July 28, 2009

Mr. Ralph A. Butler, Chief Operating Officer
Research Reactor Facility
University of Missouri
Columbia, MO 65211

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-186/OL-09-01,
UNIVERSITY OF MISSOURI – COLUMBIA

Dear Dr. Butler:

During the week of June 15, 2009, the NRC administered operator licensing examinations at your University Of Missouri – Columbia 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. 50-186

Enclosures: 1. Initial Examination Report No. 50-186/OL-09-01
2. Written examination with facility comments incorporated

cc: John Fruits, Assistant Reactor Manager of Operations
cc without enclosures:(Please see next page)

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ADAMS ACCESSION #: ML091910149 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung:		CRevelle		JEads	
DATE	07/21/2009		07/24/2009		07/28/2009	

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cc:

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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.: 50-186/OL-09-01

FACILITY DOCKET NO.: 50-186

FACILITY LICENSE NO.: R-103

FACILITY: University of Missouri-Columbia

EXAMINATION DATES: June 15 – 16, 2009

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

SUMMARY:

During the week of June 15, 2009, the NRC administered operator licensing examinations to three Reactor 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	3/0	0/0	3/0
Operating Tests	3/0	0/0	3/0
Overall	3/0	0/0	3/0

3. Exit Meeting:

Phillip T. Young, Chief Examiner, NRC
Robert Hudson, Training Coordinator, MURR
John Fruits, Assistant Reactor Manager of Operations, MURR
Les Foyto, Reactor Manager, MURR

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.

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

University of Missouri - Columbia

Operator License Examination

Written Exam with Answer Key

June 16, 2009

ENCLOSURE 2

Robert A. Hudson
Training Coordinator – Reactor Operations
University of Missouri Research Reactor
Columbia, Mo 65211

MURR OPERATIONS

June 25, 2009

Mr. Young,

We have reviewed the written portion of the licensing examination administered at MURR on 6/16/09; and submit the following comments for your consideration:

Question B.015

Per the definition in the Emergency Plan, Protective Action Guideline(s) is (are)….

a. The person or persons appointed by the Emergency Coordinator to ensure that all personnel have evacuated the facility or a specific part of the facility.
b. Projected radiological dose or dose commitment values to individuals that warrant protective action following a release of radioactive material
c. A condition or conditions which call(s) for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.
d. Specific instrument readings, or observations; radiological dose or dose rates; or specific contamination levels of airborne, waterborne, or surface-deposited materials that maybe used as thresholds for establishing emergency classes and initiating appropriate emergency measures.

Comment: The answer key indicates item 'C' to be the correct answer. The definition contained in the reference indicates the correct answer should be item 'B'.

Reference: MURR Emergency Plan, Section 9.0 - Definitions

Please contact me if you would like additional information or have any questions.

Respectfully,

Rob Hudson

Question A.001 [1.0 point] {1.0}
A reactor fuel consisting of U^{235} and U^{238} only, is 20% enriched. This means that …

a. 20% of the weight of the fuel consists of U^{235}.
b. 20% of the volume of the fuel consists of U^{235}.
c. 20% of the total number of atoms in the fuel consists of U^{235}.
d. the ratio of the number of U^{235} atoms to the number of U^{238} atoms is 0.20 (20%).

Answer: A.001 a
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §

Question A.002 [1.0 point] {2.0}
A complete core load is in progress on a non-power reactor. The following data has been taken.

Number of Elements Installed	Detector A (cpm)	Detector B (cpm)
0	11	13
2	13	15
4	17	18
6	22	22
8	34	30

Using the graph paper provided, determine which of the following is the approximate number of fuel elements that will be required to be loaded for a critical mass.

a. 8
b. 10
c. 12
d. 14

Answer: A.002 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory

Question A.003 [1.0 point] {3.0}
Which one of the following describes the source and the importance of thermal neutrons in the reactor? Thermal neutrons …

a. result from the decay of prompt neutrons and result in the major portion of the fissions occurring in U^{235}

b. result from the decay of prompt and delayed neutrons and result in the major portion of the fissions occurring U^{238}

c. result from delayed neutrons which loose energy after birth and result in the major portion of the fissions occurring in U^{238}

d. result from prompt and delayed neutrons which loose energy after birth and result in the major portion of the fissions occurring in U^{235}

Answer: A.003 d.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question deleted, due to applicant feedback, during the administration of the exam, on the difference in time-line between the question and the diagram provided.

~~Question A.004 [1.0 point] {4.0}~~
~~Which one of the following figures most closely depicts the reactivity versus time plot for xenon for the following series of evolutions: (See attached figures on last page of handout for choice selections.)~~
~~TIME EVOLUTION~~
~~1 2 10 MW startup, clean core; Operation at 10 MW for 24 hours;~~
~~3 Shutdown for 15 hours;~~
~~4 10 Mw for 12 hours.~~
~~a. a~~
~~b. b~~
~~c. c~~
~~d. d~~
~~Answer: A.004 a.~~
~~Reference:~~

Question A.005 [1.0 point] {5.0}
Which ONE of the following statements correctly describes the influence of delayed neutrons during the neutron life cycle?

a. Delayed neutrons increase the average neutron generation time.

b. Delayed neutrons are more likely to cause fission because they thermalize more quickly than prompt neutrons.

c. Delayed neutrons take longer to thermalize because they are born at a higher average energy than prompt neutrons.

d. Delayed neutrons are produced some time after prompt neutrons and make up the majority of neutrons produced by fissions.

Answer: A.005 a.
Reference: DOE Fundamentals Handbook, Module 2, Prompt and Delayed Neutrons

Question A.006 [1.0 point] {6.0}
Which ONE of the following is an example of β^+ decay?

a. $_{35}Br^{87} \rightarrow {}_{33}As^{83}$

b. $_{35}Br^{87} \rightarrow {}_{35}Br^{86}$

c. $_{35}Br^{87} \rightarrow {}_{34}Se^{87}$

d. $_{35}Br^{87} \rightarrow {}_{36}Kr^{87}$

Answer: A.006 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

Question A.007 [1.0 point] {7.0}
A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula…

Fast Fission Factor (ε)	= 1.03	Fast Non-Leakage probability (L_f)	= 0.84
Resonance Escape probability (p)	= 0.96	Thermal Non-Leakage probability (L_{th})	= 0.88
Thermal Utilization Factor (f)	= 0.70	Reproduction Factor (η)	= 1.96

A control rod is inserted to bring the reactor back to critical. Assuming all other factors remain unchanged, the new value for the thermal utilization factor (f) is…

a. 0.698
b. 0.702
c. 0.704
d. 0.708

Answer: A.007 a.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3,
Reactor Theory (Nuclear Parameters), Enabling Objective 1.2

Question A.008 [1.0 point] {8.0}
A common method for calibrating control elements (rods, blades, etc.), is to measure doubling time then calculate period. If the doubling time is 42 seconds, which ONE of the following is the period?

a. 29 seconds
b. 42 seconds
c. 61 seconds
d. 84 seconds

Answer: A.008 c.
Reference: DOE Fundamentals Handbook, Module X, Standard NRC Question[1].
Also: period = (doubling time) ÷ (ln(2)) = 42/0.693 = 60.6 ≈ 61

Question A.009 [1.0 point] {9.0}
For U^{235}, the thermal fission cross-section is 582 barns, and the capture cross-section is 99 barns. When a thermal neutron is absorbed by U^{235}, the probability that a fission will occur is:

a. 0.146
b. 0.170
c. 0.830
d. 0.855

Answer: A.009 d.
Reference: DOE Fundamentals Handbook, Module X,
Probability = $\sigma_f/(\sigma_f + \sigma_a)$ = 582/(528 + 99) = 582/681 = 0.855

Question A.010 [1.0 point] {10.0}
Which ONE of the reactions below is an example of the primary neutron source for reactor startup? $_4Be^9$ +

a. $\alpha \rightarrow {}_6C^{12} + n$
b. $\beta \rightarrow {}_4Be^8 + n$
c. $\gamma \rightarrow {}_4Be^8 + n$
d. Cosmic radiation $\rightarrow {}_4Be^8 + n$

Answer: A.010 c.
Reference: DOE Fundamentals Handbook, Module X,

Question A.011 [1.0 point] {11.0}
K_{eff} for the reactor is 0.85. If you place an experiment worth +17.6% into the core, what will the new K_{eff} be?

a. 0.995
b. 0.9995
c. 1.005
d. 1.05

Answer: A.011 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

Question A.012 [1.0 point] {12.0}
During a reactor startup, criticality occurred at a lower rod height than the last startup. Which ONE of the following reasons could be the cause?

a. Xe^{135} peaked.

b. Moderator temperature increased.

c. Adding an experiment with positive reactivity.

d. Maintenance on the control rods resulted in a slightly faster rod speed.

Answer: A.012 c.
Reference: DOE Fundamentals Handbook, Module 4, Theory (Operations), E.O. 3.2, pg. 23

Question A.013 [1.0 point] {13.0}
Which one of the following describes the characteristics of a good moderator?

a. Low scattering cross section and low absorption cross section

b. Low scattering cross section and high absorption cross section

c. High scattering cross section and low absorption cross section

d. High scattering cross section and high absorption cross section

Answer: A.013 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics & Reactor Theory Ref 1, Module 2, Theory (Neutron Characteristics), E.O. 2.13, pg. 23 - 28.

Question A.014 [2.0 points 0.20 each] {15.0}
Match the isotope from column A with its origin in column B. (Column B items may be used more than once.)

Column A	Column B
a. N^{16}	1. Water
b. Ar^{41}	2. Air
c. H^{3}	3. Aluminum Canned Reflectors
d. Na^{24}	4. Fuel (Fission Product)
e. I^{135}	

Answer: A. 14 a. = 1; b. = 2; c. = 1; d. = 3; e. = 4
REF: Standard NRC question.

Question A.015 [1.0 point] {16.0}
The term "***PROMPT JUMP***" refers to:

a. The instantaneous jump in power due to a rod withdrawal.

b. A reactor which is critical using only prompt neutrons.

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

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

Answer: A.015 a.
Reference: DOE Fundamentals Handbook, Module 4, Theory (Operations), E.O. 2.7, pg. 17

Question A.016 [1.0 point] {17.0}
As a reactor continues to operate over time, for a **CONSTANT** power level, the average **THERMAL** neutron flux…

a. decreases, due to the increase in fission product poisons.

b. increases, in order to compensate for fuel depletion.

c. decreases, because the fuel is being depleted.

d. remains the same

Answer: A.016 b.
Reference: Standard NRC Question

Question A.017 [1.0 point] {18.0}
Which ONE of the following is the reason for the -80 second period following a reactor scram?

a. The ability of U^{235} to fission source neutrons.

b. The half-life of the longest-lived group of delayed neutron precursors is 55 seconds.

c. The amount of negative reactivity added on a scram is greater than the shutdown margin.

d. The Doppler effect, which adds positive reactivity due to the temperature decrease following a scram.

Answer: A.017 b.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, *Reactor Operation*, p. 31.

Question A.018 [1.0 point] {19.0}
Which ONE of the following isotopes will cause a neutron to lose the most energy in an ELASTIC scattering reaction?

a. O^{16}

b. C^{12}

c. Be^{9}

d. H^{1}

Answer: A.018 d.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, *Nuclear Cross-Sections and Neutron Flux*, p. 5.

Question A.019 [1.0 point] {20.0}
The delayed neutron precursor β for U^{235} is 0.0065. However, when calculating reactor parameters you use the *effective* delayed neutron precursor β_{eff} with a value of ~0.0070. Which ONE of the following is the correct reason that β_{eff} is larger than β?

a. The fuel also contains U^{238} which has a relatively large β for fast fission.

b. U^{238} in the core becomes Pu^{239} (by neutron absorption), which has a higher β for fission.

c. Delayed neutrons are born at higher energies than prompt neutrons resulting in a greater worth for the neutrons.

d. Delayed neutrons are born at lower energies than prompt neutrons resulting in less leakage during slowdown to thermal energies.

Answer: A.019 d.
Reference: DOE Fundamentals Handbook, Volume 2, Module 4, *Effective Delayed Neutron Fraction*,

Question A.020 [1.0 point] {21.0}
Core excess reactivity changes with …

a. fuel element burnup

b. control rod height

c. neutron energy level

d. reactor power level

Answer: A.020 a.
Reference: Technical Specification Requirement.

Question B.001 [1.0 point] {1.0}
Which ONE of the following Radiation Monitors will NOT cause a ventilation isolation when it alarms?

a. Bridge
b. Bridge ALARA
c. West Beam Port
d. Building Exhaust Air Plenum #2

Answer: B.001 c.
Reference: Hazards Summary Report, § 9.7.1, 3rd ¶.

Question B.002 [1.0 point] {2.0}
Which ONE of the following is the MINIMUM time reactor power must be stabilized at 5 MW to allow digital calorimetric meter indication to stabilize?

a. 1 minute
b. 5 minutes
c. 10 minutes
d. 15 minutes

Answer: B.002 b.
Reference: ~~SOPII § II.1.1.P~~ Updated Reference
OP-RO-210 – Reactor Startup – Normal

Question B.003 [1.0 point] {3.0}
Normally refueling will be performed using the _____ tool with pool level _____.

a. air operated; normal
b. manually operated; normal
c. air operated; lowered
d. manually operated; lowered

Answer: B.003 a.
Reference: ~~SOP II, § 2.1.J.~~ Updated Reference
OP-RO-250 – In-Pool Fuel Handling

Question B.004 [1.0 point] {4.0}
You receive 100 mRem of beta (β), 25 mRem of (γ) and 5 mRem of neutron radiation dose. What is your total dose?

a. 130 mRem
b. 150 mRem
c. 175 mRem
d. 205 mRem

Answer: B.004 a.
Reference: 10 CFR 20 (A rem is a rem is a rem)

Question B.005 [1.0 point] {5.0}
Per the Emergency plan, "The Emergency Director may authorize personnel voluntary whole body exposures up to ____ rem dose equivalent per individual for lifesaving actions."

a. 25
b. 50
c. 75
d. 100

Answer: B.005 c.
Reference: Emergency Plan § 5.01, 4th ¶, pg. 12.

Question B.006 [1.0 point] {6.0}
According to Technical Specification 3.1 "Each movable experiments or the movable parts of any individual experiment shall not exceed ____ Δk/k."

a. 0.001
b. 0.0025
c. 0.006
d. 0.00738

Answer: B.006 a.
Reference: Technical Specification 3.1(I)

Question B.007 [1.0 point] {7.0}
Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an additional four inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr
b. 50 mR/hr
c. 75 mR/hr
d. 100 mR/hr

Answer: B.007 b.
Reference: 2 inches equal a half-thickness. Adding 4 inches results in a total of three half-thicknesses for (400) × $(½)^3$ = 400/8 = 50 mR/hr

Question B.008 [1.0 point] {8.0}
Which one of the following actions should be taken by the reactor operator if an experimenter informs him that the irradiation container has become lodged somewhere in the pneumatic tube?

a. Notify the Reactor Manager
b. Reduce power by rod run-in to less than 50% power
c. Immediately scram the reactor and notify the Lead Senior Reactor Operator
d. Notify the Lead Senior Reactor Operator or Manager of Health Physics

Answer: B.008 d
Reference: ~~MURR Hazards Summary 8-25~~ Updated Reference
REP-25 - Failure of a Rabbit to Return

Question B.009 [1.0 point] {9.0}
An experiment is removed from the reactor and is determined to have a radiation level of 10 Rem/hr at 15 feet from the experiment. Forty Five (45) minutes later the radiation level is 7.2 Rem/hr at 15 feet. Which one of the following is the length of time the experiment must decay before the radiation level at one (1) foot is less than 100 mrem/hr?

a. 3 hours
b. 5.26 hours
c. 18.6 hours
d. 40.6 hours

Answer: B.009 d.
Reference: NRC Generic Section B Question

Question B.010 [1.0 point] {10.0} Clarified Question
Which ONE of the following is the MINIMUM reactor period for placing the regulating blade in automatic mode?

a. >30 seconds
b. >35 seconds
c. >50 seconds
d. >100 seconds

Answer: B.10 b
Reference: ~~SOPII § II.1.3.~~ Updated Reference
OP-RO-210 – Reactor Startup - Normal

Question B.011 [1.0 point] {11.0}
Which ONE of the following is the 10CFR20 definition for "Annual Limit on Intake (ALI)"?

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

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

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. 10CFR20 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.

Answer: B.011 d.
Reference: 10CFR20.1003 Definitions

Question B.012 [1.0 point] {12.0}
"All control blades, including the regulating blade, shall be operable during reactor operations." This is an example of a:

a. safety limit.
b. limiting safety system setting.
c. limiting condition for operation.
d. surveillance requirement.

Answer: B.012 c.
Reference: MURR Technical Specifications, Section 3.2.a.

Question B.013 [1.0 point] {13.0}
The SHUTDOWN MARGIN of the MURR shall be at least:

a. 2% delta k/k.
b. 2% delta k/k with any one shim blade fully withdrawn.
c. 0.02% delta k/k.
d. 0.02% delta k/k with any one shim blade fully withdrawn.

Answer: B.013 b.
Reference: MURR Technical Specifications, Section 3.1.e.

Question B.014 [1.0 point] {14.0}
The Emergency Planning Zone (EPZ) …

a. is the geographical area that is beyond the site boundary.

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

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

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

Answer: B.014 b.
Reference: E-Plan Definitions 9.8

Question B.015 [1.0 point] {15.0}
Per the definition in the Emergency Plan, Protective Action Guide(s) is (are) …

a. The person or persons appointed by the Emergency Coordinator to ensure that all personnel have evacuated the facility or a specific part of the facility.

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

c. a condition or conditions which call(s) for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

d. Specific instrument readings, or observations; radiological dose or dose rates; or specific contamination levels of airborne, waterborne, or surface- deposited radioactive materials that may be used as thresholds for establishing emergency classes and initiating appropriate emergency measures.

Answer: B.015 b.
Reference: Emergency per facility comment Plan, § 9.0 Definitions.

Question B.016 [1.0 point, ¼ each] {16.0}
Match each of the radioisotopes associated with operating the reactor in column A with its PRIMARY source (irradiation of AIR or WATER, or FISSION product).

a. $_{1}H^{3}$

b. $_{18}Ar^{41}$

c. $_{7}N^{16}$

d. $_{54}Xe^{135}$

Answer: B.016 a. = water; b. = air; c. = water; d. = fission
Reference: Standard NRC Question. Also chart of the Nuclides.

Question B.017 [1.0 point] {17.0}
If the reactor is not critical when the upper ECP limit is reached, you must:

a. stop and recalculate the ECP prior to further rod withdrawal.

b. check the control rod position transmitters.

c. verify the ECP with a 1/M plot.

d. shut down the reactor.

Answer: B.017 d.
Reference: SOP I.4.3.G.5 p. SOP/I-7

Question B.017 [1.0 point] {17.0} Clarified Question for future use
If the reactor is not critical when the upper ECP limit is reached, you must:

a. insert control rods to two inches below ECP and notify LSRO.

b. stop and recalculate the ECP prior to further rod withdrawal.

c. verify the ECP with a 1/M plot.

d. shut down the reactor.

Answer: B.017 ~~d.~~ a.
Reference: ~~SOP I.4.3.G.5 p. SOP/I-7~~ Updated Reference
OP-RO-210 – Reactor Startup – Normal

Question B.018 [1.0 point] {18.0}
Which ONE of the following immediate actions should be taken by the operator if he detects a stuck rod drive mechanism during reactor power operation?

a. Scram the reactor by placing the Master Control Switch 1S1 in TEST.
b. Attempt to drive the affected rod in until power decreases by 2%.
c. Drive all shim rods in, verifying the stuck rod fails to move.
d. Stop all rod movement and notify the shift supervisor.

Answer: B.018 a.
Reference: REP-8

Question B.019 [1.0 point] {19.0}
During startup of the Primary coolant system, per procedure you start the pumps at 63 psig. After starting the second pump, the pumps cycle then on. Per procedure you should …

a. continue the system startup.
b. stop both pumps, and inform the Lead Senior Reactor Operator.
c. continue the system startup, after informing the Lead Senior Reactor Operator.
d. stop both pumps, wait for primary pressure to increase greater than 66 psig, then restart the pumps.

Answer: B.019 d.
Reference: OP-RO-410, Primary Coolant System.

Question B.020 [1.0 point] {20.0}
In the event of a high stack monitor readings (in excess of alarm points), the reactor operator should immediately:

a. notify the shift supervisor.
b. scram the reactor.
c. shut down the reactor.
d. reduce power slowly until the alarm clears.

Answer: B.020 a.
Reference: REP-21

Question C.001 [1.0 point] {1.0}
The reactor reflector is made of …

a. graphite
b. beryllium
c. D_2O
d. H_2O (the pool).

Answer: C.001 b.
Reference: ~~SOP II~~ Updated Reference
OP-RO-210 – Reactor Startup - Normal

Question C.002 [1.0 point] {2.0}
You've been asked to retrieve a rabbit sample. There is some concern that the experimenter made a math error and the sample may have a stronger radiation field than anticipated. Which ONE of the following detectors would you use as you approach the sample?

a. Geiger-Müller
b. GeLi
c. Scintillation
d. Ion Chamber

Answer: C.002 d.
Reference: Standard NRC Examination Bank Question, (MURR exam administered April, 1994.)

Question C.003 [1.0 point] {3.0}
Which ONE of the following conditions will NOT cause a rod run-in?

a. High Power
b. Vent Tank Low Level
c. Low Pressurizer Pressure
d. Rod Not in Contact with Magnet

Answer: C.003 c.
Reference: ~~MURR SOP/I-15- I-18.~~ Updated Reference
AP-RO-110 – Conduct of Operations

Question C.004 [1.0 point] {4.0}
Which ONE of the following conditions will result in a reactor scram?

a. Source Range Monitor channel 1 inoperative.

b. Low Reflector Differential Pressure.

c. Thermal Column Door Open.

d. High Off-gas Activity.

Answer: C.004 b.
Reference: SAR 2006 - TABLE 7-8 REACTOR SCRAMS & SOP/I-15, I-16–I-18.

Question C.005 [1.0 point] {5.0} Clarified Question
Which ONE of the following is the design feature which prevents an OVERPRESSURE condition from damaging the reactor containment? The containment …

a. contains a "seal trench" with a minimum of 4.~~6~~25 feet of water which will blow out onto the floor of the laboratory basement relieving the overpressure condition.

b. exhaust damper is designed to open when air pressure exceeds a preset limit.

c. contains an air relief valve which starts opening at a preset limit.

d. contains a plug designed to blow out at a preset limit.

Answer: C.005 a.
Reference: ~~Draft SAR § 6.2.3.1~~ Updated Reference
Tech Spec's 1.15 – Definition of Reactor Containment Integrity

Question C.006 [1.0 point] {6.0}
You are operating the reactor at 10 megawatts with the regulating rod in automatic at 50% withdrawn. You notice an anomaly and scram the reactor. Which ONE of the following is true. (Assume no operator action beyond scram insertion.)

a. All control elements (shim blades and regulating blade) are de-energized and at the bottom of their travel.

b. All shim blades are de-energized and at the bottom of their travel, the regulating blade is in automatic mode at 50% withdrawn.

c. All shim blades are de-energized and at the bottom of their travel, the regulating blade is in manual mode at 50% withdrawn.

d. All shim blades are de-energized and at the bottom of their travel, the regulating blade is in automatic mode and is being driven in to its bottom of travel.

Answer: C.006 c.
Reference: HSR § 9.6.2, p. 9-15. C.12

Question C.007 [2.0 points, ½ each] {8.0} Clarified Question
Identify each of the status board indications below as being either a Scram only (S), a rod Run-in only (R), an Alarm only (A), or could be either a scram or a rod run-in (E). (If you need clarification, please ask proctor.)

a. Channel 4, 5 & 6 Hi Power
b. Rod not in contact with magnet
c. Channel 4, 5 or 6 Downscale
d. Low Primary HX ~~ΔP~~ flow

Answer: C.007 a. = E; b. = R; c. = A; d. = S
Reference: Figure xx.xx

Question C.008 [2.0 points, ½ each] {10.0} Clarified Question
Match the Detector type in column B with the corresponding Nuclear Instrument Channel(s) listed in column A. (Note: Items in column B may be used more than once or not at all.)

a. SRM ~~and SRM2~~	1. Fission Chamber
b. IRM2 and IRM3	2. Uncompensated Ion Chamber
c. PRM4 and PRM5	3. Compensated Ion Chamber
d. Power Range Channel 6	4. Cherenkov Detector (Photo Tube)
e. Wide Range Monitor	5. Ion Chamber (Gamma Detector)

Answer: C.008 a. = 1; b. = 1; c. = 1; d. = 2; e. = 3
Reference: New Nuclear Instrumentation Handout from RO Training Manual.

Question C.009 [1.0 point] {11.0}
Which ONE of the following choices identifies two of the radiation detectors that upon a trip signal will generate a Reactor Isolation?

a. Air Plenum 2 and Nucleopore
b. North Wall and Room 114
c. Bridge ALARA and Fuel Vault
d. Air Plenum 1 and Bridge

Answer: C.009 d.
Reference: SAR 2006 - § 7.8.2 Containment Actuation (Reactor Isolation) System

Question C.010 [1.0 point] {12.0}
In the Reactor Isolation System, the ventilation supply and return fans, SF2 and RF2, will be secured as a result of:

a. the closing of door 504.
b. deenergizing the 16" valve solenoids.
c. energizing the containment isolation horns.
d. an alarm from “Air Plenum 1" or “Air Plenum 2" radiation detectors.

Answer: C.010 a.
Reference: SAR 2006 - § 7.8.2 Containment Actuation (Reactor Isolation) System , § 9.1 Heating, Ventilation, and Air-Conditioning Systems, and Training Manual for Reactor Operations, Area Radiation Monitors {3/29/2005}

Question C.011 [1.0 point] {13.0}
The operator wishes to transfer the operation of bypass valve S-1 from Automatic to Manual mode. If there is a large difference between the manual position demand and the position of the valve in the automatic mode:

a. rapid movement of the valve could result in damage to the valve.
b. a significant positive or negative reactivity insertion could occur.
c. the control circuit might not respond properly to the large deviation signal.
d. rapid movement of the valve could result in water hammer.

Answer: C.011 b.
Reference: OP-RO-480 (SOP VI.2)

Question C.012 [1.0 point] {14.0}
Which ONE of the following devices is NOT connected to the Emergency Air Compressors?

a. Containment Building Exhaust Valve 16A.
b. Containment Building Exhaust Valve 16B.
c. Pool Loop Isolation Valve 509.
d. Freight Door 101 gasket.

Answer: C.012 c.
Reference: OP-RO-515 Valve Line-up Checksheet

Question C.013 [1.0 point] {15.0}
Temperature detectors 980A/B will provide a reactor scram in the event of high reactor coolant temperature. If they fail to initiate a scram, a backup scram signal is provided by:

a. TE901A.
b. TE901B.
c. TE901C.
d. TE980C/D.

Answer: C.013 b.
Reference: Training Manual for Reactor Operations, Coolant Loop Lesson {6/11/2003}

Question C.014 [1.0 point] {16.0}
When the “Pressurizer Lo Press” annunciator alarms, it means that:

a. Valve 537 has opened, reducing pressure to 70 psi.
b. Valve 526 has opened, reducing pressure to 60 psi.
c. PS 945 has sensed a pressure of 60 psi.
d. PS 941 has sensed a pressure of 70 psi.

Answer: C.014 c.
Reference: Training Manual for Reactor Operations, Pressurizer System Lesson {3/14/2005}.

Question C.015 [1.0 point] {17.0}
Given the following, choose the correct reason that the regulating blade will not go into automatic mode.

Wide Range	10 Kilowatt range with black pen reading higher than red.
Annunciator Panel Status	All lights deenergized except “Reg Blade out of Auto”
IRM 2&3 Period	45 Seconds

a. Wide range meter range selected is too low.
b. Power is too low on selected range.
c. Regulating blade position is too low.
d. Intermediate range period is too short.

Answer: C.015 c.
Reference: SAR 2006 - 7.5.4 Automatic Control

Question C.016 [1.0 point] {18.0}
The SAR (Draft) discusses a neutron source in the pool. Which ONE of the following is not normally performed using the source?

a. To perform response checks ("bug") new Nuclear Instrumentation detectors.
b. To take subcriticality measurements of fuel in the spent fuel storage racks.
c. To take subcriticality measurements of fuel in shipping casks.
d. To ensure high enough counts for startup of the reactor.

Answer: C.016 d.
Reference: Draft SAR §

Question C.017 [2.0 points, 0.4 each] {20.0}
Identify the NORMAL (10 Mwatt operation) positions (Open, Shut) for the following valves:

a. 509 (Pool Loop Isolation)
b. 545 (Pressurizer Vent)
c. 527D (2" bypass drain)
d. 547 (Reflector Convective Loop Valve)
e. 527E/F (Reactor Loop Bypass Cleanup)

Answer: C.017 a. = Open; b. = Shut; c. = Shut; d. = Open; e. = Open
Reference: MURR Training Manual pages I-59 through I-65.

QUESTION DELETED – NO CORRECT ANSWER
~~**Question** C.018 [1.0 point] {21.0}~~
~~The operator wishes to place the reactor in the automatic mode of operation. Which ONE of the following conditions would prevent the operator from doing so?~~

~~a. Reactor period, as measured by IRM-3, is 40 seconds.~~
~~b. Reactor period, as measured by IRM-2, is 40 seconds.~~
~~c. The 60% annunciator alarm for the regulating blade is energized.~~
~~d. The Wide Range Monitor selector switch is in the 5 kW black scale position.~~

~~Answer: C.018 d.~~
~~Reference: Training Manual for Reactor Operations, page II~~
OP-RO-210 – Reactor Startup – Normal & MURR Print #42, Sheet 2 of 2 – Reactor Control System

Question C.019 [1.0 point] {22.0}
Which ONE statement below describes the operation of the three-way solenoid valves in the Valve Operating System? When the solenoid valve is …

a. energized, the vent side of the valve closes, directing air pressure to the isolation valve operator.

b. deenergized, the vent side of the valve closes, directing air pressure to the isolation valve operator.

c. energized, the vent side of the valve opens, directing air pressure to the isolation valve operator.

d. deenergized, the vent side of the valve opens, directing air pressure to the isolation valve operator.

Answer: C.019 a.
Reference: Training Manual for Reactor Operations, page I.5.1.

Question C.020 [1.0 point] {23.0}
In the event of a commercial power failure, the diesel engine starts and the emergency generator supplies power to_____. When normal power is restored, the emergency electrical load is shifted back after a time delay of_____.

a. Substation B; ten minutes.
b. Emergency Distribution Center ; ten minutes.
c. Substation B; seven seconds.
d. Emergency Distribution Center ; seven seconds.

Answer: C.020 b.
Reference: HSR pg 7-3 and MURR drawing 522 sheet 1 of 3