September 9, 2009

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-223/OL-09-01,
UNIVERSITY OF MASSACHUSETTS – LOWELL.

Dear Dr. Kegel:

During the week of August 17, 2009, the NRC administered operator licensing examinations at your University of Massachusetts – Lowell Reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The 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. Phillip T. Young at (301) 415-4094 or via internet e-mail Phillip.Young@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-223

Enclosures: 1. Initial Examination Report No. 50-223/OL-09-01
2. Written examination with facility comments incorporated

cc: without enclosures:(Please see next page)

September 9, 2009

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

SUBJECT: INITIAL EXAMINATION CORPORATE NOTIFICATION LETTER
NO. 50-223/OL-09-01, UNIVERSITY OF MASSACHUSETTS – LOWELL.

Dear Dr. Kegel:

During the week of August 17, 2009, the NRC administered operator licensing examinations at your University of Massachusetts – Lowell Reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The 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. Phillip T. Young at (301) 415-4094 or via internet e-mail Phillip.Young@nrc.gov.

Sincerely,
/RA/
Johnny H. Eads, Jr., Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-223
Enclosures: 1. Initial Examination Report No. 50-223/OL-09-01
2. Written examination with facility comments incorporated
cc: without enclosures: (Please see next page)

DISTRIBUTION w/ encls.:

PUBLIC	PRTB r/f	RidsNRRDPRPRTA
RidsNRRDPRPRTB	Facility File (CRevelle) O-07 F-13	

ADAMS ACCESSION #: ML092390145 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:BC	
NAME	PYoung:		CRevelle		JEads	
DATE	08/27/2009		09/1/2009		09/9/2009	

C = COVER E = COVER & ENCLOSURE N = NO COPY
OFFICIAL RECORD COPY

cc:

Mayor of Lowell
City Hall
Lowell, MA 01852

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

Department of Environmental Protection
One Winter Street
Boston, MA 02108

Director
Radiation Control Program
Department of Public Health
90 Washington Street
Dorchester, MA 02121

Nuclear Preparedness Manager
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

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

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

REPORT NO.: 50-223/OL-09-01

FACILITY DOCKET NO.: 50-223

FACILITY LICENSE NO.: R-125

FACILITY: University of Massachusetts - Lowell

EXAMINATION DATES: August 18 – 19, 2009

SUBMITTED BY: _____ _____
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of August 17, 2009, the NRC administered operator licensing examinations to one Reactor Operator and two Senior Operator candidates. All applicants passed all portions of the examination

REPORT DETAILS

1. Examiners: Phillip T. Young, Chief Examiner, NRC

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	1/0	0/0	1/0
Operating Tests	1/0	2/0	3/0
Overall	1/0	2/0	3/0

3. Exit Meeting:
Phillip T. Young, Chief Examiner, NRC
Mr. Leo Bobek, Reactor Supervisor, University of Massachusetts - Lowell
Thomas Regan, Reactor Engineer, University of Massachusetts - Lowell

At the conclusion of the site visit, the examiner met with representatives of the facility staff to discuss the results of the examinations. The examiner thanked the facility for their support of the examination. The facility stated that they would submit comments on the written examination, and these comments have been incorporated into the examination attached to this report.

Enclosure 1

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

FACILITY: University of Massachusetts – Lowell

REACTOR TYPE: GE - Pool

DATE ADMINISTERED: August 18, 2009

REGION: I

CANDIDATE:

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	% of Candidates Score	Category Value	Category
20.00	33.3	_____	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
21.00	33.3	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
23.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
64.00		_____	____%	TOTALS
			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 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.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

Section A - Reactor Theory, Thermo & Facility Operating Characteristics

Question A.001 [1.0 point] {1.0}
With the reactor on a constant positive period, which ONE of the following power changes will take the SHORTEST time?

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

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

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

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

Answer: A.001 d.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 4.3 Eq. 4-7

Question A.002 [1.0 point] {2.0}
Which ONE of the following statements describes the subcritical reactor response as Keff approaches unity?

a. 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.

Answer: A.002 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988,
Chapt. 5, pp. 5-1 — 5-28.

Question A.003 [1.0 point] {3.0}
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

Answer: A.003 a.
Reference:

Question A.004 [1.0 point] {4.0}

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.

Answer: A.004 d.
Reference: The amount of reactivity inserted by the blade is much larger than beta; therefore, maximum stable negative period of -80 seconds results.

Question A.005 [1.0 point] {5.0}

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? Graph paper provided at the end of the Section A questions.

a. 48

b. 52

c. 56

d. 60

Answer: A.005 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 5.5, pp. 5-18 — 5-25.

Question A.006 [1.0 point] {6.0}
What is the kinetic energy range of a thermal neutron?

a. > 1 MeV

b. 100 KeV – 1 MeV

c. 1 eV – 100 KeV

d. < 1 eV

Answer: A.06 d.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, § 2.5.1.

Question A.007 [1.0 point] {7.0}
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

Answer: A.007 b.
Reference: 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

Question A.008 [1.0 point] {8.0}
Which ONE of the following is the correct reason that delayed neutrons enhance control of the reactor?

a. There are more delayed neutrons than prompt neutrons.

b. Delayed neutrons take longer to reach thermal equilibrium.

c. Delayed neutrons increase the average neutron generation time.

d. Delayed neutrons are born at higher energies than prompt neutrons and therefore have a greater effect.

Answer: A.008 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §

Question A.009 [1.0 point] {9.0}
Regulating rod worth for a reactor is 0.001 ΔK/K/inch. Moderator temperature **INCREASES** by 9°F, and the regulating rod moves 4½ inches inward to compensate. The moderator temperature coefficient α_{Tmod} is …

a. $+5 \times 10^{-4}$ ΔK/K/°F

b. -5×10^{-4} ΔK/K/°F

c. $+2 \times 10^{-5}$ ΔK/K/°F

d. -2×10^{-5} ΔK/K/°F

Answer: A.009 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §
0.001 ΔK/K/~~inch~~ × 4.5 ~~inch~~ ÷ 9°F = 0.001 ÷ 2 = 0.0005 = 5×10^{-4} ΔK/K/°F

Question A.010 [1.0 point] {10.0}
INELASTIC SCATTERING is the process by which a neutron collides with a nucleus and …

a. is absorbed, with the nucleus emitting a gamma ray.

b. recoils with the same kinetic energy it had prior to the collision.

c. is absorbed, with the nucleus emitting a gamma ray, and the neutron with a lower kinetic energy.

d. recoils with a higher kinetic energy than it had prior to the collision with the nucleus emitting a gamma ray.

Answer: A.010 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, § 2.4.5, Example 2.4.5©

Question A.011 [1.0 point] {11.0}
Excess reactivity is the amount of reactivity …

a. associated with burnable poisons.

b. needed to achieve prompt criticality.

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

d. available below that which is required to make the reactor subcritical.

Answer: A.011 c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.2. p. 6-6.

Question A.012 [1.0 point] {12.0}
Which ONE of the following describes the MAXIMUM amount of Xenon in the core?

a. 8 to 12 hours following Power startup to 100%.

b. 4 to 6 hours following Power Increase, 50% to 100%.

c. 4 to 6 hours following Power Decrease, 100% to 50%.

d. 8 to 12 hours following Power shutdown from 100%.

Answer: A.012 d.
Reference: Burn, R. R., Introduction or Nuclear Reactor Operations, June 1984, § 8.4, pp. 8-12 to 8-19.

Question A.013 [1.0 point] {13.0}
Core excess reactivity changes with …

a. fuel element burnup.

b. control rod height.

c. neutron energy level.

d. reactor power level.

Answer: A.013 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §

Question A.014 [1.0 point] {14.0}
Which ONE of the following parameters is MOST significant in determining the differential worth of a control rod?

a. Rod Speed

b. Reactor Power

c. Flux Shape

d. Fuel Loading

Answer: A.014 c.
Reference: Burn, R. R., Introduction or Nuclear Reactor Operations, June 1984, § 7.2, p. 7-4.

Question A.015 [1.0 point] {15.0}

A fissile material is one which fissions upon absorption of a THERMAL neutron. A fertile material is one which upon absorption of a neutron becomes a fissile material. Which ONE of the following isotopes is an example of a fertile material?

a. U^{233}

b. U^{235}

c. U^{238}

d. Pu^{239}

Answer: A.015 c.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 3.2, Example 3.2, p. 3-2.

Question A.016 [1.0 point] {16.0}

Given:
Primary Flow rate through heat exchanger = 1400 GPM;
Secondary Flow rate through heat exchanger = 1200 GPM;
$\Delta T_{Primary}$ = 13°F
Secondary INLET temperature is 73°F.
Which one of the following should be the secondary OUTLET temperature?

a. ˜ 58°F

b. ˜ 62°F

c. ˜ 84°F

d. ˜ 88°F

Answer: A.016 d.
Reference: ΔT_{sec} = 1400/1200 * 13°F = 7/6 * 13 = 15.2°F T_{OUT} = 73 + 15.2 = 88.2

Question A.017 [1.0 point] {17.0}

Which ONE of the following is the cause of the indicated power to stabilize several hours following a reactor scram. (Assume source inserted in core, source range instrument on and reading 3 counts/second and no reactivity changes, i.e. no temperature changes, no fuel movement, no experiments added, etc.)

a. Subcritical multiplication of source neutrons.

b. Gamma saturation of the source range detector.

c. Neutron activation of the Source Range Detector.

d. Continuing decay of the shortest lived delayed neutron precursor.

Answer: A.017 a.
Reference: Burn, R. R., *Introduction or Nuclear Reactor Operations,* June 1984, § 5.3

Question A.018 [1.0 point] {18.0}
During a startup you increase reactor power from 50 watts to 1000 watts in 100 seconds. What is reactor period?

a. 25

b. 33

c. 41

d. 50

Answer: A.018 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 4.3, p. 4-4.
$P = P_0 e^{t/\tau}$ $\ln(P/P_0) = t/\tau$ $\tau = t/(\ln(P/P_0)$ $\tau = 100/\ln(20) = 33.381$

Question A.019 [1.0 point] {19.0}
As primary coolant (moderator) temperature increases, control rod worth …

a. decreases due to lower reflector efficiency.

b. increases due to the increase in thermal diffusion length.

c. decreases due to higher neutron absorption in the moderator.

d. remains the same due to constant poison cross-section of the control rods.

Answer: A.019 b.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 7.2, p. 7-1–7-9.

Question A.020 [1.0 point] {20.0}
The Chief Reactor Operator tells you that the reactor is shutdown with a Shutdown Margin of 12.0%. Nuclear Instrumentation reads 100 cpm. The CRO inserts an experiment into the core and counts increase to 200 cpm. What is the resulting K_{eff} for the core?

a. 0.920

b. 0.946

c. 0.973

d. 1.000

Answer: A.020 b
Reference: $K_{eff}(I) = 1/(1+SDM) = 1/1.120 = 0.892857$ $CR(I)[1 - K_{eff}(I)] = CR(f)[1 - K_{eff}(f)]$
$100(1 - 0.893) = 200 (1 - x)$ $½(1 - 0.893)= 1 - x$ $1 - x = 0.0535714$;
$x = 1 - 0.0535714 = \underline{0.94643}$

Section B - Normal, Emergency and Radiological Control Procedures

Question B.001 [1.0 point] {1.0}
Upon discovery that no Area Radiation Monitors on the experimental levels are operable, you may continue steady-state operation providing you replace the inoperable monitor with a portable gamma-sensitive monitor having its own alarm within _____ discovery of the condition.

a. 15 minutes
b. 30 minutes
c. an hour
d. eight hours

Answer: B.001 a.
Reference: Technical Specifications 3.4.3.

Question B.002 [1.0 point] {2.0}
Which ONE of the following is the lowest level of permission required to restart the reactor following violation of a Safety Limit?

a. Licensed Senior Operator on call.
b. Reactor Supervisor
c. Facility Director
d. Nuclear Regulatory Commission

Answer: B.002 d.
Reference: Technical Specification 6.5 1st ¶

Question B.003 [1.0 point] {3.0}
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 confines of the North Campus.
c. within 15 minutes walk of the reactor facility.
d. within the reactor containment or the Pinanski Building.

Answer: B.003 d.
Reference: T.S. 6.0

Section B Normal, Emergency and Radiological Control Procedures

Question B.004 [1.0 point] {4.0}
Which ONE of the following types of experiments is required to be doubly encapsulated? Experiments which contain …

a. explosive materials.

b. corrosive materials.

c. fissionable materials.

d. compounds highly reactive with water.

Answer: B.004 b.
Reference: Technical Specification 3.4.2.a

Question B.005 [1.0 point] {5.0}
All of the monitors checked by RO-13 are checked using a Co^{60} source, except one which uses a Cf^{252} neutron emitting source. The channel which uses the Cf^{252} source is channel …

a. C (Continuous Air Monitor #1)

b. E (Fission Product Monitor)

c. I (Plenum)

d. L (Thermal Column)

Answer: B.005 b.
Reference: RO-13 § 13.1.a.

Question B.006 [1.0 point] {6.0}
So far this calendar year, you have received 3.3 Rem whole body dose. You must work on a control drive mechanism where there is an average dose of 250 mR/hr. Which ONE of the following times is closest to your stay time WITHOUT going over? (Assume you are over the age of 18.)

a. 3¼ hours.

b. 6½ hours.

c. 12¾ hours.

d. 19 hours.

Answer: B.006 b.
Reference: 10CFR20.1201
5.0 - 3.3 = 1.7 Rem allowable. 1.7 Rem ÷ 0.25 Rem/hr = 6.8̃ 6½

Section B - Normal, Emergency and Radiological Control Procedures

Question B.007 [1.0 point] {7.0}
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.

Answer: B.007 b.
Reference: Requalification Plan, Sect. 3.3

Question B.008 [1.0 point] {8.0}
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 may continue running with all isolation valves closed.

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

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

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

Answer: B.008 b.
Reference: T.S. 3.5

Section B Normal, Emergency and Radiological Control Procedures

Question B.009 [1.0 point] {9.0}
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 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.

c. 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.

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

Answer: B.009 a.
Reference: 10CFR20.1003

Question B.010 [1.0 point] {10.0}
"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.

Answer: B.010 c.
Reference: Tech. Specs.

Question B.011 [1.0 point] {11.0}
Which one of the following statements describes the reason for the Technical Specifications limit on pool water conductivity?

a. restrict the concentration of coolant dissolved oxygen.
b. maintain the coolant in a slightly basic condition.
c. to ensure that leaking fuel are detected.
d. to minimize the rate of corrosion.

Answer: B.011 d.
Reference: Tech. Specs 3.8

Section B - Normal, Emergency and Radiological Control Procedures

Question B.012 [1.0 point] {12.0}
According to the Emergency plan, the Emergency Planning Zone …

a. is the area enclosed within the containment vessel.

b. lies within the site boundary and is bounded by a 150 meter radius from the exhaust stack.

c. is the geographical area beyond the site boundary, where the Reactor Director has direct authority over all activities.

d. specifies contamination levels (airborne, radiation dose, or dose rates) that may be used as thresholds for establishing emergency classes.

Answer: B.012 a.
Reference: Emergency Plan Chapter 2.0, Definitions, § 2.11.

Question B.013 [1.0 point] {13.0}
Which ONE of the following is the definition of a CHANNEL TEST?

a. an adjustment of the channel such that it output corresponds with acceptable accuracy to known values of the parameter which the channel measures. This shall encompass the entire channel, including equipment actuation, alarm, or trip.

b. a qualitative verification of acceptable performance by observation of channel behavior. This verification, where possible, shall include a comparison of the channel with other Independent channels or systems measuring the same variable.

c. the combination of sensor, line, amplifier, and output devices which are connected for the purpose of measuring the value of a parameter.

d. the introduction of a signal into the channel for verification that it is operable.

Answer: B.013 d.
Reference: Technical Specifications §§ 1.2, 1.3, 1.4 and 1.5.

Question B.014 [1.0 point] {14.0}
Consider two point sources, each having the SAME curie strength. Source A's gammas have an energy of 0.5 MeV, while Source B's gammas have an energy of 1.0 MeV. Using a Geiger-Müller detector the reading from source B will be … (NOTE: Ignore detector efficiency.)

a. four times that of source A.
b. twice that of source A.
c. the same.
d. half that of source A.

Answer: B.14 c.
Reference: Standard NRC Health Physics Question.

Question B.015 [1.0 point] {15.0}
While working on an experiment, you receive the following radiation doses: 100 mrem (β), 25 mrem (γ), and 5 mrem (thermal neutrons). Which ONE of the following is your total dose?

a. 175 mrem
b. 155 mrem
c. 145 mrem
d. 130 mrem

Answer: B.015 d.
Reference: A rem is a rem is a rem.

Question B.016 [1.0 point] {16.0}
After a reactor scram, neither you nor the SRO is able to determine the cause of the scram. What is the minimum level of management who may authorize restart of the reactor under this condition?

a. The Senior Reactor Operator on his/her own.
b. The Reactor Supervisor after consultation with the Reactor Director.
c. The Chief Reactor Operator after consultation with the Reactor Supervisor.
d. The Senior Reactor Operator on consultation with either the Chief Reactor Operator or the Reactor Supervisor.

Answer: B.016 d.
Reference: RO-7, Reactor Shutdown, § 7.32.4. pp. RO7-2 & 3.

Section B - Normal, Emergency and Radiological Control Procedures

Question B.017 [1.0 point] {17.0}
Which ONE of the following classifications for an emergency is not credible for the U. Mass.-Lowell reactor? (Note: Items are listed alphabetically, NOT in order of severity!)

a. Alert

b. Non-Reactor Safety Related Event

c. Notification of Unusual Event

d. Site Area Emergency

Answer: B.017 d.
Reference: Emergency Plan §§ 4.0 through 4.5.

Question B.018 [1.0 point] {18.0}
When taking logs readings, you must inform the Chief Reactor Operator when you notice a discrepancy between power channels greater than …

a. 2%

b. 3%

c. 4%

d. 5%

Answer: B.018 b.
Reference: Standing Order #4, Sequence of Operations during Startup and at Rated Power.

Question B.019 [1.0 point] {19.0}
An experiment irradiated in the pool reads 50mr/hr at 2 feet below the pool surface and 100 mr/hr at 1 foot below the pool surface. You decide to place the experiment at 20 feet below the surface of the pool. Based on the attenuation you noted between the 2 foot and 1 foot levels, you would expect the shielding due to 20 feet of water to reduce the dose by a factor of approximately … (Note: Ignore dose decrease due to distance.)

a. 1000
b. 10,000
c. 100,000
d. 1,000,000

Answer: B.019 d.
Reference: 2^{20} = 1,048,756 ~ 1,000,000

Section B Normal, Emergency and Radiological Control Procedures

Question B.020 [2.0 points 0.5 each] {21.0}

Match the general area radiation levels listed in column A with the corresponding type of radiation area listed in column B. (Note: Only one answer for each item in column A. Items from column B may be used more than once or not at all.)

Column A	Column B
a. 2 mRem/hr.	1. High Radiation Area
b. 65 mRem/hr.	2. Radiation Area
c. 203 mRem/hr.	3. Unrestricted Area
d. 520 mRem/hr.	4. Very High Radiation Area

Answer: B.020 a. = 3; b. = 2; c. = 1; d. = ~~4~~ 1

Reference: 10CFR20 Definitions

Section C - Facility and Radiation Monitoring Systems

Question C.001 [1.0 point] {1.0}
Which one of the following scrams is NOT disabled when the RANGE switch is placed in the 0.10 MW position?

a. Bridge Position

b. Reactor Period Low

c. Coolant Gate Open

d. Core Inlet High Temperature

Answer: C.001 b.
Reference: Technical Specifications § 3.3 also, RO-9 § 9.2.2.d"

Question C.002 [1.0 point] {2.0}
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 primary coolant pump.

b. The pool divider gate.

c. The pool wall liner.

d. The break valve.

Answer: C.002 d.
Reference: SAR, Paragraph 4.2.2., "Primary Coolant System."

Question C.003 [1.0 point] {3.0}
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.

Answer: C.003 c.
Reference: SAR § 6.5.1, p. 6-7.

Section C - Facility and Radiation Monitoring Systems

Question C.004 [1.0 point] {4.0}
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.

Answer: C.004 a.
Reference: SAR, Paragraph 4.1.7, "Control Blade Drives."

Question C.005 [1.0 point] {5.0}
Which ONE of the following is used when the reactor is operating to reduce the buildup of Ar^{41} in the reactor bay?

a. Purification system via the ion bed.

b. Diffuser pumps which decrease the release of Ar^{41} from the pool.

c. Operation of the ventilation system, which releases the Ar^{41} through the stack.

d. None required due to the relatively short half-life of Ar^{41} (seven seconds).

Answer: C.005 c.
Reference: SAR §

Question C.006 [1.0 point] {6.0}
Which ONE of the following correctly describes the manual operation of Valve A in the ventilation system? The valve is opened …

a. by air acting on a piston against a spring. The valve is closed by opening a quick release valve which bleeds air off of an auxiliary piston which in turn opens a port bleeding air off the main piston.

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

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

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

Answer: C.006 a.
Reference: SAR figure 3.7, page 3-16

Section C - Facility and Radiation Monitoring Systems

Question C.007 [1.0 point] {7.0}
Which ONE of the following correctly describes the operation of the RTD (temperature detector used for the temperature recorder).

a. A precision wound resistor, which changes resistance proportional to temperature.

b. A precision wound inductor, which changes inductance proportional to temperature.

c. A bimetallic junction, which generates a potential (micro-volt range) proportional to temperature.

d. A bimetallic strip which because of differing thermal expansion coefficients causes the strip to bend proportional to temperature.

Answer: C.007 a
Reference: SAR § 4.4.17.5

Question C.008 [1.0 point] {8.0}
Which ONE of the following correctly describes how a compensated ion chamber detects neutrons? A neutron interacts with the …

a. B^{10} lining of the tube.

b. U^{235} lining of the tube.

c. N_2 gas which fills the tube.

d. BF_3 gas which fills the tube.

Answer: C.008 a.
Reference: Standard NRC Question

Question C.009 [2.0 points, 0.5 each] {10.0}
The liquid radwaste system divides cooling water into four sections for the purpose of performance checks/monitoring. Match the cooling water sections in Column A with its appropriate performance checks from Column B. Note that some performance checks in Column B may be used more than once or not at all.

Column A	Column B
a. Pool	1. External gamma monitor and delayed neutron detector.
b. Primary Loop	2. Continuous conductivity measurements.
c. Cleanup Loop	3. Periodic sampling for quality and presence of radionuclides.
d. Secondary Loop	4. Daily sampling for Na^{24}.

Answer: C.009 a. = 3; b. = 1; c. = 2; d. = 4
Reference: SAR § 7.2.4, Page 7-5

Section C - Facility and Radiation Monitoring Systems

Question C.010 [1.0 point] {11.0}
Which ONE of the following communications systems allows all stations to talk to each other simultaneously?

a. phone system

b. main intercom system

c. public address system

d. sound powered headset system

Answer: C.010 c.
Reference: UMLR Safety Analysis Report, § 6.3.1, *Communications System*

Question C.011 [1.0 point] {12.0}
Which ONE of the following loads is supplied from the air compressor located on the intermediate level inside the reactor building?

a. Air lock doors.

b. Thermal column door.

c. Pneumatic tube system.

d. Containment isolation valves.

Answer: C.011 a.
Reference: ULR SAR, § 6.2, p 6-5

Question C.012 [1.0 point] {13.0}
Which ONE of the following is the type of startup neutron source use for your reactor?

a. Californium

b. Plutonium-Beryllium

c. Neptunium-Antimony

d. Americium-Beryllium

Answer: C.012 d.
Reference: SAR § 4.1.4, page 4-6

Question C.013 [1.0 point] {14.0}
Which ONE of the following describes how the signal for regulating rod position indication is generated?

a. A tachometer that counts the revolutions of the lead screw.

b. A series of magnetic switches which respond to lead screw position.

c. A mechanical position transmitter that is chain driven by the drive motor.

d. A series of limit switches that are actuated by the ball bearing screw assembly.

Answer: C.013 c.
Reference: ULR SAR, §4.1.8, p 4-11; Figures 4.6 and 4.7. C.14

Question C.014 [1.0 point] {15.0}
The purpose of the filter in the reactor pool cleanup system is to …

a. prevent demineralizer resin fines from entering the pool.

b. prevent larger particles from plugging the demineralizer resin.

c. remove particles that could clog the cleanup system pump seals.

d. remove crud from the coolant limiting the radiation levels associated with the demineralizer.

Answer: C.014 a.
Reference: ULR SAR, §4.2.5, p 4-29.

Question C.015 [1.0 point] {16.0}
Which ONE of the following is an *"ELECTRONIC"* scram?

a. High flux

b. Seismic

c. Low pool water level

d. High temperature primary coolant

Answer: C.015 a.
Reference: ULR SAR, §4.4.15.2, p 4-74.

Section C - Facility and Radiation Monitoring Systems

Question C.016 [2.0 points, 0.33 each] {18.0}
Using the drawing of the primary system provided, if the reactor is in position 1, with the coolant system in the cross-stall mode (preferred line-up). Identify the position of the valves listed (Open, Closed, Throttled).

a. P-1

b. P-2

c. P-3

d. P-4

e. P-9

f. P-11

Answer: C.016 a. = Open; b. = Open; c. = Closed; d. = Closed;
e. = Open; f. = Throttled
Reference: SAR § 4.2.2, also, Training Handout section on Primary System, and drawing.

Question C.017 [2.0 points, ¼ each] {20.0}
Using the drawing of the ventilation system provided, give the status of the following valves (OPEN, SHUT) and fans (ON, OFF) upon receipt of a GRVS signal.

a. Valve A

b. Valve B

c. Valve C

d. Fans 3 through 6

e. Valve E

f. Valve F

g. Fan EF-12

h. Fan AC-2

Answer: C.017 a. = SHUT; b. = SHUT; c. = SHUT; d. = OFF;
e. = SHUT; f. = OPEN; g. = OFF; h. = ON
Reference:

Question C.018 [1.0 point] {21.0}
Fan EF-14 and valve D operate independently of a GRVS signal. For which of the listed conditions below, would fan EF-14 be operating? Containment Pressure =

a. +0.6 inches H_2O

b. +0.3 inches H_2O

c. -0.3 inches H_2O

d. -0.6 inches H_2O

Answer: C.018 b.
Reference: Training Handout Section on Containment/Ventilation, last page.

Question C.019 [1.0 point] {22.0}
The reactor is operating at 1 Megawatt, when the SECONDARY coolant pump trips on overload. Assuming NO OPERATOR ACTION, which ONE of the following trips would most likely cause a reactor scram?

a. High Flux

b. Short Period

c. Low Secondary Flow

d. High Coolant Inlet Temperature

Answer: C.019 d.
Reference: Modified previous NRC Examination Question

Question C.020 [1.0 point] {23.0}
Which one of the following ventilation valves will fail OPEN on a loss of service air?

a. G, Sanitary System Vent Isolation Valve

b. D, Emergency Exhaust Isolation Valve

c. F, Ventilation Supply Bypass Valve

d. H, Acid Vent (Basement)

Answer: C.020 c.
Reference: U. Mass. Lowell Reactor, FSAR, § 3.4.2.2