt. 5, pp. 5-1 — 5-28.

ANSWER: 016 (1.00)
a.
REFERENCE:
PSTR Training Manual, Chapter 7 pg. 31

ANSWER: 017 (1.00)
c.
REFERENCE:
Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, § 2.108 – 2.114, pp. 77 – 80.

ANSWER: 018 (1.00)
d.
REFERENCE:
The amount of reactivity inserted by the blade s much larger than beta; therefore, maximum stable negative period of -80 seconds results.

ANSWER: 019 (1.00)
b.
REFERENCE:
Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, 1991, § 5.98, p. 264.

ANSWER: 001 (1.00)
c.

REFERENCE:
$$R = \frac{6\ C\ E\ n}{6^2} = \frac{6\ (12\ ci)\ (1.36 + 1.14\ Mev)}{36} = 5\ R/hr.$$

ANSWER: 002 (1.00)
c.
REFERENCE:
$$\frac{DR_1}{X_2^2} = \frac{DR_2}{X_1^2} \rightarrow X_2^2 = \frac{DR_1}{DR_2} X. = \frac{2000}{5} \times 1^2 = 400 ft^2 = 20 ft$$

ANSWER: 003 (1.00)
a.
REFERENCE:
10CFR20.1601(a)(3)

ANSWER: 004 (1.00)
a.
REFERENCE:
GM is not sensitive to energy.

ANSWER: 005 (1.00)
a.
REFERENCE:
10CFR20.1003

ANSWER: 006 (1.00)
c.
REFERENCE:
10CFR50.54(y)

ANSWER: 007 (1.00)
b.
REFERENCE:
Technical Specifications 2.1

ANSWER: 008 (1.00)
c.
REFERENCE:
Tech. Specs.

ANSWER: 009 (1.00)
d.
REFERENCE:
RO-6; Step 1.1.2

ANSWER: 010 (1.00)
d.
REFERENCE:
Tech. Specs 3.8

ANSWER: 011 (1.00)
d.
REFERENCE:

EO-7

ANSWER: 012 (1.00)
b.
REFERENCE:
Tech. Specs 2.1.2

ANSWER: 013 (1.00)
d.
REFERENCE:
SP-18; Step 4.8.1

ANSWER: 014 (1.00)
b.
REFERENCE:
Requalification Plan, Sect. 3.3

ANSWER: 015 (2.00)
a.
REFERENCE:
E-Plan Definitions

ANSWER: 016 (1.00)
d.
REFERENCE:
E-Plan Definitions

ANSWER: 017 (1.00)
d.
REFERENCE:
RO-6 Step 1.8

ANSWER: 018 (1.00)
b.
REFERENCE:
RO-13

ANSWER: 019 (1.00)
a.
REFERENCE:
T.S. 3.5

ANSWER: 020 (1.00)
b.
REFERENCE:
T.S. 6.0

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ANSWER: 001 (1.00)
d
REFERENCE:
SAR, Section 3.1.2.1, last paragraph.

ANSWER: 002 (1.00)
a
REFERENCE:
SAR, Section 3.4.2.1, "System Closure," and 3.4.2.2, "Response to Initiation of System Closure."

ANSWER: 003 (1.00)
b
REFERENCE:
SAR, Paragraph 4.2.2, Primary Coolant Systems.

ANSWER: 004 (1.00)
b
REFERENCE:
SAR, figure 3.7, 3-16

ANSWER: 005 (1.00)
c
REFERENCE:
SAR, Paragraphs 4.1.7, "Control Blade Drives," and 4.1.8, "Servo Regulating Rod Drive."

ANSWER: 006 (1.00)
d
REFERENCE:
SAR, Paragraph 4.2.2., "Primary Coolant System."

ANSWER: 007 (1.00)
c
REFERENCE:
SAR § 6.5.1, p. 6-7.

ANSWER: 008 (1.00)
a
REFERENCE:
SAR, Paragraph 4.3.2, "Beam Ports."

ANSWER: 009 (1.00)
d
REFERENCE:
SAR, Paragraph 4.3.1, "Thermal Column."

ANSWER: 010 (1.00)
c
REFERENCE:
SAR, Paragraph 4.3.3.2 & 4.3.3.3, "Pneumatic Tube System."

ANSWER: 011 (1.00)
d
REFERENCE:
Procedure RO-9, "Reactor and Control System Checkout Procedures," Steps 3.17 & 4.11.

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ANSWER: 012 (1.00)
b
REFERENCE:
SAR, Paragraphs 4.4.5, 4.4.6, and 4.4.7, (Power Supplies)

ANSWER: 013 (1.00)
a
REFERENCE:
SAR, Paragraph 4.1.7, "Control Blade Drives."

ANSWER: 014 (1.00)
b
REFERENCE:
Standing Order #11 and SAR Table 4.4

ANSWER: 015 (1.00)
c
REFERENCE:
SAR, Paragraph 4.4.17.5

ANSWER: 016 (1.00)
d
REFERENCE:
SAR, Paragraph 4.1.1 & 4.1.2 and reactor theory.

ANSWER: 017 (1.00)
a
REFERENCE:
SAR, ¶¶ 3.3.2, Facilities Exhaust, & 3.4.1, Normal Operation.

ANSWER: 018 (1.00)
c
REFERENCE:
Technical Specifications, 3.8, Coolant System, and SAR, ¶ 4.2.5, Cleanup System.

ANSWER: 019 (1.00)
d
REFERENCE:
Technical Specifications § 3.3 also, RO-9 § 9.2.2.d"

ANSWER: 020 (1.00)
b
REFERENCE:
SAR, Table 4.2