October 25, 2006

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

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-186/OL-07-01, University of Missouri – Columbia

Dear Mr. Butler:

During the week of October 02, 2006, 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/

Johnny Eads, 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-07-01
2. Facility comments with NRC resolution
3. Examination and answer key with facility comments incorporated.

cc w/encls: Please see next page

October 25, 2006

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cc w/encls: Please see next page
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OFFICE	PRTB:CE	IOLB:LA	PRTB:SC
NAME	PYoung:tls*	EBarnhill*	JEads:tls*
DATE	10/18/2006	10/23/2006	10/25/2006

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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 02 - 03, 2005

SUBMITTED BY: _____**/RA/**_____ 10/17 /2006

Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of October 02, 2006, the NRC administered operator licensing examinations to one Reactor Operator candidate and three Senior Operator Upgrade candidates. All four 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	1/0	0/0	1/0
Operating Tests	1/0	3/0	4/0
Overall	1/0	3/0	4/0

3. Exit Meeting:
   Phillip T. Young, NRC, Examiner
   Robert Hudson, Training Coordinator, MURR
   Michael Dixon, Assistant Reactor Manager, Operations
   Les Foyto, Reactor Manager
   Ralph A. Butler, Chief Operating Officer

   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 to some references. All corrections and enhancements to the examination have been incorporated into the copy included with this report.

Facility Comments with NRC Resolution

SECTION A - **None**

SECTION B

Facility Comment:
B.001 'Facility Director' should be replaced with 'Emergency Director'. Although the Facility Director may assume the role of the Emergency Director, the responsibility of authorizing emergency exposures lies with the position of Emergency Director.

NRC Resolution:
The question was revised as recommended by the Facility Comment.

Facility Comment:
B.004 Replace 'Shift Supervisor' with 'Lead Senior Reactor Operator'

NRC Resolution:
The question was revised as recommended by the Facility Comment.

Facility Comment:
B.006 New reference is OP-RO-250 pg 3

NRC Resolution:
The question reference was revised as recommended by the Facility Comment.

Facility Comment:
B.008 New reference is OP-RO-250 section 3.4 "When unlatching a fuel a fuel element, the fuel handling tool must float off the fuel element with no operator assistance."

NRC Resolution:
The question reference was revised as recommended by the Facility Comment, plus the question will be re-written prior to reuse.

Facility Comment:
B.009 New Reference is EP-RO-012 section 2.2 " The Lead Senior Reactor Operator or his delegate shall:....ENSURE all personnel are cleared from all levels of the containment building and ....." We think 'a' should be the correct answer

NRC Resolution:
The question reference was revised as recommended by the Facility Comment.
The NRC will accept answer ‘a’ as the only correct answer and in the future choice ‘a’ will state the Lead Senior Reactor Operator

Facility Comment:
B.016 The 2.5MeV avg for Co-60 wasn't on the equation sheet or given in the problem statement.

NRC Resolution:
The 2.5MeV average for Co-60 should be included in the question when used in future examinations.

Facility Comment:
B.019 Our local requirement per AP-RO-110 section 6.13.2 requires 8 hours. CFRs and our requal plan require 4 hours so we think answer 'b' or 'c' is correct.

NRC Resolution:
Due to conflicting requirements in applicable documents, this question was deleted from the examination.

SECTION C

Facility Comment:
C.007 A modification we did last year abandoned floor drains and now has scupper pumps that would pump the DCT overflow to Waste Tank #4 which would then pump to Waste tank #3. Therefore, we think 'b' is the correct answer.

NRC Resolution:
Agree with the facility comment. Answer ’b.’ will be the only response accepted as the correct for this examination.

Facility Comment:
C.008 New Reference is MURR Hazards Summary Report section 9.7.1 and REP-RO-100, REP-6

NRC Resolution:
The question reference was revised as recommended by the Facility Comment.

Facility Comment:
C.015 New Reference is MURR Hazards Summary Report section 7.1.3 and MURR drawing 156

NRC Resolution:
The question reference was revised as recommended by the Facility Comment.

Facility Comment:
C.016 New Reference is MURR Hazards Summary Report section 4.3

NRC Resolution:
The question reference was revised as recommended by the Facility Comment.

UNIVERSITY OF MISSOURI - COLUMBIA
WRITTEN EXAM w/ANSWER KEY

OPERATOR LICENSING EXAMINATION
OCTOBER 02, 2006

ENCLOSURE 3

QUESTION A.001 [1.0 point] (1.0)
The number of neutrons passing through a one square centimeter of target material per second is the definition of which one of the following?

a. Neutron Population (np)

b. Neutron Impact Potential (nip)

c. Neutron Flux (nv)

d. Neutron Density (nd)

A.001 c
REF: Reference 1, Module 2, Rx Theory (Neutron Characteristics), E.O. 2.1.b, pg. 15

QUESTION A.002 [1.0 point] (2.0)
K_{eff} is K_{∞} times …

a. the fast fission factor (ε)

b. the total non-leakage probability ($\mathcal{L}_f \times \mathcal{L}_{th}$)

c. the reproduction factor (η)

d. the resonance escape probability (p)

A.002 b
REF: Reference 1, Module 3, Rx Theory (Nuclear Parameters), E.O. 1.1 a&b, pg. 9

QUESTION A.003 [2.0 points, ½ each] (4.0)
Using the drawing of the Integral Rod Worth Curve provided, identify each of the following reactivity worths.

a. Total Rod Worth

b. Actual Shutdown Margin

c. Technical Specification Shutdown Margin Limit

d. Excess Reactivity

1. B - A
2. C - A
3. C - B
4. D - C
5. E - C
6. E - D
7. E - A

A.003 a. = 7; b. = 2; c.= 1 ; d.= 5
REF: Standard NRC Question

QUESTION A.004 [1.0 point] (5.0)
Which ONE of the following is an example of neutron decay?

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

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

c. $_{35}Br^{87} \rightarrow {}_{34}Se^{86}$

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

A.004 b
REF: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.005 [1.0 point, ¼ each] (6.0)
Match the neutron interaction in column A with the reaction from column B.

Column A	Column B
a. Inelastic Scattering	1. The neutron recoils with the same kinetic energy it had prior to the collision
b. Elastic Scattering	2. The neutron recoils with less kinetic energy than it had prior to the collision with the nucleus emitting a gamma ray.
c. Absorption	3. The neutron is absorbed, with the nucleus emitting a gamma ray.
d. Fission	4. The neutron is absorbed, with the nucleus splitting and higher energy neutrons

A.005 a. = 2; b. = 1; c. = 3; d. = 4
REF: Standard NRC Question

QUESTION A.006 [1.0 point] (7.0)
As the reactor continues to operate over a period of a week, to maintain a constant power level the average thermal neutron flux will …

a. decrease due to the increase in fission product poisons.

b. decrease because fuel is being depleted.

c. increase in order to compensate for fuel depletion.

d. remain the same.

A.006 c
REF: DOE Fundamentals Handbook, Module 2, Reaction Rates, page 21.

QUESTION A.007 [1.0 point] (8.0)
The reactor is operating at a constant power level with equilibrium xenon. You double Reactor power. The equilibrium xenon level at the higher power level will be …

a. the same as at the lower power level.

b. higher than its value at the lower power level, but not twice as high.

c. twice as high.

d. more than twice as high.

A.007 b
REF: DOE Fundamentals Handbook, Module 3, Xenon, page 37.

QUESTION A.008 [1.0 point] (9.0)
The reactor is at a power of 1 watt, with a 26 second stable period. How long will it take for power to reach 1000 watts?

a. ≈180 seconds

b. ≈153 seconds

c. ≈121 seconds

d. ≈78 seconds

A.008 a.
$P = P_0 e^{t/T}$ → ln(1000/1) = t/26sec → 26sec × 6.9078 = 179.6 ≈ 180
REF: Primary Reference, Volume 2, Module 4, Reactor Theory (Reactor Operations), Enabling Objective 2.1.

QUESTION A.009 [1.0 point] (10.0)
If the primary flow rate is 3700 gpm and the ΔT across the primary side of the heat exchanger is 15.5°F, what is the power being transferred to the secondary side of the heat exchanger? (Assume no losses to the ambient surroundings, including the pool).

a. 12 megawatts.

b. 10 megawatts.

c. 8 megawatts.

d. 6 megawatts.

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

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

$$\dot{Q} = 3700 \frac{gallons}{minute} \times 8 \frac{lbm}{gallon} \times 60 \frac{minutes}{hour} \times 1 \frac{BTU}{°F\text{-}lbm} \times 15.5°F \times \frac{1 Mw\text{-}Hr.}{3.412 \times 10^6 BTU}$$

QUESTION A.010 [1.0 point] (11.0)
The reactor is subcritical with a K_{eff} of 0.96 and 30 counts per second indicated. After a fuel element is removed the count rate drops to 10 counts per second. No other changes have occurred. What is the K_{eff} of the core with the fuel element removed?

a. 0.9733

b. 0.8800

c. 0.8400

d. 0.8000

A.010 b
$CR_1/CR_2 = [1 - K_{eff2}]/[1 - K_{eff1}]$ $30/10 = [1 - K_{eff}]/[1 - 0.96]$ $1 - K_{eff} = 3 \times 0.04 = 0.12$ $K_{eff} = 0.88$
REF: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.011 [1.0 point] (12.0)
Which one of the following factors is most easily varied by the reactor operator?

a. reproduction factor

b. fast fission factor

c. fast non-leakage probability

d. thermal utilization factor

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

QUESTION: A.012 [1.0 point] (13.0)
The moderator-to-fuel ratio describes the relationship between the number of moderator atoms in a volume of core to the number of fuel atoms. A reactor which is:

a. undermoderated will have a positive moderator temperature coefficient.

b. undermoderated will have a negative moderator temperature coefficient.

c. overmoderated will have a constant moderator temperature coefficient.

d. overmoderated will have a negative moderator temperature coefficient.

ANSWER: 012 b.
REFERENCE: DOE Fundamentals Handbook, Module 3, Reactivity Coefficients, page 25.

QUESTION: A.013 [1.0 point] (14.0)
The primary coolant temperature coefficient of reactivity is $-5x10^{-5}$ delta K/K/deg.F. When a control rod with an average rod worth of 0.01% delta K/K/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, the primary coolant temperature has:

a. increased by 20 deg.F.

b. decreased by 20 deg.F.

c. increased by 2 deg.F.

d. decreased by 2 deg.F.

ANSWER: 013 a.
REFERENCE: DOE Fundamentals Handbook, Module 3, Reactivity, page 21. Control rod inserts positive reactivity = 0.0001delta k/k/inch x 10 inches = +0.001 delta k/k. Primary coolant temperature inserts negative reactivity = $-5x10^{-5}$ delta k/k/deg.F x(+20 deg.F) = -0.001 delta k/k.

QUESTION: A.014 [1.0 point] (15.0)
Which ONE of the following statements correctly describes a characteristic of subcritical multiplication?

a. The number of neutrons gained per generation doubles for each succeeding generation.

b. A constant neutron population is achieved when the total number of neutrons produced in one generation is equal to the number of source neutrons added in the next generation.

c. For equal reactivity additions, it requires less time for the equilibrium neutron population to be reached.

d. When the indicated count rate doubles, the margin to criticality has been reduced by approximately one-half.

ANSWER: 014 d.
REFERENCE: DOE Fundamentals Handbook, Module 4, Subcritical Multiplication, page 6.

QUESTION A.015 [1.0 point] (16.0)
Which ONE of the following is the purpose for having a neutron source?

a. To compensate for neutrons absorbed by experiments installed in the reactor.

b. To generate a sufficient population to start a fission chain reaction for reactor startup.

c. To provide a means for allowing reactivity changes to occur in a subcritical reactor.

d. To generate a detectable neutron level for monitoring reactivity changes in a shutdown reactor.

A.015 d
REF: Reference 1, Volume 2, p. 1.

QUESTION A.016 [1.0 point] (17.0)
After a week of full power operation, Xenon will reach its peak following a shutdown in approximately:

a. 5 hours

b. 10 hours

c. 20 hours

d. 40 hours

A.016 b
REF: Reference 1, Volume 2, Module 3, p. 38.

QUESTION A.017 [1.0 point] (18.0)
Five minutes following a reactor shutdown, the source range monitor is reading 3×10^6 counts/minute. Which ONE of the following is the count rate you would expect to see three minutes later

a. 10^6 counts/minute

b. 8×10^5 counts/minute

c. 5×10^5 counts/minute

d. 3×10^5 counts/minute

A.017 d
REF: Standard NRC Question

QUESTION A.018 [2.0 points, ½ each] (20.0)
Match type of radiation (Column A) with the proper penetrating power (Column B).

a. Gamma	1.	Stopped by thin sheet of paper
b. Beta	2.	Stopped by thin sheet of metal
c. Alpha	3.	Best shielded by light material
d. Neutron	4.	Best shielded by dense material

A.018 a. 4; b. 2; c. 1; d. 3
REF: Basic Nuclear Concepts, p. 7.4.2

QUESTION B.001 [1.0 point] (1.0)
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

B.001 c
REF: EP-RO-018, *Emergency Radiation Exposure*, page 2.

QUESTION B.002 [1.0 point] (2.0)
The reactor has been shutdown for the last three hours due to electrical storms, (intermittent loss of power). No shutdown checksheet has been performed. Which of the following meets the MINIMUM requirements to restart the reactor?

a. You may startup after ensuring the Primary system is on-line per the applicable SOP, then performing a short form Startup Checksheet.
b. You may startup after performing a short form Startup Checksheet.
c. You may perform a hot startup with the SRO directing.
d. You may startup after performing a Full Power Startup Checksheet.

B.002 d
REF: NRC Examination administered September 11, 2001.

QUESTION B.003 [1.0 point] (3.0)
During normal operation of the reactor, you take a complete set of process data every …

a. ½ hour
b. hour
c. 2 hours
d. 4 hours

B.003 c
REF: AP-RO-110, Conduct of Operations, § 6.5.6.b. pg. 11.

QUESTION B.004 [1.0 point] (4.0)
You are operating the reactor when it scrams (unscheduled). After looking for hours neither you nor the SRO, nor the ~~shift supervisor~~ Lead Senior Reactor Operator can find the reason for the scram. Which one of the following conditions must be met to restart the reactor?

a. You may startup the reactor if authorized by the Reactor Manager.
b. You may startup the reactor if authorized by any Senior Reactor Operator.
c. You may startup the reactor if authorized by the Lead Senior Reactor Operator.
d. You may NOT startup the reactor under any conditions until the cause of the scram is found and corrected.

B.004 a
REF: AP-RO-110, § 6.6.8.

QUESTION B.005 [1.0 point] (1.0)
Identify each of the following reactor plant limitations as a Safety Limit (SL), Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO). (Choices may be used more than once or not at all.)

a. Reactor Inlet Temperature 155°F (Maximum)

b. Primary Coolant Flow, 1625 gpm either Loop (Minimum)

c. The reactor shall be subcritical by a margin at least 0.02 ΔK with an any one shim blade fully withdrawn.

d. The reactor shall not be operated … unless the following are operable: <u>The Siphon Break System</u>

B.005 a. = LSSS; b. = LSSS; c. = LCO; d. = LCO
REF: Technical Specifications 2.2, 3.1.e and 3.9a(1).

QUESTION B.006 [1.0 point] (6.0)
During refueling, the lowest level of staff who may move fuel **INTO OR OUT OF THE CORE WITHOUT DIRECT SUPERVISION** is …

a. Auxiliary Operator
b. Reactor Operator
c. Senior Reactor Operator
d. Operations Manager

B.006 b
REF: ~~SOP II, 2.1.H.~~ OP-RO-250 pg 3

QUESTION B.007 [1.0 point] (7.0)
The NRC has four standard emergency classifications. Which ONE of the four listed below is NOT applicable at MURR?

a. Alert
b. General Emergency
c. Site Area Emergency
d. Notification of Unusual Event

B.007 b
REF: Emergency Plan, § 3.0 Classification of Emergency Conditions

QUESTION B.008 [1.0 point] (8.0)
Per SOP I, Section 2 Fuel Handling, when unlatching an element in the reactor _____ on the tool while pushing down on the air operator handle to locked released position.
"When unlatching a fuel a fuel element, the fuel handling tool must float off the fuel element with no operator assistance."

a. lightly lift up
b. lightly push down
c. quickly jerk up
d. quickly jerk down

B.008 b
REF: ~~SOP II § 2.0 Fuel Handling~~ OP-RO-250 section 3.4

QUESTION B.009 [1.0 point] (9.0)
Who has responsibility for ensuring all personnel are cleared from all levels of the containment building, according to the immediate actions for a Reactor Isolation?

a. The Shift Supervisor {In the future revise to: the Lead Senior Reactor Operator}
b. The Reactor Director
c. The Duty Reactor Operator
d. The Duty Health Physics person

B.009 ~~c~~ - a.
Ref: ~~FEP-2, page 2 of 4.~~ EP-RO-012 section 2.2 The Lead Senior Reactor Operator or his delegate shall:....ENSURE all personnel are cleared from all levels of the containment building and

QUESTION B.010 [1.0 point] (10.0)
The Primary System Fuel Failure Monitor is secured due to an electrical problem. How often must the primary coolant be sampled to continue reactor operation?

a. every hour
b. every two hours
c. every four hours
d. every eight hours

B.010 c
Ref: Technical Specifications, § 3.9, Coolant System, page 1 of 3.

QUESTION B.011 [1.0 point] (11.0)
Which ONE of the following types of experiments is **REQUIRED** to be doubly encapsulated? Experiments which contain …

a. explosive materials.
b. Iodine isotopes 131 through 135.
c. corrosive materials.
d. cryogenic liquids.

B.011 c
REF: Technical Specification 3.6.

QUESTION B.012 [1.0 point] (12.0)
The procedure for starting up the secondary system for 10 Mw operation requires a 5 to 10 minute delay in starting the second pump. Which ONE of the following is the correct reason for this delay?

a. To prevent a low sump level trip.
b. To prevent an electrical overload on the system.
c. To prevent damage to the pump discharge check valves.
d. To prevent water hammer damage to the heat exchangers.

B.012 a
Ref: OP-RO-480, Secondary Coolant System

QUESTION B.013 [1.0 point, ¼ each] (13.0)
Identify whether Gang operation of the control blades is **ALLOWED** or is **NOT** allowed with the **reactor critical** for the listed evolutions.

a. Reactor Shutdown
b. Normal Reactor Startup
c. Hot Reactor Startup
d. Power Recovery Startup

B.013 a. = **ALLOWED**; b. = **NOT**; c. = **ALLOWED**; d. = **NOT**
Ref: AP-RO-110 Conduct of Operations, § 6.6.6 Control Blade Operation.

QUESTION B.014 [1.0 point, ¼ each] (14.0)
Common radioisotopes associated with research reactors are N^{16}, Ar^{4l}, H^3 and Na^{24}. The half-life for each is (seconds (sec), minutes (min) hours (hr) or years (yr)).

a. N^{16} is 7.0 _____.
b. Ar^{41} is 1.9 _____.
c. H^3 is 12.0 _____.
d. Na^{24} is 15.0 _____.

B.014 a. = sec, b. = hr; c. = yr; d. = hr;
REF: NRC bank question

QUESTION B.015 [1.0 point] (15.0)
An experiment is removed from the reactor with a radiation level of **10R/hr** at **1 foot**. The radioisotope has a half-life of 120 seconds. Approximately how long must you let the experiment decay before the radiation level has decreased by a factor of 1000?

a. 600 seconds (ten minutes)
b. 1200 seconds (twenty minutes)
c. 6000 seconds (1hour 40 minutes)
d. 12000 seconds (3 hours 20 minutes)

B.015 b
REF: Standard NRC question $1/1000 \approx ½^{10}$

QUESTION B.016 [1.0 point] (16.0)
Which ONE of the following is the exposure you would expect (approximately) two feet from a point source containing 5 curies of Co^{60}. {2.5MeV avg for Co-60 }

a. 190 mR/hr
b. 1.9 R/hr
c. 19 R/hr
d. 190 R/hr

B.016 c R/hr = $6CiE/d^2$, R/hr = $(6 \times 5 \text{ curies} \times 2.5MeV)/(2 \text{ feet})^2 = 75/4 = 18.75$ R/hr $\approx$ 19 R/hr
REF: Standard NRC question.

QUESTION B.017 [1.0 point] (17.0)
Technical Specification 5.8 requires that "All fuel elements or fueled devices outside the reactor core shall be stored in a geometry such that the calculated K_{eff} is less than _____ under all conditions of moderation.

a. 0.80
b. 0.85
c. 0.90
d. 0.95

B.017 c
REF: Technical Specifications, § 3.8(d)

QUESTION B.018 (1.00) (18.0)
A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. However, there is a small section of pipe which reads 10 mrem/hr at one (1) meter. Assuming that the pipe is a point source, which ONE of the following defines the posting requirements for the area in accordance with 10CFR Part 20?

a. Restricted Area.
b. Radiation Area.
c. High Radiation Area.
d. Grave Danger, Very High Radiation Area.

B.018 c.
REF 10 mrem/hr at 1 meter (100 cm.) = 111.1mrem/hr at 30 cm.

DELETED FROM THIS EXAMINATION ~~**QUESTION** B.019 [1.0 point] (19.0)~~
~~Which ONE of the following is the minimum number of hours you must stand watch per quarter to maintain your license active?~~
~~a. 2~~
~~b. 4~~
~~c. 8~~
~~d. 12~~
~~B.019 b~~
~~REF: 10CFR55.53e~~

QUESTION B.020 [1.0 point] (20.0)
The Quality Factor is used to convert …

a. dose in rads to dose equivalent in rems.

b. dose in rems to dose equivalent in rads.

c. contamination in rads to contamination equivalent in rems

d. contamination in rems to contamination equivalent in rads

B.020 a
REF: 10CFR20.100x

QUESTION C.001 [1.0 point] (1.0)
Which ONE of the following conditions will cause Secondary Coolant Pump SP-4 to stop?

a. Secondary coolant pump SP-1 is also running, and you start secondary coolant pump SP-2.
b. Secondary coolant pump SP-1 which is also running, fails.
c. Building Supply Fan SF-1, fails.
d. Building Exhaust Fans EF-13 and 14 both fail.

C.001 c
REF: OP-RO-430 Secondary Coolant System, § 3.4

QUESTION C.002 [1.0 point] (2.0)
The ventilation system has two backup doors located in the ventilation supply and return plenums which shut on containment isolation. Which ONE of the following is the method used to shut these doors? The doors are …

a. air motor operated, with their own emergency air supply tanks.
b. motor operated, with air supplied from the emergency air supply system.
c. held open by solenoid, which when deenergized, the door closes via gravity.
d. held open by air pistons, which when vented, the doors close via gravity.

C.002 d
REF: HSR § 3.2.5, Last ¶ on pg. 3-4 and 1st ¶ on pg. 3-5.

QUESTION C.003 [1.0 point] (3.0)
During normal operation a thermal column door open alarm will …

a. cause a rod run-in.
b. cause a reactor scram.
c. prevent withdrawal of control rods.
d. have no effect on the operation of the reactor.

C.003 c
REF: Rewrite of facility supplied question, also HSR § 8.6 last sentence.

QUESTION C.004 [2.0 points, ¼ each] (5.0)
Identify the components labeled a through h on the figure of a Control Blade Drive Mechanism provided. (Note: Items are used only once. Only one answer per letter.)

a. ___ 1. Drive Tube Bearing
b. ___ 2. Gear Motor
c. ___ 3. Lead Screw
d. ___ 4. Limit Switch Actuator
e. ___ 5. Lower Limit Switch and Stop
f. ___ 6. Position Transmitter
g. ___ 7. Scram Magnet Assembly
h. ___ 8. Upper Limit Switch and Stop

C.004 a. = 2; b. = 6; c. = 8; d. = 3; e. = 4; f. = 5; g. = 1; h. = 7
REF: MURR Schematic Diagram of a Control Blade Mechanism

QUESTION C.005 [1.0 point] (6.0)
Which ONE of the following is the method used to DE-ICE the cooling tower fans.

a. Run the cooling tower fan in reverse.
b. Use the facilities steam line located in the area for that purpose.
c. Use a heat gun (similar to a hair dryer) designated for de-icing use.
d. De-icing is not necessary due to anti-freeze added to cooling tower water.

C.005 a
REF: OP-RO-480, § 6.3

QUESTION C.006 [1.0 point] (7.0)
Which ONE of the following is the reason that the pool DI system water returns to the pool about 2 feet below the pool surface? In order to …

a. reduce pool surface temperature, since DI water is cooler than pool water.
b. aid in the mixing of the water, which results in a more even temperature distribution.
c. reduce interference between the pool cooling system and the pool skimmer, which takes its suction at the pool surface.
d. create a blanket of warmer water at the top of the pool to reduce mixing, and therefore reduce the dose rate at the surface of the pool.

C.006 d
REF: MURR HSR, § 7.1.10 p. 7-15.

QUESTION C.007 [1.0 point] (8.0)
Where does the Drain Collection tank overflow, overflow to?

a. “Floor Drain in room 114".
b. Retention Tank #3
c. Sanitary Sewer
d. Reactor Pool

C.007 ~~a.~~ b.
REF: ~~Reactor Operator Training Manual, § I.8. Drain Collection Tank System, p. I.8.1. ¶ B~~
A modification we did last year abandoned floor drains and now has scupper pumps that would pump the DCT overflow to Waste Tank #4 which would then pump to Waste tank #3. Therefore, we think 'b' is the correct answer.

QUESTION C.008 [1.0 point] (9.0)
Which ONE of the following Area Radiation Monitoring System Detectors is capable of causing an automatic reactor isolation?

a. Air Plenum 2
b. Fuel Vault
c. Room 114
d. Beamport Floor North Wall

C.008 a
Ref: ~~FEP-2 p. 1. Also Training Manual for ROs § II.9 Area Radiation Monitoring System.~~
MURR Hazards Summary Report section 9.7.1 and REP-RO-100, REP-6

QUESTION C.009 [1.0 point] (10.0)
Which one of the following is the design feature used to seal the COOLING SYSTEM WATER LINES entering the reactor building?

a. The lines enter the side of the building through a 4.6 foot water leg
b. The lines enter beneath the pool and are sealed with a packing gland
c. The lines have a 6.4 foot loop seal which extends above the active fuel
d. The lines enter the side of the building and are sealed with an inflatable gasket

C.009 b
Ref: MURR Hazards Summary Report Section 1.4.5

QUESTION C.010 [2.0 points, 0.5 each] (12.0)
For each status of the Alarm and Annunciate System indicate which of the conditions listed would result in that status.

Status Descriptions	Conditions
a. Illumination On Dim	(1) Alarm was received and the operator pressed the Acknowledge pushbutton. The alarm condition has not yet cleared.
b. Illumination Flashing	(2) Alarm was received but the operator has not yet pressed the Acknowledge pushbutton. The alarm condition has not yet cleared.
c. Illumination On Bright	(3) Alarm was received and the operator pressed the Acknowledge pushbutton. The alarm condition subsequently cleared but the operator has not yet pressed the Reset button.
d. Illumination Off	(4) Alarm was received and the operator pressed the Acknowledge pushbutton. The alarm condition subsequently cleared and the operator pressed the Reset button.

C.010 a. = 3; b. = 2; c. = 1; d. = 4
Ref: Training Manual, p. II-68, Hazards Summary Report, p. 9-19

QUESTION C.011 [1.0 point] (13.0)
When setting the reactor power calculator flow potentiometer you must make a correction for cleanup flow. Which ONE of the following is the correct adjustment and reason for this adjustment? Explain why the cleanup flow is subtracted from the indicated flow in reactor loops A and B when determining the pot setting for the reactor power calculator flow potentiometer.

a. Subtract cleanup flow. Cleanup flow bypasses the core, but **IS** measured by the indicated flow.

b. Add cleanup flow. Cleanup flow also goes through the core, but **IS NOT** measured by the indicated flow.

c. Subtract cleanup flow. Cleanup flow also goes through the core, but **IS NOT** measured by the indicated flow.

d. Add cleanup flow. Cleanup flow bypasses the core, but **IS** measured by the indicated flow.

C.011 a
Ref: OP-RO-350 Reactor Power Calculator Flow Potentiometer Adjustment.

QUESTION C.012 [1.0 point] (14.0)
Which ONE of the following electrical load CANNOT be supplied by the Emergency Generator?

a. Air Locks

b. Exhaust Fan EF-13

c. Intercom System

d. Pool Pump P508A

C.012 d
Ref: Training Manual for Reactor Operators, § III.1 Electrical Power Distribution and § III.3 Emergency Electrical System

QUESTION C.013 [1.0 point] (15.0)
A high airborne activity accident in the containment has caused a reactor isolation. All personnel have evacuated containment. How can you determine whether there is still a high airborne activity?

a. Take an air sample using a connection on the containment air building leak rate system.

b. Remote readout of containment building exhaust #1 and #2 area radiation monitors.

c. Remote readout of Stack Gas, Particulate and Iodine Monitors.

d. Take an air sample at the facility stack.

C.013 a
Ref: SV-HP-135

QUESTION C.014 [1.0 point] (16.0)
The Building Exhaust System is operating normally, one fan in fast speed, both fan controllers in the auto position. Upon loss of power to the running fan the stand-by fan will …

a. start in fast speed.

b. start in slow speed, the operator must push a button to shift it to fast speed.

c. start in slow speed, after 15 seconds it will automatically shift to fast speed.

d. remain off, the operator must push a button to start the standby pump in either slow or fast speed.

C.014 b
REF: OP-RO-730, *Building Exhaust System Fans*

QUESTION C.015 [1.0 point] (17.0)
The Fission Product Monitor samples primary coolant at a point:

a. between the outlet of the primary pumps and the inlet to the heat exchangers.
b. between the outlet of the heat exchangers and the inlet to the core.
c. between the outlet of the core and the inlet to the primary pumps.
d. at the inlet to the holdup tank.

C.015 b.
REF: ~~Training Manual for Reactor Operations, page II.7.1.~~
MURR Hazards Summary Report section 7.1.3 and MURR drawing 156

QUESTION: C.016 [1.0 point] (18.0)
The neutron absorbing material of the shim rods is:

a. aluminum.
b. boron carbide.
c. stainless steel.
d. beryllium.

C.016 b.
REF: ~~Training Manual for Reactor Operations, page I.1.1.~~
MURR Hazards Summary Report section 4.3

QUESTION C.017 [1.0 point] (19.0)
According to Technical Specifications the shim rods shall be capable of insertion to the 20% withdrawn position in less than …

a. 0.3 seconds
b. 0.5 seconds
c. 0.7 seconds
d. 0.9 seconds

C.017 c
REF: Technical Specification 3.2.c.

QUESTION C.018 [1.0 point] (20.0)
WHICH ONE of the following detectors is used primarily to measure N^{16} release to the environment?

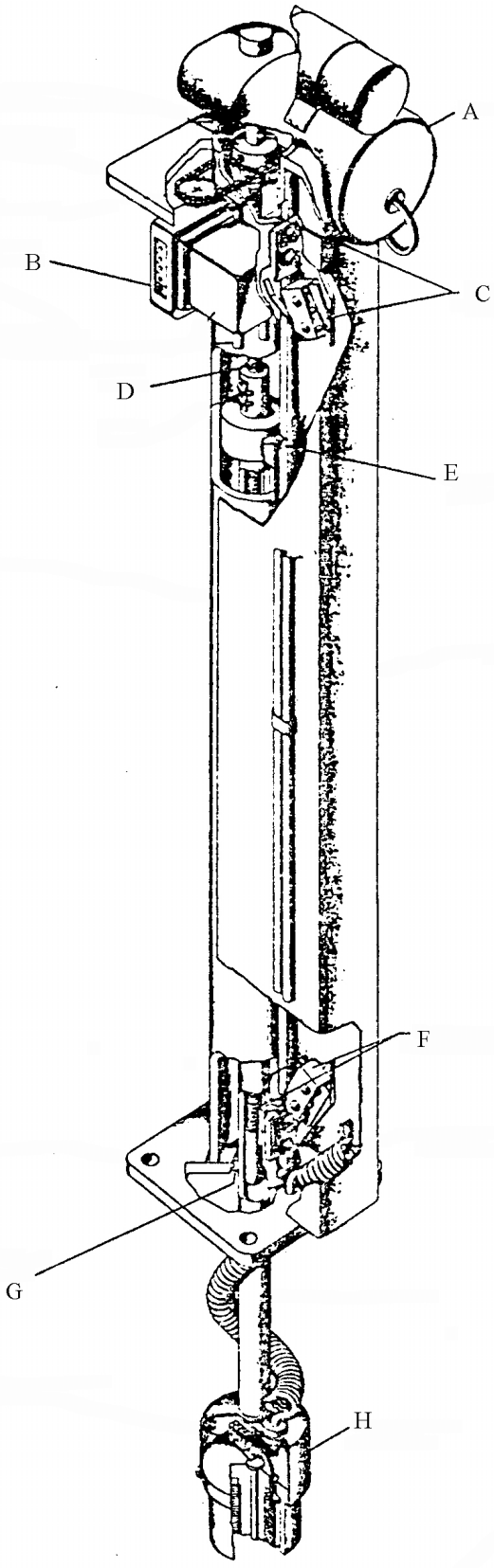
a. NONE, N^{16} has too short a half-life to require environmental monitoring.

b. Stack Gas Monitor

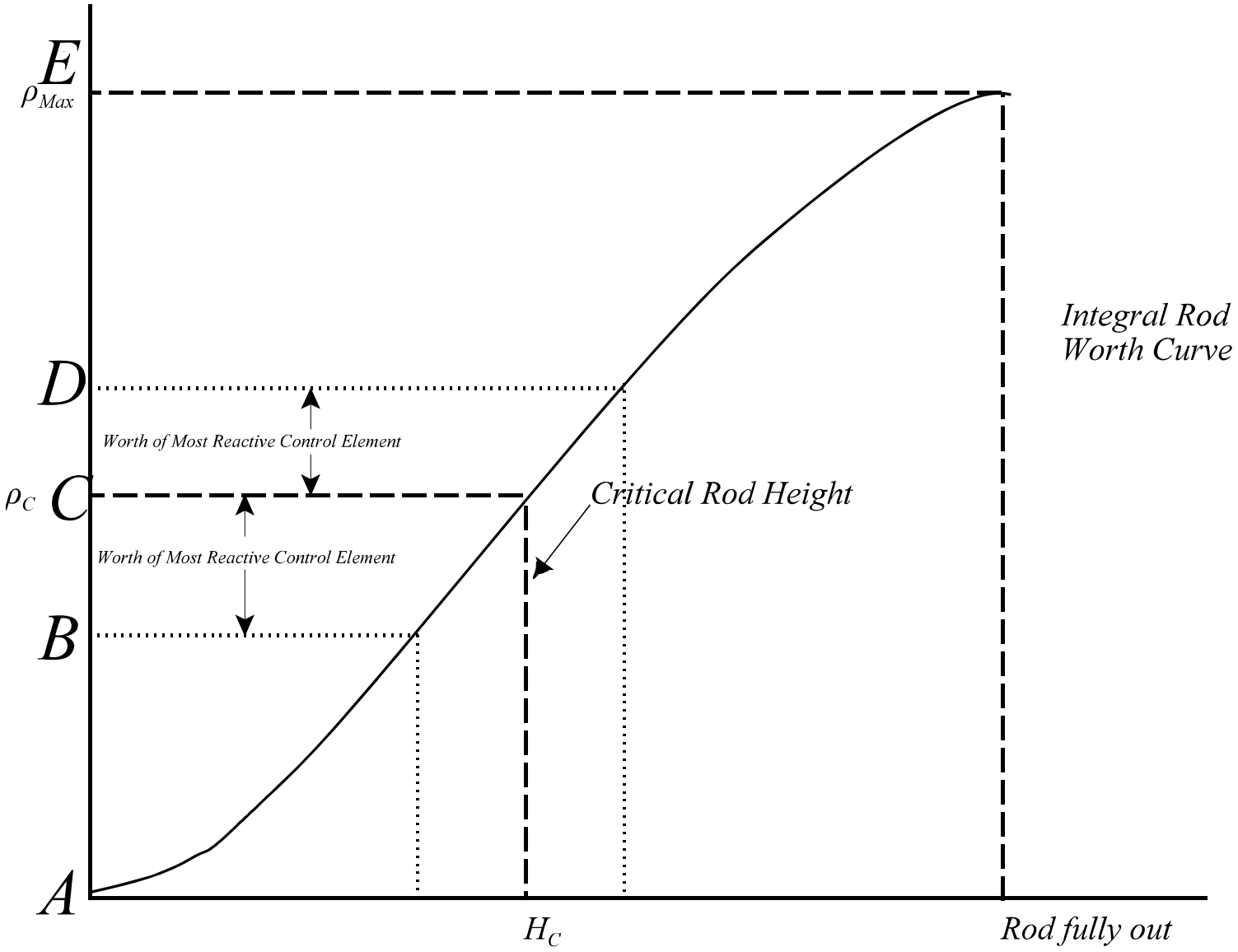
c. Stack Particulate Monitor

d. Bridge Area Monitor

C.018 a
REF: Standard NRC quesiton



Control Blade Drive Mechanism


E
ρ_{Max}
D
Worth of Most Reactive Control Element
ρ_C
C
Worth of Most Reactive Control Element
B
A
Integral Rod
Worth Curve
Critical Rod Height
H_C
Rod fully out