December 6, 2005

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-186/OL-06-01, University of Missouri – Columbia

Dear Mr. Butler:

During the week of October 17, 2005, the NRC administered operator licensing examinations at your University of Missouri – Columbia Reactor. The examinations were conducted according to NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. 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 10 CFR 2.390 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) 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 by M. Mendonca Acting for/

Brian E. Thomas, Branch Chief
Research and Test Reactors Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186

Enclosures: 1. Initial Examination Report No. 50-186/OL-06-01
2. Examination and answer key with facility comments incorporated

cc w/encls: Please see next page

December 6, 2005

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-186/OL-05-01, UNIVERSITY OF MISSOURI - COLUMBIA

Dear Mr. Butler:

During the week of October 17, 2005, the NRC administered operator licensing examinations at your University of Missouri – Columbia Reactor. The examinations were conducted according to NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. 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 10 CFR 2.390 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) 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.

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Docket No. 50-186

Enclosures: 1. Initial Examination Report No. 50-186/OL-06-01
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cc w/encls: Please see next page

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EXAMINATION PACKAGE ACCESSION NO.: ML052920654
REPORT ACCESSION #: ML053290150 **TEMPLATE #: NRR-074**

OFFICE	PRT:CE		IOLB:LA	E	PRT:SC	
NAME	PYoung		EBarnhill		BThomas/MM	
DATE	11/29/2005		12/01/2005		12/02/2005	

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

REPORT NO.: 50-186/OL-06-1

FACILITY DOCKET NO.: 50-186

FACILITY LICENSE NO.: R-103

FACILITY: University of Missouri – Columbia

EXAMINATION DATES: October 17 - 18, 2005

SUBMITTED BY: _____*/RA/*_____ 11/29/2005

Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of October 17, 2005, the NRC administered operator licensing examinations to three Reactor Operator candidates. All three candidates passed all portions of their respective examinations.

REPORT DETAILS

1. Examiners:
   Phillip T. Young, Chief Examiner

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, NRC, Examiner
   Robert Hudson, Training Coordinator, MURR
   Michael Dixon, Assistant Reactor Manager, Operations
   Les Foyto, Reactor Manager

   During the exit meeting the examiner thanked the facility for their support in the administration of the examination. The facility provided comments for correction of the written examination, changes which would enhance the written examination, and updates some references sent to the examiner. All corrections and enhancements to the examination have been incorporated into the copy included with this report.

ENCLOSURE 1

Facility Comments with NRC Resolution

Question B.018:
How long (by standard practice) must the reactor be secured prior to venting a beam port containing Ar^{41}?
a. 1 hour
b. 12 Hours
c. 1 day
d. 2 days
Answer: B.018 b.
Reference: Reactor Operator Training Manual, § I.11 5th ¶.

Facility Comment:
Current practice for changing beam port status is to have the reactor shutdown for at least 8 hours. Reference AP-RO-110 step 6.9.2.d

NRC Resolution:
Comment accepted. Because as written the question does not contain a correct answer it will be deleted and will not factor into the candidates grades. In the future the question will be modified as indicated in the attached examination copy.

Question C.014:
Where does the Drain Collection tank overflow, overflow to?
a. “Floor Drain in room 114".
b. Sanitary Sewer
c. Retention Tank #3
d. Reactor Pool
Answer: C.014 a.
Reference: Reactor Operator Training Manual, § I.8. Drain Collection Tank System, p. I.8.1. ¶ B

Facility Comment:
We did a recent change that plugged all floor drains so the Drain Collection tank overflow is directed to a sump for a scupper pump.

NRC Resolution:
Comment accepted. Because as written the question does not contain a correct answer it will be deleted and will not factor into the candidates grades. A modified or replacement question has not been developed at this time.

Question C.015:
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-2, is 40 seconds.
b. The 60% annunciator alarm for the regulating blade is energized.
c. Reactor period, as measured by IRM-3, is 40 seconds.
d. The Wide Range Monitor selector switch is in the 5 kW black scale position.
Answer: C.015 d.
Reference: Training Manual for Reactor Operations, page II

Facility Comment:
All answers are conditions that would allow you to go to the automatic mode of operation. The wide range monitor switch has to be in 5kW red or greater. 5kW black is greater. Reference OP-RO-210 first Note for step 5.2.24. Replacing 5kW black with 500W black would make d the correct answer.

NRC Resolution:
Comment accepted. Because as written the question does not contain a correct answer it will be deleted and will not factor into the candidates grades. A modified or replacement question has not been developed at this time.

Question C.018:
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 A; ten minutes.
b. Substation B; ten minutes.
c. Substation A; seven seconds.
d. Substation B; seven seconds.
Answer: C.019 b.
Reference: Training Manual for Reactor Operations, pages III.2.1, III.2.2.

Facility Comment:
The diesel supplies the Emergency Distribution Center instead of Substation B. Reference HSR pg 7-3 and MURR drawing 522 sheet 1 of 3. Load is shifted back after a 10 minute time delay.

NRC Resolution:
Comment accepted. Because as written the question does not contain a correct answer it will be deleted and will not factor into the candidates grades. In the future the question will be modified as indicated in the attached examination copy.

OPERATOR LICENSING EXAMINATION

With Answer Key

UNITED STATES NUCLEAR REGULATORY COMMISSION

UNIVERSITY OF MISSOURI-COLUMBIA

October 17, 2005

Enclosure 2

QUESTION A.001 [2.0 points, 0.5 each] {2.0}

The listed isotopes are all potential daughter products due to the radioactive decay of $_{35}Br^{87}$. Identify the type of decay necessary (Alpha, Beta, Gamma or Neutron emission) to produce each of the isotopes.

a. $_{33}As^{83}$

b. $_{35}Br^{86}$

c. $_{35}Br^{87}$

d. $_{36}Kr^{87}$

Answer: A.001 a. = alpha; b. = neutron; c. = gamma; d. = Beta
Reference: Volume 1, Module 1, *Modes of Radioactive Decay*, pp. 22–29.

QUESTION A.002 [1.0 point] {3.0}

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.002 d.
Reference: Volume 1, Module 2, *Neutron Moderation*, p. 23.

QUESTION A.003 [1.0 point] {4.0}

Suppose the temperature coefficient of a core is -2.5×10^{-4} ΔK/K/°C and the average control rod worth of the regulating control rod is 5.895×10^{-3} ΔK/K/inch. If the temperature INCREASES by 50°C what will the automatic control command the regulating rod to do? Select the answer that is closest to the calculated value.

a. 5.6 inches in

b. 2.1 inches out

c. 0.5 inches in

d. 4.3 inches out

Answer: A.003 b.
Reference: The temperature increase will result in a change in reactivity of: -2.5×10^{-4} ΔK/K/°C × 50°C = -1.25×10^{-2} ΔK/K. Since the temperature rise results in a negative reactivity insertion, the control rod will need to drive out to add positive reactivity. D = (1.25×10^{-2} ΔK/K) ÷ (5.895×10^{-3} ΔK/K/inch) = 2.12 inches. Reference 1, Volume 2, Module 3, *Reactivity Coefficients,* p. 48.

QUESTION A.004 [1.0 point] {5.0}

Given the following data, which ONE of the following is the closest to the half life of the material?

TIME	ACTIVITY
0	2400 cps
10 min.	1757 cps
20 min.	1286 cps
30 min.	941 cps
60 min.	369 cps

a. 11 minutes

b. 22 minutes

c. 44 minutes

d. 51 minutes

Answer: A.004 b.
Reference: Standard NRC Question $A = A_0 e^{-\lambda T}$ (22 minutes)

QUESTION A.005 [1.0 point] {6.0}

The neutron microscopic cross-section for absorption σ_a generally …

a. increases as neutron energy increases

b. decreases as neutron energy increases

c. increases as target nucleus mass increases

d. decreases as target nucleus mass increases

Answer: A.005 b.
Reference: Module 2, Rx Theory (Neutron Characteristics), E.O. 2.3, pg. 9

QUESTION A.006 [1.0 point] {7.0}

Initially Nuclear Instrumentation is reading 30 CPS and the reactor has a K_{eff} of 0.90. You add an experiment which causes the Nuclear instrumentation reading to increase to 60 CPS. Which ONE of the following is the new K_{eff}?

a. 0.91

b. 0.925

c. 0.95

d. 0.975

Answer: A.006 c.
Reference: $CR_2/CR_1 = (1 - K_{eff1})/(1 - K_{eff2})$
$60/30 = (1 - 0.900)/(1 - K_{eff2})$ $1- K_{eff2} = ½ \times 0.1 = 0.05$
$K_{eff2} = 1 - 0.05 = 0.95$

QUESTION A.007 [1.0 point] {8.0}

During a fuel loading of the core, as the reactor approaches criticality, the value of 1/M:

a. Increases toward one

b. Decreases toward one

c. Increases toward infinity

d. Decreases toward zero

Answer: A.007 d.
Reference: Module 4, Rx Theory (Rx Operations), E.O. 1.4, pg. 7 and DOE Fundamentals Handbook Nuclear Physics and Reactor Theory Volumes 1 and 2, January 1993.

QUESTION A.008 [1.0 point] {9.0}

Which ONE of the following is the reason for an installed neutron source within the core? A startup without an installed neutron source …

a. is impossible as there would be no neutrons available to start up the reactor.

b. would be very slow due to the long time to build up neutron population from so low a level.

c. could result in a very short period due to the reactor going critical before neutron population built up high enough to be read on nuclear instrumentation.

d. can be compensated for by adjusting the compensating voltage on the source range detector.

Answer: A.008 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.009 [1.0 point] {10.0}

By definition, an exactly critical reactor can be made prompt critical by adding positive reactivity equal to …

a. the shutdown margin

b. the K_{excess} margin

c. the β_{eff} value

d. 1.0 %ΔK/K.

Answer: A.009 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.010 [1.0 point] {11.0}

Reactor power doubles in 42 seconds. Based on the period associated with this transient, how long will it take for reactor power to increase by a factor of 10?

a. 80 seconds

b. 110 seconds

c. 140 seconds

d. 170 seconds

Answer: A.010 c.
Reference: $P = P_0 e^{t/\tau}$ 1st find τ. τ = time/(ln(2)) = 42/0.693 = 60.6 sec.
Time = $\tau \times \ln(10)$ = 60.6 × 139.5 sec DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.011 [1.0 point] {12.0}

Which one of the following statements correctly describes the property of a **GOOD MODERATOR**?

a. It slows down fast neutrons to thermal energy levels via a large number of collisions.

b. It reduces gamma radiation to thermal energy levels via a small number of collisions.

c. It slows down fast neutrons to thermal energy levels via a small number of collisions.

d. It reduces gamma radiation to thermal energy levels via a large number of collisions.

Answer: A.011 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.012 [1.0 point] {13.0}

Which of the following statements correctly describe the influence of ***DELAYED NEUTRONS*** on the neutron life cycle? Delayed neutrons …

a. increase the time required for PU^{239} to moderate the fission process.

b. decrease the time required for the neutron population to change between generations.

c. increase the time required for the neutron population to change between generations.

d. decrease the amount of reflection possible with a steel reflector.

Answer: A.012 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.013 [1.0 point] {14.0}

Why is the stable negative period following a scram always the same value, regardless of initial power level? The rate of power change is dependent on the …

a. mean lifetime of the longest lived delayed precursor.

b. constant decay rate of prompt neutrons.

c. mean lifetime of the shortest lived delayed neutron precursor.

d. constant decay rate of prompt gamma emitters.

Answer: A.013 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.014 [1.0 point] {15.0}

Which one of the following correctly describes the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

a. DRW is the slope of the IRW curve at a given location.

b. DRW is the area under the IRW curve at a given location.

c. DRW is the square root of the IRW curve at a given location.

d. There is no relationship between DRW and IRW.

Answer A.014 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.015 [1.0 point] {16.0}

Which one of the following accurately details a factor contributing to Xenon balance within the reactor?

a. Most Xe^{135} is formed by fission.

b. Te^{135} is a fission product which quickly decays to I^{135}.

c. Within approximately 8 hours after startup, Xe^{135} has reached its equilibrium value.

d. Several minutes following a reactor shutdown, Xe level is increasing because I^{135} is not being produced.

Answer: A.015 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.016 [1.0 point] {17.0}

Delayed neutrons comprise approximately what percent of all neutrons produced in the reactor?

a. 0.65%

b. 1.3%

c. 6.5%

d. 13%

Answer: A.016 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.017 [1.0 point] {18.0}

Which of the following factors has the LEAST effect on rod worth?

a. number and location of adjacent rods.

b. temperature of the moderator.

c. temperature of the fuel.

d. core age.

Answer: A.017 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.018 [1.0 point] {19.0}
What is the ***PRINCIPAL*** source of heat in the reactor after shutdown?
a. Cosmic radiation causing fission
b. Decay of fission products
c. Spontaneous fission within the core
d. Stored energy from the reactor and core materials

Answer: A.018 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.019 [1.0 point] {20.0}

β and β_{eff} both describe the total fraction of delayed neutrons. The difference between the two is that β_{eff} is …

a. smaller than β since delayed neutrons are born at lower energy levels than prompt neutrons.

b. larger than β since delayed neutrons are born at lower energy levels than prompt neutrons.

c. smaller than β since delayed neutrons are born at higher energy levels than prompt neutrons.

d. larger than β since delayed neutrons are born at higher energy levels than prompt neutrons.

Answer: A.019 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION B.001 [1.0 point] {1.0}

You are the reactor operator performing a reactor startup to 10 Mw. During the shutdown 4 new experiments were placed in a beamport which could result in an undefined radiation hazard. At what power levels during the startup (besides criticality) are you required to inform the health physics technician monitoring the experiments?

a. 5 Kws, 0.5 Mws, 5 Mws

b. 50 Kws, 2.5 Mws, 10 Mws

c. 5 Kws, 2.5 Mws, 5 Mws

d. 50 Kws, 5 Mws, 10 Mws

Answer: B.001 d.
Reference: AP-RO-110, Conduct of Operations § 6.6.7.b, p. 16.

QUESTION B.002 [1.0 point] {2.0}

How long before a Radiation Work Permit expires (no extension)?

a. 8 hours

b. 24 hours

c. 48 hours

d. one week

Answer: B.002 b.
Reference: AP-HP-105 & Examination Bank.

QUESTION B.003 [1.0 point] {3.0}

Technical Specifications require the facility to test the operability of the Pool Fill system …

a. Weekly

b. Monthly

c. Semiannually

d. Annually

Answer: B.003 c.
Reference: Technical Specifications § 5.6 *Auxiliary Systems*.

QUESTION B.004 [1.0 point, ¼ each] {4.0}

Identify whether each of the following experiments has no special requirements (NSR), requires Double encapsulation (DBL), requires venting through HEPA and charcoal filters to the stack (HEPA) or is Not Authorized (NA).

a. Corrosive Materials

b. Cryogenic Materials (in pool experiment)

c. At the peak will contain 3 milligrams of explosive material.

d. At the peak will contain 100 millicuries of Strontium 90 (Sr^{90}).

Answer: B.004 a. = DBL; b. = NA; c. = NSR; d. = HEPA
Reference: Technical Specification 3.8. j, m, d and o.

QUESTION B.005 [1.0 point] {5.0}

What is the minimum amount of primary grade makeup water allowable for reactor operation?

a. 1000 gallons

b. 2000 gallons

c. 3000 gallons

d. 4000 gallons

Answer: B.005 b.
Reference: Technical Specification 3.10

QUESTION B.006 [1.0 point] {6.0}

What is the maximum allowable dose which the ~~facility director~~ Emergency Director can authorize for a volunteer to receive to save the life of someone injured and trapped in the reactor compartment?

a. 125 Rem

b. 100 Rem

c. 75 Rem

d. 50 Rem

Answer: B.006 c.
Reference: ~~EP-RO-018, *Emergency Radiation Exposure*, page 2~~. EP-RO-018 step 1.1

QUESTION B.007 [1.0 point] {7.0}

During a normal reactor startup you must stop pulling the shim-safety blades in gang when you reach the position equivalent to _____ inches below the ECP position.

a. 5

b. 2-½

c. 2

d. 1-¼

Answer: B.007 c.
Reference: OP-RO-210, Precaution 3.4.

QUESTION B.008 [2.0 points, ½ point each] {9.0}

Identify each of the actions listed below as either a Channel Check (Check), a Channel Test (Test), or a Channel Calibration (Cal).

a. Prior to startup you place a known radioactive source near a radiation detector, noting meter movement, and alarm function operation.

b. During startup you compare all of your nuclear instrument channels ensuring they track together.

c. At power , you perform a heat balance (calorimetric) and determine the need to adjust Nuclear Instrumentation readings.

d. During reactor shutdown you note -80 second period on nuclear instrumentation.

Answer: B.008 a. = Test; b. = Check; c. = Cal; d. = Check
Reference: Technical Specifications

QUESTION B.009 [1.0 point, ¼ each] {10.0}

The appropriate federal regulation contains many requirements for Operator Licenses, match each of the requirements listed in column A with it's appropriate time period in column B. (Note: Periods from column B may be used more than once or not at all.)

	Column A (Requirements)	Column B (Years)
a.	License Renewal	1
b.	Requalification Written Examination	2
c.	Requalification Operating Test	4
d.	Medical Examination	6

Answer: B.009 a. = 6; b. = 2; c. = 1; d. = 2
Reference: 10CFR55

QUESTION B.010 [1.0 point] {11.0}

During a startup the reactor is not critical within ECP limits ~~at ECP~~, per AP-RO-110, the minimum level of staff authorized to permit a continuation of the startup is …

a. Any licensed Senior Reactor Operator

b. Lead Senior Reactor Operator

c. Assistant Reactor Manager

d. Reactor Manager

Answer: B.010 c.
Reference: AP-RO-110, § 6.6.5.d

QUESTION B.011 [1.0 point] {12.0}

In the case of a partial site area evacuation, according to EP-RO-013, all personnel who have evacuated the reactor building will proceed to

a. USDA Research Laboratory parking lot

b. Dalton parking lot

c. Science Instrument Shop

d. Research Park Development Building

Answer: B.011 b.
Reference: EP-RO-013, Facility Evacuation, Attachement 5.1, Evacuation Map

QUESTION B.012 [1.0 point] {13.0}

Which ONE of the following types of experiments may NOT be irradiated within the confines of the pool?

a. explosive materials

b. fueled experiments

c. materials corrosive to reactor components

d. cryogenic liquids

Answer: B.012 d.
Reference: Technical Specification 3.6(m)

QUESTION B.013 [1.0 point] {14.0}

Which **ONE** of the following locations is **NOT** an Emergency Command Center per the Emergency Plan?

a. Control Room

b. Research Park Development Building

c. Dalton Cardiovascular Research Center

d. Facility Front Lobby

Answer: B.013 c.
Reference: Emergency Plan section 6.1 ~~SEP-1, §II.2 and 6.~~

QUESTION B.014 [1.0 point] {15.0}

Which **ONE** of the following radiation monitors may be placed out of service for two hours for maintenance or calibration, providing no experimental or maintenance activities are conducted which could likely result in the release of unknown quantities of airborne radioactivity.

a. Reactor Bridge Radiation Monitor

b. Reactor Building Exhaust air plenum Radiation Monitor

c. Stack Radiation Monitor

d. Reactor Bridge ALARA Radiation Monitor

Answer: B.014 c.
Reference: Technical Specifications, Table in § 3.4(a).

QUESTION B.015 [1.0 point] {16.0}

The Primary System Fuel Failure Monitor has failed. Which **ONE** of the following actions must you take, if any, to comply with Technical Specifications?

a. Immediately SCRAM the reactor.

b. Commence a normal reactor shutdown within 15 minutes.

c. Make arrangements to have the primary coolant sampled once every 4 hours.

d. No actions are required.

Answer: B.015 c.
Reference: Technical Specifications, § 3.9 Coolant System, pg. 1 of 3.

QUESTION B.016 [1.0 point] {17.0}

Which ONE of the following control rod manipulations is **NOT** by procedure?

a. Gang operation of the control rods after criticality to reduce power.

b. Gang operation of the control rods as part of automatic shimming.

c. Simultaneous withdrawal of one control blade and the regulating blade.

d. Gang operation of the controls rods during hot startup.

Answer: B.016 c.
Reference: AP-RO-110 step 6.6.6 ~~SOP-I.4.3.D Control Blade Operation, p. SOP/I-5~~

QUESTION B.017 [1.0 point] {18.0}

According to Technical Specifications, the drop time for each rod shall be measured ____ and one of four blades shall be inspected _____.

a. monthly every six months

b. quarterly every six months

c. quarterly annually

d. every six months annually

Answer: B.017 b.
Reference: Technical Specification 5.3.

Question B.018 deleted from examination, no correct answer, question as shown is modified such that b. is the correct answer.

~~QUESTION B.018 [1.0 point] {19.0}~~

How long (by standard practice) must the reactor be secured prior to venting a beam port containing Ar^{41}?

a. 1 hour
b. ~~12~~ 8 hours
c. ~~1 day~~ 12 hours
d. ~~2 days~~ 24 hours

Answer: B.018 b.
Reference: AP-RO-110 step 6.9.2.d ~~Reactor Operator Training Manual, § I.11 5th ¶~~.

QUESTION B.019 [1.0 point] {20.0}

Which ONE of the following is NOT a responsibility of the Console Operator following a reactor isolation?

a. Verify that the containment building has sealed by the ventilation door and exhaust valve indication lights.
b. Ensure all personnel have evacuated all levels of the containment building.
c. Position himself at the outer airlock allowing only authorized personnel entry.
d. Investigate the cause of the alarm and magnitude of the incident.

Answer: B.019 d.
Reference: EP-RO-012 step 2.0 ~~FEP~~

QUESTION C.001 [1.0 point] {1.0}

How long after shutdown must the Primary system be in operation?

a. 5 minutes

b. 10 minutes

c. 15 minutes

d. 30 minutes.

Answer: C.001 c.
Reference: OP-RO-410, *Primary Coolant System*, § 6.0 Caution

QUESTION C.002 [1.0 point] {2.0}

What is the purpose of the ventilation ducts built in to the pool wall? These ducts are designed to remove …

a. H^3

b. N^{16}

c. Ar^{41}

d. I^{131}

Answer: C.002 a.
Reference: Reactor Operator Training Manual, § I.11, Containment Building Exhaust System p. I.11.1, 2nd ¶.

QUESTION C.003 [1.0 point] {3.0}

Mechanical strain when shifting Cooling Tower Fans from fast to slow speed is minimized by …

a. a delay timer allowing the fan to coast down (about 20 seconds), before the slow speed windings energize.

b. a large torsion spring designed to absorb the shock of energizing the slow speed windings.

c. the use of special fan belts designed to absorb the shock of energizing the slow speed windings.

d. a directed spray of coolant aiding in the slowing down of the fans.

Answer: C.003 a.
Reference: OP-RO-480, *Secondary Coolant System*, § 6.2 NOTE.

QUESTION C.004 [1.0 point] {4.0}

Which one of the following describes the automatic operation of the Shim Rods?

a. The Shim Rods insert when the Regulating Rod position decreases to 20% withdrawn

b. The Shim Rods withdraw when the Regulating Rod position decreases to 20%

c. The Shim Rods insert when the Regulating Rod position increases to 20% withdrawn

d. The Shim Rods withdraw when the Regulating Rod position increases to 10% withdrawn-81

Answer: C.004 a.
Reference: HSR, § 9.6.2 last ¶,

QUESTION C.005 [1.0 point] {5.0}

The corrosion inhibitors require a pH range between 7 and 8 to work correctly. Which ONE of the following is added to the secondary to maintain the pH?

a. Carbonic Acid

b. Sulfuric Acid

c. Sodium Hydroxide

d. Potassium-Tetraborate-Tetrahydrate.

Answer: C.005 b.
Reference: HSR § 5.4.6, pg. 5-26.

QUESTION C.006 [1.0 point] {6.0}

Which ONE of the following conditions will NOT result in the changing the regulating blade control from automatic to manual.

a. Scram

b. Run-In

c. Shimming a control blade

d. Operating the regulating blade switch

Answer: C.006 c.
Reference: HSR, § 9.6.2

QUESTION C.007 [1.0 point] {7.0}

How is Reactor Coolant temperature controlled?

a. Varying reactor loop flow by varying speed of pumps P501A/B.

b. Varying reactor loop flow by varying the position of butterfly valve 901.

c. Varying secondary loop flow by varying speed of pumps P1, P2 and P3.

d. Varying secondary loop flow by varying the position of butterfly valve S-1.

Answer: C.007 d.
Reference: Reactor Operator Training Manual, § I.2.E, p. I.2.11. 3rd ¶.

QUESTION C.008 [1.0 point] {8.0}

Which ONE of the following Area Radiation Monitoring System (ARMS) channels does NOT cause a building isolation?

a. Air Plenum 2

b. Bridge ALARA

c. Room 114

d. Bridge

Answer: C.008 c.
Reference: Reactor Operator Training Manual §II.10, p. II.10.1 B.2 Reactor Isolation, p. II.10.3.

QUESTION C.009 [1.0 point] {9.0}

Which ONE of the following is the correct (temporary) method for maintaining power to critical reactor instrumentation when performing maintenance on the Uninterruptible Power Supply?

a. Close the bypass switch, allowing the batteries to feed a backup UPS.

b. Close the static switch, allowing the batteries to feed a backup UPS.

c. Close the bypass switch, allowing site power to feed the instrumentation.

d. Close the static switch, allowing site power to feed the instrumentation.

Answer: C.009 c.
Reference: Reactor Operator Training Manual § III.3.C.1.3, page II.3.3,

QUESTION C.010 [1.0 point, ⅓ each] {10.0}

For the setpoint actions in Column A select the appropriate pressurizer system pressure listed in Column B. Pressures in Column B may be used once, more than once or not at all. Only one answer may occupy each space in column A. (Three answers required at 0.333 each)

COLUMN A - ACTIONS	COLUMN B - SETPOINTS
a. High pressure scram	1. 69.5 psig
b. Nitrogen makeup valve opens	2. 63 psig
c. High pressure relief valve lifts	3. 66.5 psig
	4. 70 psig
	5. 73.5 psig
	6. 77 psig
	7. 80.5 psig
	8. 100 psig

Answer: C.010 a. = 6; b. = 3; c. = 8
Reference: MURR Training Manual for Reactor Operators Section I.3 pp I

QUESTION C.011 [1.0 point] {11.0}

Regarding the five control rods …

a. all five are boron carbide clad in aluminum.

b. the shims are boron carbide clad in aluminum, the regulating rod is stainless steel.

c. the shims are boron carbide clad in stainless steel, the regulating rod is aluminum.

d. all five are stainless steel.

Answer: C.011 b.
Reference: Reactor Operator Training Manual, §

QUESTION C.012 [1.0 point] {12.0}

Starting a Secondary Coolant Pump during reactor startup may cause the reactor to scram due to …

a. low core inlet temperature

b. low core outlet temperature

c. low core discharge pressure

d. low pool temperature

Answer: C.012 c.
Reference: OP-RO-210 step 3.8 .

QUESTION C.013 [2.0 points, ⅛ point each] {14.0}

Identify each of the following valve operator system valve indications as being either via limit switch **(L/S)** on the valve (actual valve position) or air operator **(A/O)** position, and whether the **OPEN** position is **GREEN** or **RED**. (**NOTE**: Two answers should be circled per item.)

a. Pool Loop 6" isolation valve

b. ℞ Loop 12" isolation valve

c. Pressurizer, 2" Bypass Drain

d. Pressurizer 1" Supply Valve

e. Reflector Convective Loop Valve

f. Anti-siphon Valve

g. N_2 ½" Exhaust valve.

h. Liquid Level 2" fill

Answer: C.013 a & b = L/S (green); c & d = A/O (red); e & f = L/S (red); g & h = A/O (red)
REF: Reactor Operator Training Manual,

Question C.014 deleted, a recent change that plugged all floor drains so the Drain Collection tank overflow in directed to a sump for a scupper pump.

~~QUESTION C. 14 [1.0 point] {15.0}~~
~~Where does the Drain Collection tank overflow, overflow to?~~
~~a. "Floor Drain in room 114".~~
~~b. Sanitary Sewer~~
~~c. Retention Tank #3~~
~~d. Reactor Pool~~
~~Answer: C.014 a.~~
~~Reference: Reactor Operator Training Manual, § I.8. Drain Collection Tank System, p. I.8.1. ¶ B~~

QUESTION C.015 deleted. All answers are conditions that would allow you to go to the automatic mode of operation. The wide range monitor switch has to be in 5kW red or greater. 5kW black is greater.

~~QUESTION C.015 [1.0 point] {16.0}~~

~~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-2, is 40 seconds.~~

~~b. The 60% annunciator alarm for the regulating blade is energized.~~

~~c. Reactor period, as measured by IRM-3, is 40 seconds.~~

~~d. The Wide Range Monitor selector switch is in the 5 kW black scale position.~~

~~Answer: C.015 d.~~

~~Reference: Training Manual for Reactor Operations, page II~~

QUESTION C.016 [1.0 point] {17.0}

A Facility Evacuation can be manually initiated from the control console and:

a. the reactor bridge.

b. equipment room 278.

c. the front lobby.

d. equipment room 114.

Answer: C.016 c.

Reference: Training Manual for Reactor Operations, page II.10.3.

QUESTION C.017 [1.0 point] {18.0}

Which Area Radiation Monitors below can cause a Reactor Isolation?

a. Bridge, Bridge ALARA, Fission Product Monitor, Air Plenum 1.

b. Beamport Floor North Wall, Beamport Floor West Wall, Beamport Floor South Wall, Bridge.

c. Bridge, Bridge ALARA, Air Plenum 1, Air Plenum 2.

d. Fission Product Monitor, Air Plenum 1, Air Plenum 2, Bridge ALARA.

Answer: C.017 c.

Reference: Training Manual for Reactor Operations, page II.9.2.

QUESTION C.018 deleted from the examination, no correct answer as stated. The diesel supplies the Emergency Distribution Center instead of Substation B. Reference HSR pg 7-3 and MURR drawing 522 sheet 1 of 3. Load is shifted back after a 10 minute time delay. The question below shows corrections required to modify and make it acceptable.

~~QUESTION C.018 [1.0 point] {19.0}~~

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

Answer: C.019 b.
Reference: ~~Training Manual for Reactor Operations, pages III.2.1, III.2.2.~~
HSR pg 7-3 and MURR drawing 522 sheet 1 of 3

QUESTION C.019 [1.0 point] {20.0}

Which ONE of the following is NOT a feature of the pneumatic tube system designed to limit the radiation hazard?

a. Speed at which the sample container is transported through the system.

b. When the blower is initially turned on both blowers start simultaneously.

c. Facility exhaust fans operation prevent stagnant air in the vicinity of the rabbit system.

d. Double encapsulation of samples.

Answer: C.019 b.
Reference: HSR 8-20 – 8-25. Also NRC Examination Question Bank question 6837