October 20, 2008

Dr. John A. Bernard, Jr.
Director of Reactor Operations
Massachusetts Institute of Technology
Research Reactor
MITNRL-NW 12
138 Albany Street
Cambridge, MA 02139

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-20/OL-08-01, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dear Dr. Bernard:

During the week of September 1, 2008, the NRC administered an operator licensing examination at your Massachusetts Institute of Technology Reactor. The examination was 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 pty@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. 50-20

Enclosures: 1. Initial Examination Report No. 50-20/OL-08-01
2. Written examination with facility comments incorporated

cc without enclosures: See next page

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RidsNRRDPRPRTB Facility File (CHart) O-13 D-07

ADAMS ACCESSION #: ML082750036 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung pty		CRevelle cr		JEads jhe	
DATE	10/04/08		10/10/08		10/20/08	

OFFICIAL RECORD COPY

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Test, Research, and Training
Reactor Newsletter
University of Florida
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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-20/OL-08-01

FACILITY DOCKET NO.: 50-20

FACILITY LICENSE NO.: R-37

FACILITY: MITR-II

EXAMINATION DATES: September 02 – 04, 2008

SUBMITTED BY: **/RA/** 10/4/08
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of September 1, 2008 the NRC administered operator licensing examinations to one Reactor Operator applicant and four Senior Operator applicants. All applicants passed all portions of the examinations.

REPORT DETAILS

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

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	1/0	4/0	5/0
Operating Tests	1/0	4/0	5/0
Overall	1/0	4/0	5/0

3. Exit Meeting:
   Phillip T. Young, NRC, Examiner
   Mr. Ed Lau, MIT, Reactor Superintendent
   Mr. Frank Warmsley, MIT, Training Supervisor

The examiner thanked the facility for all the work and coordination required to conduct the examinations.

ENCLOSURE 1

US NRC License Operator Examination

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Operator Written Examination with Answer Key

September 02, 2008

ENCLOSURE 2

Hi Phillip,

This is Frank Warmsley from the MIT Nuclear Reactor Lab.
Below are the 3 questions that had incorrect answers from the exam you administered at the facility.

FACILITY COMMENT **Question** C.006
The question had to do with the expected response of the ventilation system. The answer key had A, the ventilation would trip due to low temperature of the outside air. It is not the outside air that would cause a trip, it is the air after going through the preheating system that would cause a trip.
The correct answer is D, that the dampers in weekend open position would close on receipt of a high level signal.

NRC RESPONSE
Facility comment accepted, answer key changed to reflect “d.” As the correct answer.

FACILITY COMMENT **Question** C.010
The next 2 problems are to be found in the multiple choice question where the question said to assume the reactor is critical. The 2 questions you have marked the answers as 2, rod withdrawal prohibited, are actually 1, no system response. This is because the question stated that the reactor was already critical, hence the blades are already withdrawn.

NRC RESPONSE
Facility comment accepted, answer key changed for parts “a.” And “d.” To reflect 1 as the correct answer..

Frank Warmsley
Training Supervisor
MIT Nuclear Reactor Lab

A. Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.001 [1.0 point] (1.0)
Given the following condition, which reactor would go critical first? (All other conditions are identical.)

a. Reactor with a blade withdrawal speed of 1 inch per minute.
b. Reactor with a blade withdrawal speed of 4 inches per minute.
c. Reactor with a blade withdrawal speed of 6 inches per minute.
d. Reactor with a blade withdrawal speed of 9 inches per minute.

Answer: A.001 d.
Reference: Reactor Physics Notes "Reactor Subcritical Multiplication"

Question A.002 [1.0 point] (2.0)
The void coefficient for the MIT reactor (core center) is?

a. 0.02 mbeta/cm3
b. 0.2 mbeta/cm3
c. 2 mbeta/cm3
d. 20 mbeta/cm3

Answer: A.002 c.
Reference: RSM 10.8

Question A.003 [1.0 point] (3.0)
After a week of full power operation, Xenon will reach its peak following shutdown in approximately:

a. 6 hours
b. 9 hours
c. 12 hours
d. 40 hours

Answer: A.003 a.
Reference: MIT Reactor Physics Notes, Reactivity Feedback and measurement of a Xenon Transient; RSM 10.6

Question A.004 [1.0 point] (4.0)
A subcritical reactor is being started up. A control rod (shim blade) is raised in four equal steps (inches). Which statement most accurately describes the expected reactor response?

a. Each withdrawal will add the same amount of reactivity.
b. Power increases by the same amount for each withdrawal.
c. The time for power to stabilize after each successive withdrawal increases.
d. A lower critical rod height is attained by decreasing the time intervals between withdrawals.

Answer: A.004 c.
Reference: MIT Reactor Physics Notes, Reactor Startup and Subcritical Multiplication

Question A.005 [1.0 point] (5.0)
A control rod is withdrawn until 100 millibeta is added to a critical reactor.
Which ONE of the following will be the expected reactor period immediately after rod motion stops? (Assume delayed neutron decay constant is 0.1 s-1)

a. 30 second
b. 45 second
c. 90 second
d. 110 second

Answer: A.005 c.
Reference: T = (B-p)/(lambda x p); T= (1-0.1)/(0.1x0.1); T=90s

Question A.006 [1.0 point] (6.0)
Shortly after a reactor trip, reactor power indicates 0.5% where a stable negative period is attained. Reactor power will be reduced to 0.05% in approximately _____ seconds.

a. 90
b. 180
c. 270
d. 360

Answer: A.006 b.
Reference: Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, § 5.47, p. 246.

Question A.007 [1.0 point] (7.0)
An initial count rate of 100 is doubled five times during startup. Assuming an initial Keff = 0.950, what is the new Keff?

a. 0.957
b. 0.979
c. 0.988
d. 0.998

Answer: A.007 d.
Reference: Glasstone, S. and Sesonske,§ 3.161 — 3.163, pp. 190 — 191.
$(1/32\ (1 - 0.95) = 1 - Keff_2)$ $(1 - 0.05/32 = Keff_2)$ $Keff_2 = 0.9984$

Question A.008 [1.0 point] (8.0)
Which one of the following is the MAXIMUM amount of reactivity that can be promptly inserted into the reactor WITHOUT causing the reactor to go "Prompt Critical"?

a. 100 mβ
b. 500 mβ
c. 750 mβ
d. 1900 mβ

Answer: A.008 c.
Reference: Glasstone, S. and Sesonske, § 5.55, p. 250.
$k = 1 / (1- \beta)$ $k = 1$ when $\rho = \beta$

Question A.009 [1.0 point] (9.0)
Which statement illustrates a characteristic of Subcritical Multiplication?

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

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

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

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

Answer: A.009 a.
Reference: Glasstone, S. and Sesonske, §§ 3.161 — 3.163, pp. 190 — 191.

Question A.010 [1.0 point] (10.0)
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.010 a.
Reference: Glasstone, S. and Sesonske, 1991, § 10.34, pp. 639.

Question A.011 [1.0 point] (11.0)
Assuming the Samarium worth is 0.006 ΔK/K at full power, which one of the following is the Samarium worth 10 days after shutdown from full power?

a. Essentially zero.

b. It increases by a factor of 2.

c. Less than 0.006 ΔK/K but greater than zero.

d. Greater than 0.006 ΔK/K

Answer: A.011 d.
Reference: Glasstone, S. and Sesonske, § 5.81 — 5.83, p. 260.

Question A.012 [1.0 point] (12.0)
How does shim bank position relate to the reactivity worth of dumping the D_2O reflector?

a. For the lowest shim bank position, the reactivity worth of a D_2O dump is at it's greatest.
b. For the highest shim bank position, the reactivity worth of a D_2O dump is at it's greatest.
c. For the intermediate shim bank position, the reactivity worth of a D_2O dump is at it's greatest.
d. For the intermediate shim bank position, the reactivity worth of a D_2O dump is at it's minimum.

Answer: A.012 b.
Reference: RSM 10-7

Question A.013 [1.0 point] (13.0)
How will raising the temperature of the water in the core and the heavy water in the shield affect reactivity?

	Light Water	Heavy Water
a.	Positive	Negative
b.	Positive	Positive
c.	Negative	Negative
d.	Negative	Positive

Answer: A.013 c.
Reference: RSM 10-8

Question A.014 [1.0 point] (14.0)
What is the definition of reactivity?

a. A measure of the number of neutrons being produced in the core.
b. A measure of the number of neutrons being absorbed by the fuel.
c. A measure of the reactor's departure from critical.
d. A measure of the reactor's multiplication factor.

Answer: A.014 c.
Reference: MITR II Reactor Physics Notes - Reactor Kinetics

Question A.015 [1.0 point] (15.0)
On average, how many neutrons will be emitted per fission from the MITR-II core?

a. 3
b. 2.5
c. 2
d. 1.5

Answer: A.015 b.
Reference: MITR II Reactor Physics Notes - Reactor Startup and Subcritical Multiplication (2)

Question A.016 [1.0 point] (16.0)
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.016 d.
Reference: Glasstone, S., Nuclear Reactor Engineering, Kreiger Publishing, Malabar: Florida, 1991. 3rd Edition. pg. 13

Question A.017 [1.0 point] (17.0)
What is the normal MITR-II neutron startup source for a startup when the reactor has only been shut down for a few hours?

a. Spontaneous fission from Cf^{252}
b. Beta produced from Ra results in a neutron from Li^{8}
c. Alpha produced from Po results in a neutron from Be^{9}
d. Gamma produced from fuel results in a neutron from H^{2}

Answer: A.017 d.
Reference: MITR II Reactor Physics Notes - Reactor Startup and Subcritical Multiplication

Question A.018 [1.0 point] (18.0)
What are the advantages/disadvantages of using light water as compared to heavy water as a moderator or reflector? Light water has a:

a. lower moderating power and a lower absorption cross-section
b. higher moderating power and a lower absorption cross-section
c. lower moderating power and a higher absorption cross-section
d. higher moderating power and a higher absorption cross-section

Answer: A.018 d.
Reference: RSM 10-11

Question A.019 [1.0 point] (19.0)
Which ONE of the following atoms will cause a neutron to lose the most energy in an elastic collision?

a. U-238
b. Pb-208
c. C-12
d. H-1

Answer: A.019 d.
Reference: Glasstone and Sesonske, Nuclear Reactor Engineering, Chapter 3, Section 3.77

Question A.020 [1.0 point] (20.0)
Based on the time versus exposure rate table below, which ONE of the following is the half life of an experimental sample irradiated in the core?

Time	Exposure Rate
0	20 mR/hr
5 min	15.7 mR/hr
10 min	12.3 mR/hr
15 min	9.6 mR/hr
20 min	7.6 mR/hr

a. 11 min
b. 14 min
c. 17 min
d. 20 min

Answer: A.020 b.
Reference: Standard NRC Question

$$DR = DR_0 e^{-\lambda t} \rightarrow 12.3 = 20 e^{-\lambda * 10} \rightarrow \lambda = -1 * \frac{\ln\left(12.3/20\right)}{10} = 0.0486\,\text{min}^{-1}$$

$$t_{1/2} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{0.0486\,\text{min}^{-1}} = 14.258\,\text{min}$$

Question B.001 [1 point] (1.0)
Select the MINIMUM amount of time that must be spent performing license activities in order to maintain your license active.

a. 4 hours per month
b. 8 hours per month
c. 4 hours per quarter
d. 8 hours per quarter

Answer: B.001 c.
Reference: 10 CFR 55.53

Question B.002 [1 point] (2.0)
Which one of the followings describes requirements which must be observed when "locking out" facility equipment after permission is granted?

a. SRO witness lockout, SRO will verify safe system condition, Superintendent must be notified, the system must be tagged out, a notation as to the system being locked out shall be made on the status board.

b. SRO will witness lockout, RO will verify safe system condition, Superintendent must be notified, the system must be tagged out, a notation as to the system being locked out shall be made on the status board.

c. SRO will witness lockout, person performing the work will perform lockout, person performing the work will retain the key on their person, the system must be tagged out, a notation as to the system being locked out shall be made on the status board.

d. SRO will verify safe system condition, any member of the NRL/RRPO Staff will witness lockout, person performing the work will perform lockout, the person performing the work will retain the key on their person, the system must be tagged out.

Answer: B.002 c.
Reference: PM 1.14.3

Question B.003 [1 point] (3.0)
Which ONE of the following describes the effect of a loss of electrical power to the Scam System?

a. Reactor protection from the automatic scrams are still in effect.

b. The reactor will experience a minor scram but no alarm functions or instrument indications are active.

c. Signal lights associated with the scrams are active but reactor protection from automatic scrams are lost.

d. The Scam System Power Failure alarm will actuate if all electrical power to the reactor building has occurred.

Answer: B.003 a.
Reference: PM 5.7.1

Question B.004 [1 point] (4.0)
Which one of the following Film Badge colors identifies the wearer as someone who is permitted to escort members of the general public through the reactor building?

a. Blue

b. Red

c. Yellow

d. Green

Answer: B.004 c.
Reference: PM 1.12, p. 1

Question B.005 [1 point] (5.0)
Which of the following is not considered to cause a whole body exposure?

a. Ar-41

b. I-131

c. Xe-133

d. Kr-88

Answer: B.005 b.
Reference: Glasstone/Sesonske - Chapter 9

Question B.006 [1 point] (6.0)
The fuel management pattern of the MITR-II usually calls for refueling (following operation at full power for a long period of time) when the shim bank position reaches 16 inches. Approximately what is the core excess reactivity at this time?

a. Approximately 200 mbeta of excess reactivity
b. Approximately 0.2 Beta of excess reactivity
c. Approximately 1 Beta of excess reactivity
d. Approximately 2 Beta of excess reactivity

Answer: B.006 c.
Reference: RSM 10.8

Question B.007 [1 point] (7.0)
The maximum reactivity worth of a single movable experiment allowed by Tech. Specs is:

a. 0.2 %Delta K/K
b. 0.5 %Delta K/K
c. 1.0 %Delta K/K
d. 1.8 %Delta K/K

Answer: B.007 a.
Reference: MIT TS 6.1.1

Question B.008 [1 point] (8.0)
Per Technical Specifications, who may authorize the use of a temporary change to a checklist provided it does not change the intent of the original approved procedure?
The Director of Reactor Operations.
a. The Director of Reactor Operations.
b. The SRO on duty and the Reactor Operator.
c. A licensed SRO and another member of the facility staff.
d. A licensed Reactor Operator and the Reactor Radiation Protection Officer.

Answer: B.008 c.
Reference: T.S. 7.8.3

Question B.009 [1 point] (9.0)
The basis for the D_2 concentration limit in the Helium gas cover blanket for the D_2O reflector system is to:

a. minimize personnel radiation exposure.
b. limit the disassociation of D_20 in the reflector.
c. minimize the contamination of the Helium cover gas.
d. prevent a flammable concentration of D_2 gas in the Helium blanket.

Answer: B.009 d.
Reference: TS 3.3

Question B.010 [1 point] (10.0)
A radiation survey performed 30 minutes after shutdown from a week of full power operation indicated 1500 mR/hr on contact with the main heat exchangers. Which of the following is true?

a. This reading is normal, most likely caused by N-16.
b. This reading is normal, most likely caused by Na-24.
c. This reading is abnormal, most likely caused by tritium.
d. This reading is abnormal, most likely caused by fission products.

Answer: B.010 d.
Reference: AOP 5.0

Question B.011 [1 point] (11.0)
A 15 ml sample of primary water is removed from the sample station. What is the dominant nuclide you would expect assuming routine (normal) operation?

a. Na-24
b. U-235
c. Co-60
d. Ar

Answer: B.011 a.
Reference: RRPO surveys

Question B.012 [1 point] (12.0)
If the reactor core tank level can not be maintained at or above the low level scram (-4"), what class of emergency would be declared?

a. Unusual Event
b. Alert
c. Site Area
d. General

Answer: B.012 a.
Reference: PM 4.4.4.15

Question B.013 [1 point] (13.0)
Which one of the following most closely represent the exposure rate on top of the reactor (above the shielding) when the reactor is operating at 4.9 MW?

a. 1 mR/hr
b. 10 mR/hr
c. 20 mR/hr
d. 50 mR/hr

Answer: B.013 b.
Reference: RRPO surveys

Question B.014 [1 point] (14.0)
Which ONE of the following is the assembly area in the event of a NW12 fire alarm?

a. Reception Area.
b. NW13 Machine Shop.
c. Far side of Albany Street.
d.Campus Police Headquarters.

Answer: B.014 c.
Reference: PM 4.4.4.11 Appendix A

Question B.015 [1 point] (15.0)
What must be assumed if the high radiation set-up area vault alarm has actuated?
a

a. Inadvertent criticality has occurred.
b. Person went by with hot source.
c. Electrical short in instrument.
d. Vault monitor failed.

Answer: B.015 a.
Reference: AOP 5.6.1

Question B.016 [1 point] (16.0)
During continuous power operation with the automatic control system it may be necessary for the operator to reshim the control blades to maintain the regulating rod within its useful range.
Which ONE of the following describes the requirements associated with this reshim of control blades?

a. The duty supervisor must approve all reshims prior to performance.
b. Reactor power is to be maintained within 2.5% of the desired level while reshimming.
c. The first motion of any control absorber during a reshim should be inward so as to lower reactor power.
d. All shim blades must be maintained within 2.5 inches of each other during the reshim and within 1.0 inch following the reshim.

Answer: B.016 c.
Reference: PM 2.4, Step 3(a), p 3.

Question B.017 [1 point] (17.0)
Which one of following is the maximum reactor outlet temperature that will prevent exceeding the MITR-II safety limit?

Assume the following core conditions:

Reactor Power = 4.9 MW

Primary Flow = 1960 gpm

Core Tank level = 8 ft.

a. 82 ºC

b. 78 ºC

c. 73 ºC

d. 68 ºC

Answer: B.017 b.
Reference: T.S. 2.1 (Safety Limits); PM 5.1.3 (Follow-up Action Step 7)

Question B.018 [1 point] (18.0)
In the event of a large tritiated water spill, what type of action should be followed for operation of the ventilation system?

a. Close the dampers, thus securing the ventilation system.

b. Turn off the ventilation system until radiation levels decrease.

c. Continue to operate the ventilation system as normal, except do not blow air directly on the spill.

d. Turn up the trips on the gas and particulate monitors so that the dampers will not close unless done so manually.

Answer: B.018 c.
Reference: MIT Comments to 1997 written examination.

Question B.019 [1 point] (19.0)
Which one of the following statements regarding reactor operations is TRUE?

a. Reactor operations may continue if a required member of the shift must leave for emergency personal problems. An adequate replacement shall be secured as soon as possible.

b. Work shall not be conducted in the reactor building unless a reactor supervisor or a reliable person appointed by a reactor supervisor is present at the facility.

c. If a reactor startup is scheduled for 3.00 PM, the morning surveillance checksheet shall be completed at least 1 hour prior to the startup.

d. The shift supervisor may grant permission to an experimenter to irradiate acids or other corrosive liquids.

Answer: B.019 b.
Reference: MITR PM 1.14

Question B.020 [1 point] (20.0)
What are the four (4) variables that constitute the safety limit?

a. Excess reactivity of the control system; height of water above the outlet end of the heated section; total reactor thermal power; reactor coolant outlet temperature.

b. Reactor coolant total flow rate; radiation level above the core tank; reactor coolant outlet temperature; height of water above the outlet end of the heated section.

c. Total reactor thermal power; reactor coolant total flow rate; reactor coolant outlet temperature; height of water above the outlet end of the heated section.

d. Height of water above the outlet end of the heated section; total reactor thermal power; reflector tank D_20 flow rate; reactor coolant total flow rate.

Answer: B.020 c.
Reference: MITR-II TS 2.1

Question C.001 [1.0 point] (1.0)
The spent fuel storage pool alarm will activate in response to:

a. spent fuel storage pool pump high discharge pressure.

b. a leak in the cleanup system.

c. high radiation in the pool.

d. high level in the pool.

Answer: C.001 b.
Reference: PM 5.7.12

Question C.002 [1.0 point] (2.0)
The minimum complement of radiation monitors is:

a. one effluent (stack or plenum), one area monitor capable of warning personnel, one water monitor and one tritium sampler.

b. one plenum monitor capable of closing the dampers, one area monitor capable of warning personnel, one water monitor and one tritium sampler.

c. one plenum monitor capable of closing the dampers, one area monitor capable of warning personnel, one water monitor and one tritium sampler.

d. one plenum monitor capable of closing the dampers, one stack monitor, one area monitor capable of warning personnel, one water monitor and one tritium sampler.

Answer: C.002 d.
Reference: Tech. Spec. 3.8.2

Question C.003 [1.0 point] (3.0)
Which ONE of the following alarm conditions will result in an automatic scram?

a. High Temperature Reflector Outlet.

b. Low Voltage Chamber Power Supply

c. High Level Emergency Power Channel.

d. Low Level Shield Coolant Storage Tank.

Answer: C.003 b.
Reference: RSM-9.3 to 9.5

Question C.004 [1.0 point] (4.0)
MP-6 and MP-6A measure inlet pressure to the reactor core. What flowrate corresponds to a minimum flow rate required by the technical specifications?

a. 1000 gpm
b. 1500 gpm
c. 1800 gpm
d. 2000 gpm

Answer: C.004 c.
Reference: PM 5.2.10

Question C.005 [1.0 point] (5.0)
Which ONE of the following describes the purpose for the subcritical interlock?

a. To prevent withdrawing more than one shim blade at a time.
b. To allow for performance of individual shim blade drop time testing.
c. To ensure the nuclear instruments are on scale prior to allowing shim blade withdrawal.
d. To aid in maintaining the shim blade bank at a uniform height during the final approach to criticality.

Answer: C.005 d.
Reference: RSM-4.3

Question C.006 [1.0 point] (6.0)
Which ONE of the following describes an automatic response of the ventilation system?

a. If temperature of the outside air drops below freezing the intake fan will trip.
b. If the main intake damper fails to close within ten seconds of a trip signal, then the intake fan will trip.
c. If the auxiliary intake damper fails to close within ten seconds of a trip signal, then the main damper will close.
d. In the "weekend-open" position, if activity is detected by the plenum monitors, the inlet dampers and intake fan will trip.

Answer: C.006 d. ~~a.~~ Answer changed per facility comment.
Reference: RSM-8.12

Question C.007 [1.0 point] (7.0)
If the radiation monitor in the off-gas system detects abnormal radiation levels, the pool ventilation will be automatically secured. Protection from overpressure of the coolant system in this condition is provided by:

a. a Blowout patch on the coolant storage tank.
b. a Vacuum breaker on suction side of the off-gas blower.
c. the sample line connections between the isolation valves.
d. a relief valve on the off-gas discharge piping which relieves to the main ventilation exhaust plenum.

Answer: C.007 a.
Reference: RSM-3.4, Section 3.2.5

Question C.008 [1.0 point] (8.0)
Which one of the following is the alarm setting on the core outlet temperature recorder?

a. 50 ºC
b. 53 ºC
c. 55 ºC
d. 60 ºC

Answer: C.008 b.
Reference: PM 5.2.6

Question C.009 [1.0 point] (9.0)
During refueling of the core the indicated neutron level has increased by a factor of 2.5. Which one of the following operator actions is required to be taken?

a. Evacuate personnel from the reactor top.
b. Dump the reflector, if not already dumped.
c. Notify Radiation Protection to perform a radiation survey of the reactor top area.
d. Notify personnel on the reactor top to insert a dummy element in place of the fuel element just removed.

Answer: C.009 b.
Reference: PM 3.3.1.1, Step 39, p 3.

Question C.010 [2.0 point, 0.25points each] (11.0)
Match the facility conditions in Column I with the type of response expected to occur from the Reactor Safety System in Column II. (Assume the reactor is critical.) Items in Column I have only one correct answer and items in Column II may be used once, more than once or not at all.

Column I (Condition)	Column II (Response)
a. Core tank level 2 inches below overflow pipe.	1. Alarm ONLY.
b. Shield coolant flow equals 55 gpm.	2. Rod withdrawal inhibited.
c. Reactor outlet temperature equals 50 ºC.	3. Scram.
d. Reactor building vacuum equals 1.2 inches water above atmospheric.	4. No safety system response
e. Primary cleanup system temperature equals 52 ºC.	
f. D_2O flow equals 88 gpm.	
g. Core Purge flow equals 2.0 cfm	
h. Secondary Water Monitor sample flow equals 1 gpm	

Answer: C.010 a. = 1. ~~2~~; b. = 3; c. = 4; d. = 1. ~~2~~; e. = 1; f. = 3; g. = 1;
h. = 1 Answer key changed per facility comment.
Reference: MIT RSM 9.9 & RSM 7.10 (7.5)

Question C.011 [1.0 point] (12.0)
Why is blowdown of the cooling tower basins required to be secured whenever the reactor is shutdown?

a. Shutdown cooling system efficiency may be adversely affected due to blowdown.

b. The secondary water monitors cannot detect leakage when the reactor is shutdown due to short-lived isotopes.

c. The cooling tower level detectors and automatic makeup system is not energized when the reactor is shutdown.

d. Secondary system level cannot be adequately measured when shutdown due to thermal expansion during operation.

Answer: C.011 b.
Reference: RSM 7.4.1

Question C.012 [1.0 point] (13.0)
The reactor is operating at 4.9 MW with an experiment loaded in the pneumatic system.
How long after receiving a "Vacuum Off Pneumatic System" alarm will the temperature in the pneumatic tubes reach 100 ºC?

a. 30 seconds
b. 6 minutes
c. 45 minutes
d. 120 minutes

Answer: C.012 b.
Reference: PM 5.5.1

Question C.013 [1.0 point] (14.0)
What automatic action occurs when a high radiation alarm is received on the Sewer Monitor? Assume that the Sewer Monitor is in its normal mode of monitoring liquid radioactive waste being pumped from the sumps to the waste tanks.

a. The Radioactive Liquid Waste System Containment Isolation valve closes.
b. The Inlet City Water Solenoid valve closes.
c. The on-line Sewer pump trips.
d. The Sump pumps trip.

Answer: C.013 d.
Reference: RSM 7.7 and 8.24

Question C.014 [1.0 point] (15.0)
Rod withdrawal times are measured at least annually. The blade system must be adjusted if the time to withdraw a blade a distance of 8.5 inches is measured to be other than:

a. 7 minutes ± 1%
b. 5 minutes ± 10%
c. 2 minutes ± 10%
d. 1 minutes ± 10%

Answer: C.014 c.
Reference: MIT Question Bank Sect. B pg. 6 of 13

Question C.015 [1.0 point] (16.0)
Which one of the following sensors uses a flow nozzle?

a. Shield flow PF-1.

b. Primary flow MF-1

c. Reflector flow DF-1

d. Secondary flow HF-1A

Answer: C.015 b.
Reference: RSM 6.4.1 & 6.4.2

Question C.016 [1.0 point] (17.0)
Which one of the following gives the reason for the stepped design of the beam port sleeve and plug?

a. Precludes radiation streaming.

b. Facilitates ease of insertion and removal.

c. Prevents D_2O leakage if a break were to occur.

d. Maintains a negative pressure to inhibit activated air from leaking.

Answer: C.016 a.
Reference: RSM 2-6

Question C.017 [1.0 point] (18.0)
If an Area Monitor detector is saturated, the Detector Signal Conditioner LED will read …

a. All nines (9)

b. All zeros (0)

c. All dashes (-)

d. A blank screen

Answer: C.017 c.
Reference: RSM 7-2

Question C.018 [1.0 point] (19.0)
Where are the plenum particulate monitors located in the ventilation system?

a. After the stack exhaust fan
b. Before the main exhaust damper
c. In between the exhaust filtering unit and the stack exhaust fan
d. In between the main exhaust damper and the exhaust filtering unit

Answer: C.018 b.
Reference: RSM 8-14

Question C.019 [1.0 point] (20.0)
Why is Helium used to blanket the D_2O reflector system?

a. To prevent corrosion caused by nitrous oxide formation in air
b. To cool the empty spaces in the reflector above the D_2O level
c. To keep the D_2 and O_2 from being released into the atmosphere
d. To prevent activation of the Oxygen in CO_2 if CO_2 were used instead

Answer: C.019 a
Reference: RSM 3-19