April 5, 2006

Mr. Robert Agasie
Reactor Director
Nuclear Engineering Laboratory
1513 University Avenue, Room 141ME
University of Wisconsin
Madison, WI 53706

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-156/OL-06-01, UNIVERSITY OF WISCONSIN

Dear Mr. Agasie:

During the week of March 13, 2006, the NRC administered an operator licensing examination at your University of Wisconsin Reactor. The examination was 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 2.790 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/NRC/ADAMS/index.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/

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

Docket No. 50-156

Enclosures: 1. Initial Examination Report No. 50-156/OL-06-01
2. Facility comments with NRC resolution
3. Examination and answer key (RO/SRO)

cc w/encls.: Please see next page

cc:

Mayor of Madison
City Hall
Madison, WI 53705

Chairman, Public Service
Commission of Wisconsin
610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854

April 05, 2006

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Reactor Director
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cc w/encls.: Please see next page
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PUBLIC DRT/PRT r/f BThomas
Facility File (EBarnhill) O-6 F-2 AAdams, PM

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ADAMS CORPORATE NOTIFICATION LETTER NO.: ML060870492 **TEMPLATE NO.: NRR-079**

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OFFICE:	PRT:CE	IOLB:LA	PRT:BC
NAME:	PTYoung*	EBarnhill*	BThomas:tls*
DATE:	4/4/06	4/4/06	4/5/06

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

REPORT NO.: 50-156/OL-06-01

FACILITY DOCKET NO.: 50-156

FACILITY LICENSE NO.: R-74

FACILITY: University of Wisconsin

EXAMINATION DATES: March 13 – 17, 2004

SUBMITTED BY: /**RA**/ 3/28/06
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of March 13, 2006, the NRC administered operator licensing examinations to four Reactor Operator candidates and one Senior Reactor Operator (Upgrade) candidate. All other 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	4/0	1/0	5/0
Operating Tests	4/0	1/0	5/0
Overall	4/0	1/0	5/0

3. Exit Meeting:
   Phillip T. Young, NRC, Examiner
   Robert Agasie, Reactor Director, University of Wisconsin

   During the exit meeting, the examiners commented on the fact that the candidates displayed a difference in use of radiation monitoring instrumentation when opening a beam port for pre-startup and post shutdown checks.

ENCLOSURE 1

Facility Comments Regarding NRC Exam Administered on March 14, 2006

Question A.019
Facility Comment: Eliminated by the examiner due to the answer and reference being left in the printed copy of the exam.
NRC Resolution: Agree with comment.

Question B.005
Facility Comment: Eliminated by the examiner because there was no correct answer.
NRC Resolution: Agree with comment.

Question B.010
Facility Comment: The answer key indicates the correct answer is B. However, the correct answer is C.
NRC Resolution: Agree with comment. Due to typographical error the wrong correct answer was indicated.

Question B.012
Facility Comment: The answer key indicates the correct answer is A. However, the correct answer is D.
NRC Resolution: Agree with comment. Due to typographical error the wrong correct answer was indicated.

Question B.013
Facility Comment: Facility management objects to this question because the reactor director feels it is the responsibility of an SRO to understand the basis for all procedure steps including those based in the Code of Federal Regulations. The director does not believe an RO should need to know which federal regulations cover specific requirements. An RO should follow facility procedures explicitly.
NRC Resolution: The question ask for an overview level general knowledge of four major sections of the Code and does not require detailed knowledge to answer. The four part question is valued at 1 point to prevent attaching a higher significance to the knowledge. The examiner feels that, given the level of knowledge asked for and the relative low worth of the question, it is an appropriate RO level question and will remain part of the examination.

Question C.003
Facility Comment: The answer key indicates the correct answer is B. However, the correct answer is D.
NRC Resolution: Agree with comment. Due to typographical error the wrong correct answer was indicated.

Question C.015

Facility Comment: The reactor director objects to this question because he feels it is inappropriate for an RO to rely upon memory for any procedure steps or system set points beyond those immediate actions of the emergency procedures and reactor protection system settings. The area radiation monitors are not part of the RPS and the setting can be changed; therefore, the set points are posted on the instrument. Memorization can lead to RO response that is inappropriate should the system set point change.

NRC Resolution: The examiner feels that the applicants should be able to display a cognizance of trip and alarm set points in order to ensure they understand when a parameter would have exceeded these points without providing the appropriate alarm or trip. The question will remain part of the examination.

UNIVERSITY OF WISCONSIN

EXAMINATION WITH ANSWER KEY

OPERATOR LICENSING EXAMINATION

March 13, 2006

ENCLOSURE 3

Question: A.001 [1.5 point 0.75 points each] (1.5)

in column A with the correct definition in column B.

	Column A		Column B
a.	Prompt Neutron	1.	A neutron in equilibrium with its surroundings.
b.	Fast Neutron	2.	A neutron born directly from fission.
c.	Thermal Neutron	3.	A neutron born due to decay of a fission product.
d.	Delayed Neutron	4.	A neutron at an energy level greater than its surroundings.

Answer: A.001 a. = 2; b. = 4; c. = 1; d. = 3
Reference: NEEP 234, p. 87.

Question: A.002 [1 point] (2.5)

A reactor is subcritical with a K_{eff} of 0.955. A positive reactivity of 4.9% delta k/k is inserted into the core. At this point, the reactor is:

a. subcritical.
b. exactly critical.
c. supercritical.
d. prompt critical.

Answer: A.002 c.
Reference: UWNR Operator Training Manual, Reactor Physics II. When k_{eff} = 0.955, ρ = -0.047 delta k/k; 4.9% delta k/k = + 0.049 delta k/k - 0.047 + 0.049 delta k/k = + 0.002 delta k/k, therefore reactor is supercritical.

Question: A.003 [1.5 point 0.75 points each] (4.0)

Which ONE of the following describes the **MAJOR** contributor to the production and depletion of Xenon respectively in a **STEADY-STATE** OPERATING reactor?

	Production	Depletion
a.	Radioactive decay of Iodine and Tellurium	Radioactive Decay
b.	Radioactive decay of Iodine and Tellurium	Neutron Absorption
c.	Directly from fission	Radioactive Decay
d.	Directly from fission	Neutron Absorption

Answer: A.003 b.
Reference: NEEP 234, p. 93

Question: A.004 [1.0 point] (5.0)

Which factor of the Six Factor formula is most easily varied by the reactor operator?

a. Thermal Utilization Factor (f)

b. Reproduction Factor (η)

c. Fast Fission Factor (ε)

d. Fast Non-Leakage Factor (Λ_f)

Answer: A.004 a.
Reference: NEEP 234, p. 89.

Question: A.005 [1.0 point] (6.0)

Which ONE of the following is an example of neutron decay?

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

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

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

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

Answer: A.005 b.
Reference: NEEP 234, p.

Question: A.006 [1.0 point] (7.0)

In order to compensate for the reduction in U^{238} atoms in FLIP fuel, General Atomics added _____ to compensate to the fuel.

a. Hydrogen
b. Erbium
c. Hafnium
d. Carbon

Answer: A.006 b.
Reference: NEEP 234, p. 112

Question: A.007 [1.0 point] (8.0)

Several processes occur that may increase or decrease the available number of neutrons. SELECT from the following the six-factor formula term that describes an **INCREASE** in the number of neutrons during the cycle.

a. Thermal utilization factor (f).
b. Resonance escape probability (p).
c. Thermal non-leakage probability (Λ_{th}).
d. Reproduction factor (η).

Answer: A.007 d.
Reference: NEEP 234, p. 88.

Question: A.008 [1.0 point] (9.0)

Which ONE of the following isotopes will cause a neutron to lose the most energy in an elastic collision?

a. $Uranium^{238}$

b. $Carbon^{12}$

c. $Hydrogen^{2}$

d. $Hydrogen^{1}$

Answer: A.008 d.
Reference: NEEP 234, p. 87.

Question: A.009 [1.0 point] (10.0)

K_{eff} for the reactor is 0.98. If you place an experiment worth **+$1.00** into the core, what will the new K_{eff} be?

a. 0.982

b. 0.987

c. 1.013

d. 1.018

Answer: A.009 b.
Reference: SDM = $(1-k_{eff})/k_{eff}$ = (1-0.98)/0.98 = 0.02/0.99 = 0.02041 or 0.02041/.0075 = $2.72, or a reactivity worth (ρ) of -$2.72.
Adding +$1.00 reactivity will result in a SDM of $2.72 - $1.00 = $1.72, or .0129081 ΔK/K
K_{eff} = 1/(1+SDM) = 1/(1 + 0.0129081) = 0.987

Question: A.010 [1.0 point] (11.0)

About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5}% full power what will the power be in three minutes.

a. 5×10^{-6}% full power

b. 2×10^{-6}% full power

c. 1×10^{-6}% full power

d. 5×10^{-7}% full power

Answer: A.010 c.
Reference: $P = P_0 e^{-T/\tau} =$
$10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

Question: A.011 [1.0 point] (12.0)

You perform two initial startups a week apart. Each of the startups has the same starting conditions, (core burnup, pool and fuel temperature, and count rate are the same). The only difference between the two startups is that during the **SECOND** one you stop for 10 minutes to answer the phone. For the second startup compare the critical rod height and count rate to the first startup.

	Rod Height	Count Rate
a.	Higher	Same
b.	Lower	Same
c.	Same	Lower
d.	Same	Higher

Answer: A.011 d.
Reference: NEEP 234, pp. 121–126.

Question: A.012 [1.0 point] (13.0)

The term "prompt jump" refers to:

a. the instantaneous change in power due to raising a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

c. a reactor which is critical using both prompt and delayed neutrons.

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

Answer: A.012 a.
Reference: Standard NRC Question

Question: A.013 [1.0 point] (14.0)

The reactor is to be pulsed. The reactivity to be inserted is twice the reactivity inserted in a previous pulse. Compared to the previous pulse, the new pulse will have approximately:

a. twice the peak power and four times the energy.

b. four times the peak power and twice the energy.

c. twice the peak power and twice the energy.

d. four times the peak power and four times the energy.

Answer: A.013 b.
Reference: UWNR Operator Training Manual, Reactor Physics IV, Reactor Pulsing.

Question: A.014 [1.0 point] (15.0)

Which one of the following is the definition of the FAST FISSION FACTOR?

a. The ratio of the number of neutrons produced by fast fission to the number produced by thermal fission

b. The ratio of the number of neutrons produced by thermal fission to the number produced by fast fission

c. The ratio of the number of neutrons produced by fast and thermal fission to the number produced by thermal fission

d. The ratio of the number of neutrons produced by fast fission to the number produced by fast and thermal fission

Answer: A.014 c.
Reference: NEEP 234, p. 89.

Question: A.015 [1.0 point] (16.0)

Reactor power increases from 30 watts to 60 watts in one minute. Reactor period is …

a. 30 seconds

b. 42 seconds

c. 60 seconds

d. 87 seconds

Answer: A.015 d.

Reference: $\ln\left(\frac{P}{P_0}\right) = \frac{t}{t}\, t = \frac{60\text{sec}}{\ln(2)} = 86.56$

Question: A.016 [1.0 point] (17.0)

A characteristic peculiar to TRIGA fuel is that it has a relatively large (and quickly acting) …

a. pressure coefficient.

b. void coefficient.

c. bath temperature coefficient.

d. fuel temperature coefficient.

Answer: A.016 d.
Reference: NEEP 234, pp. 112–114.

Question: A.017 [1.0 point] (18.0)

Which **ONE** of the following is the **MAJOR** source of energy released during fission?

a. Kinetic Energy of fission neutrons

b. Kinetic Energy of fission fragments

c. Decay of the fission fragments

d. Prompt gamma rays

Answer: A.017 b.
Reference: NEEP 234, p ??

Question: A.018 [1.0 point] (19.0)

An experimenter makes an error loading a rabbit sample. Injection of the sample results in a 100 millisecond period. If the scram setpoint is 1.25 MW and the scram delay time is 0.1 seconds, **WHICH ONE** of the following is the peak power of the reactor at shutdown. (Assume Rabbit system is operational for this question.)

a. 1.25 MW

b. 2.5 MW

c. 3.4 MW

d. 12.5 MW

Answer: A.018 c.
Reference: $P = P_0 e^{t/\tau}$, P = 1.25 Mwatt × $e^{0.1/0.1}$ = 1.25 × e = 3.3979.

Question Deleted

~~Question: A.019 [1.0 point] (20.0)~~
~~Which ONE of the following is the correct reason that delayed neutrons enhance control of the reactor?~~
~~a. There are more delayed neutrons than prompt neutrons.~~
~~b. Delayed neutrons take longer to reach thermal equilibrium.~~
~~c. Delayed neutrons increase the average neutron generation time.~~
~~d. Delayed neutrons are born at higher energies than prompt neutrons and therefore have a greater effect.~~
~~Answer: A.019 c.~~
~~Reference: NEEP 234, p. 101.~~

END OF SECTION A Rx THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

Question: B.001 [1.0 point] (1.0)

Equipment that is tagged with “Do Not Operate” tags (other than cognizance tags) may be operated with the approval of the:

a. Reactor Director.
b. Reactor Operator.
c. Senior Reactor Operator.
d. Individual who signed the tag.

Answer: B.001 d.
Reference: UWNR 001

Question: B.002 [1.0 point] (2.0)

Which ONE of the following is the minimum number of fixed radiation monitors required to be operable per Technical Specifications?

a. Four (4) Area Radiation Monitors and the Continuous Air Monitor
b. Four (4) Area Radiation Monitors and the Stack Air Monitor
c. Three (3) Area Radiation Monitors and the Continuous Air Monitor
d. Three (3) Area Radiation Monitors and the Stack Air Monitor

Answer: B.002 d.
Reference: Tech Spec 3.7.1, SAR 14-21

Question: B.003 [2.0 points, ½ point each] (4.0)
Identify each of the following as either a Safety Limit (SL), Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO).

a. The reactivity to be inserted for pulse operation shall be determined and mechanically limited such that the reactivity insertion will not exceed 1.4% ΔK/K.

b. … 400EC as measured in an instrumented fuel element.

c. The maximum temperature in a FLIP-type TRIGA fuel rod shall not exceed 1150EC under any conditions of operation.

d. The Reactor shall not be operated with damaged fuel.

Answer: B.003 a. = LCO; b. = LSSS; c. = SL; d. = LCO
Reference: T.S. a: = § 3.2; b: = § 2.2.a; c:= § 2.1.a; d = § 3.7

Question: B.004 [2.0 points, ½ point each] (6.0)

Identify each of the following actions as either a channel **CHECK**, a channel **TEST**, or a channel **CAL**ibration.

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 instrumentation channels ensuring they track together.

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

d. During a reactor shutdown you note a -80 second period on Nuclear Instrumentation.

Answer: B.004 a. = Test; b. = Check; c. = Cal; d. = Check
Reference: Technical Specification 1.3 Definitions, p. 2.

Question Deleted

~~Question: B.005 [1.0 points] (7.0)~~
~~Which ONE set of the readings for demineralizer inlet resistivity and exhaust filter Δp are BOTH within the normal range?~~
~~a. The sum of the deep does equivalent and the committed effective dose equivalent.~~
~~b. The dose that your whole body receives from sources outside the body.~~
~~c. The sum of the external deep dose and the organ dose.~~
~~d. The dose to a specific organ or tissue resulting from an intake of radioactive material.~~
~~Answer: B.005 a.~~
~~Reference: 10 CFR 20.1003 *Definitions*~~

Question: B.006 [2.0 points, ½ point each] (9.0)

Match the radiation reading from column A with its corresponding radiation area classification (per 10 CFR 20) listed in column B.

COLUMN A	COLUMN B
a. 10 mRem/hr	1. Unrestricted Area
b. 150 mRem/hr	2. Radiation Area
c. 10 Rem/hr	3. High Radiation Area
d. 550 Rem/hr	4. Very High Radiation Area

Answer: B.006 a. = 2; b. = 3; c. = 3; d. = 4
Reference: 10 CFR 20.1003, Definitions

Question: B.007 [1.0 point] (10.0)

Which ONE of the following evolutions **DOES NOT** require the presence of a licensed **SENIOR** reactor operator?

a. Recovery from an unplanned shutdown.
b. An unlicensed individual operating the reactor for training.
c. An unlicensed individual moving fuel within the core.
d. An initial startup.

Answer: B.007 b.
Reference: UWNR 001

Question: B.008 [1.0 point] (11.0)

How many hours per calendar quarter must you perform the functions of an RO or SRO to maintain an active RO or SRO license?

a. 2

b. 4

c. 8

d. 12

Answer: B.008 b.
Reference: 10CFR55.53(e).

Question: B.009 [1.0 point] (12.0)

Which ONE of the following Measuring Channels is required to be operable in ALL modes of operation per Technical Specifications?

a. Fuel Temperature

b. Log Power

c. Linear Power

d. Startup Count Rate

Answer: B.009 a.
Reference: Tech Spec 3.2.8 Table 3.2.8 - SAR 14-17

Question: B.010 [1.0 point] (13.0)

Which of the following states the immediate actions for a POOL Level annunciator during reactor operations?

a. SCRAM the reactor, initiate abnormal or emergency pool fill, and notify Police and Security of response.

b. Run in all control blades, notify Police and Security that laboratory is manned and corrective action is taking place.

c. SCRAM the reactor if automatic scram did not occur, notify Police and Security laboratory is manned and corrective action is taking place.

d. Determine the status of the pool level, if level is rapidly changing then SCRAM the reactor and notify Police and Security , otherwise investigate the cause of the change and restore the pool to normal level.

Answer: B.010 ~~b.~~ Per Facility comment correct answer is c.
Reference: UWNR 155

Question: B.011 [1.0 point] (14.0)

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.011 b.
Reference: Standard NRC Question re: "Half-Thickness and Tenth-Thickness"

Question: B.012 [1.0 point] (15.0)

Which ONE of the listed emergency classifications is the ONLY applicable at University of Wisconsin?

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

Answer: B.012 ~~a.~~Per Facility comment correct answer is d.
Reference: Emergency Plan, Table 2

Question: B.013 [1.0 point, ¼ each] (16.0)

Match the Federal Regulation chapter in column A with the requirements covered in column B.

Column A	Column B
a. 10 CFR 20	1. Operator Licenses
b. 10 CFR 50	2. Facility Licenses
c. 10 CFR 55	3. Radiation Protection
d. 10 CFR 73	4. Special Nuclear Material

Answer B.013 a. = 3; b. = 2; c. = 1; d. = 4
Reference: Facility License and 10 CFR Parts 20, 50, 55 and 73

Question: B.014 [1.0 point] (17.0)

A small source emits 2 MeV of gamma per disintegration and has a six-hour half-life. If it had a source strength of 4 Curies three hours ago, the gamma dose rate at 10 feet is:

a. 48 rem/hr

b. 34 rem/hr

c. 480 mrem/hr

d. 340 mrem/hr

Answer: B.014 d.
Reference: UWNR OTM, Misc III, UWNR OTM, Physics I, “Radiation Level”
$\lambda = \ln 2/T$ - $\lambda = \ln 2/(6\ hr)$ - $\lambda = 0.115525/hr$
Source strength now = A
$A = A_0 e^{-\lambda * t}$ - $A = (4Ci)*\exp(-0.115525/hr * 3hr)$ - $A = 2.83\ Ci$
Dose at one foot = 6*C*E = 6*(2.83 Ci)*(2MeV) = 33.96 R/hr or 34 R/hr
Dose at ten feet = $(1/10)^2$*dose at one foot = 34/100 = .340 R/hr = 340 mrem/hr

Question: B.015 [1.0 point] (18.0)

The dose rate 10 feet from a point source is 25 mrem/hour. If a person works for 1.5 hours at a distance of 3 feet from the source, the dose received will be:

a. 42 mrem/hr
b. 278 mrem/hr
c. 417 mrem/hr
d. 1.25 rem/hr

Answer: B.015 c.
Reference: UWNR OTM, Misc III, Section B, “Distance - Point Source”

Question: B.016 [1.0 point] (19.0)

The Emergency Response Kit is located in the …

a. Reactor Control Room

b. Reactor Directors Office

c. Police and Security dispatch center

d. Engineering Research Building Room B-130

Answer: B.016 b.
Reference: UWNR 006 - Section 8.0 par #1, page #6, and UWNR 150 Section E.4 page #3

Question: B.017 [1.0 point] (20.0)

Which of the following correctly identifies the level of authorization required for the type of experiment identified in the statement?

a. Routine experiments may be performed at the discretion of the reactor operator responsible for operation without further review or approval.

b. Modified routine experiments may be performed at the discretion of the senior operator responsible for operation, without further review or approval provided he/she makes a determination that the experiment hazards are neither nor significantly different from the corresponding routine experiment.

c. Modified routine experiments require a review and concurrence by the Reactor Supervisor, for determination that the experiment hazards are neither nor significantly different from the corresponding routine experiment, followed by final approval by the senior operator responsible for operation.

d. Special experiments require a review, by the Reactor Supervisor, to determine the effect on consequences of failure, including chemical reactions, physical integrity, cooling, and reactivity effects. The Reactor Safety Committee will review all favorable evaluations but does not have to approve performance of the experiment.

Answer: B.017 b.
Reference: UWNR Technical Specifications, Administrative Controls, Section 6.8

END OF SECTION B NORMAL/EMERGENCY PROCEDURES AND RADIOLOGICAL CONTROLS

Question: C.001 [2.0 points, $^1/_6$ each] (2.0)

Using the figure provided identify components A through L.

1. Beam Port #1
2. Beam Port #2
3. Beam Port #3
4. Beam Port #4
5. CIC #1
6. CIC #2
7. Fission Counter
8. Log N
9. Regulating Blade
10. Safety Blade #1
11. Safety Blade #2
12. Safety Blade #3

Diagram on the last page of this examination.

Answer: C.001 a. = 5; b. = 6; c. = 7; d. = 4; e. = 12; f. = 9;
g. = 3; h. = 11; I. = 10; j. = 8; k. = 2; l. = 1

Reference: Safety Analysis Report (SAR), (April, 1973), Figure 11, pg. 2-17.

Question: C.002 [1.0 point] (3.0)

The gas used to move pneumatic tube "rabbit" samples into and out of the reactor is …

a. H_2
b. Air
c. CO_2
d. N_2

Answer: C.002 c.
Reference: SAR § 2.4.4, 1st ¶, p. 2-41

Question: C.003 [1.0 point] (4.0)

A thermocouple operates on the principle that an electromotive force (EMF) is generated in a closed circuit if:

a. two similar metals when their junctions are at the same temperature.
b. two similar metals when their junctions are at different temperatures.
c. two dissimilar metals when their junctions are at the same temperature.
d. two dissimilar metals when their junctions are at different temperatures.

Answer: C.003 ~~b.~~ Per Facility comment correct answer is d.
Reference: UWNR OTM, Contols & Instrumentation VII, "Temperature Measurement"

Question: C.004 [2.0 points, ½each] (6.0)

Match the purification system functions in column A with the purification component listed in column B

Column A	Column B
a. remove floating dust, bug larvae, etc.	1. Demineralizer (Ion Exchanger)
b. remove dissolved impurities	2. Skimmer
c. remove suspended solids	3. Filter
d. maintain pH	

Answer: C.004 a.= 2; b. = 1; c. = 3; d. = 1
Reference: UWNR OTM, Reactor Water Systems I, Makeup and Recirculation Systems pp. 152 – 154 of 281.

Question: C.005 [2.0 points, ½each] (8.0)

When filling the pool, you have 4 options as listed below. Identify each of the options as either **n**ormal, **a**bnormal or **e**mergency methods for filling the reactor.

a. Distilled Water
b. Softened Water
c. Raw (city) water.
d. Raw (city) water, via nozzle at pool top.

Answer: C.005 a. = n; b. = a; c. = a; d. = e
Reference: UWNR OTM, Reactor Water Systems I, Makeup and Recirculation Systems, p. 153 of 281.

Question: C.006 [1.0 point] (9.0)

Which ONE of the following is the method used to minimize mechanical shock to the safety blades on a scram?

a. A small spring located at the bottom of the rod.

b. An electrical-mechanical brake energizes when the rod down limit switch is energized.

c. A piston enters a special dashpot as the rod reaches five inches of the fully inserted position.

d. An electromagnet energizes as the blade approaches the last few inches of travel slowing the decent of the blade.

Answer: C.006 c.
Reference: SAR § 2.2.1, pp. 2-16 – 2-19.

Question: C.007 [1.0 point] (10.0)

During reactor shutdown, you attempt to drive the fission chamber in, but it will not move. Which ONE of the following is the probable reason?

a. Count Rate < 120 cpm

b. Interlock switch in “Defeat” position.

c. Count Rate > 1×10^6 cpm

d. Any one of the control elements is in motion.

Answer: C.007 c.
Reference: OTM, Controls & Instrumentation I & II, pp. 3 of 9

Question: C.008 [1.0 point] (11.0)

Which ONE of the following is the actual design feature which prevents siphoning of pool water on a failure of the purification system?

a. A valve upstream of the primary pump will shut automatically.

b. A valve downstream of the primary pump will shut automatically.

c. The Emergency Fill system will automatically maintain pool level.

d. “Vacuum breaks” in the system, prevent draining the pool below the 1 foot from “full” line.

Answer: C.008 d.
Reference: OTM, Water Systems

Question: C.009 [1.0 point] (12.0)

Each shim/safety blades consists of a grooved,

a. stainless steel sheet.

b. boron-carbide sheet.

c. boral (boron and aluminum alloy) sheet.

d. aluminum sheet.

Answer: C.009 c.
Reference: SAR Chapter (new) 4 SAR § 2.1.5, p. 2-9 (old).

Question: C.010 [1.0 point] (13.0)

Which ONE of the following control elements can NOT be used for automatic control of the reactor?

a. #2 Shim Blade

b. Transient Rod

c. Regulating Blade

d. #3 Shim Blade

Answer: C.010 d.
Reference: UWNR OTM, Contols & Instrumentation V, Mode Switch

Question: C.011 [1.0 point] (14.0)

Given: Period and power level trips are bypassed, control element withdrawal is prohibited, HPVS current is limited and servo control is bypassed. Which ONE of the following is the MODE switch position?

a. Manual

b. Automatic

c. Pulse

d. Square Wave

Answer: C.011 c.
Reference: UWNR OTM, Contols & Instrumentation V, Mode Switch

Question: C.012 [1.0 point] (15.0)

Which ONE of the following is the actual method used to determine safety blade position?

a. As the rod moves up and down, the magnet opens and closes a series of over 1000 limits switches which generate a signal which is converted to rod position.

b. A logic circuit receives input from two sensors which count 100 pulses per revolution along with detecting direction, converting these signals to rod position.

c. As the rod moves, it move into or out of a coil, generating a signal proportional to rod position.

d. A potentiometer, driven by the rod drive motor, generates a signal proportional to rod position.

Answer: C.012 d.
Reference: SAR Chapter 4 (new) SAR § 2.2.1, pp. 2-16 – 2-19 (old).

Question: C.013 [1.0 point] (16.0)

Which ONE of the following methods is used to compensate for gamma radiation in a Compensated Ion Chamber?

a. Pulses smaller than a pre-set height (voltage) are stopped by a pulse-height discriminator circuit from entering the instrument channel's log diode pump circuit.

b. The chamber contains concentric tubes one of which detects both neutrons and gammas the other only gammas, are wired electronically to subtract the gamma signal, leaving only the signal due to neutrons.

c. The signal travels through a Resistance-Capacitance (RC) circuit, converting the signal to a power change per time period effectively deleting the signal due to gammas.

d. A compensating voltage equal to a predetermined "source gamma level" is fed into the pre-amplifier electronically removing source gammas from the signal. Fission gammas are proportional to reactor power and therefore not compensated for.

Answer: C.013 b.
Reference: OTM, Controls & Instrumentation I & II, page 4 of 8

Question: C.014 [1.0 point] (17.0)

The high count rate alarm on the startup channel is provided to …

a. prevent detector damage from high neutron fluxes.

b. prevent control element withdrawal when count rate is too high.

c. provide warning of high power level before the scram point is reached.

d. provide automatic withdrawal of the drive when count rate is off range.

Answer: C.014 a.
Reference: UWNR OTM, Contols & Instrumentation I & II, "log Count Rate - Fission Counter Drive"

Question: C.015 [2.0 points, 0.5 each] (19.0)

Match the four area radiation monitors which can cause a building evacuation, in column A, with their respective setpoints, in column B. (Each detector has only one setpoint. Setpoints may be used more than once or not at all.)

	Column A	Column B
a.	Demineralizer	10 mr/hr
b.	Reactor Bridge	30 mr/hr
c.	Thermal Column Door	50 mr/hr
d.	Console	70 mr/hr
		90 mr/hr

Answer: C.015 a. = 90; b. = 50; c. = 10; d. = 10
Reference: UWNR OTM, Contols & Instrumentation VI, “Area Radiation Monitors

Question: C.016 [2.00 point, 0.5 each] (21.0)

Match the following abnormal alarm condition with the appropriate alarm status on the Panalarm Annunciator.

	Alarm Condition	Alarm Status
a.	condition initiates	1. annunciator extinguished
b.	condition acknowledged	2. annunciator, slow flash
c.	condition corrected	3. annunciator, flashes rapidly
d.	condition reset	4. audible signal silences

Answer: C.016 a. = 3; b. = 4; c. = 2; d. = 1
Reference: SAR 7.6 page 7-12

*****END OF SECTION C FACILITY AND RADIATION MONITORING SYSTEMS*****

*******END OF EXAMINATION*******

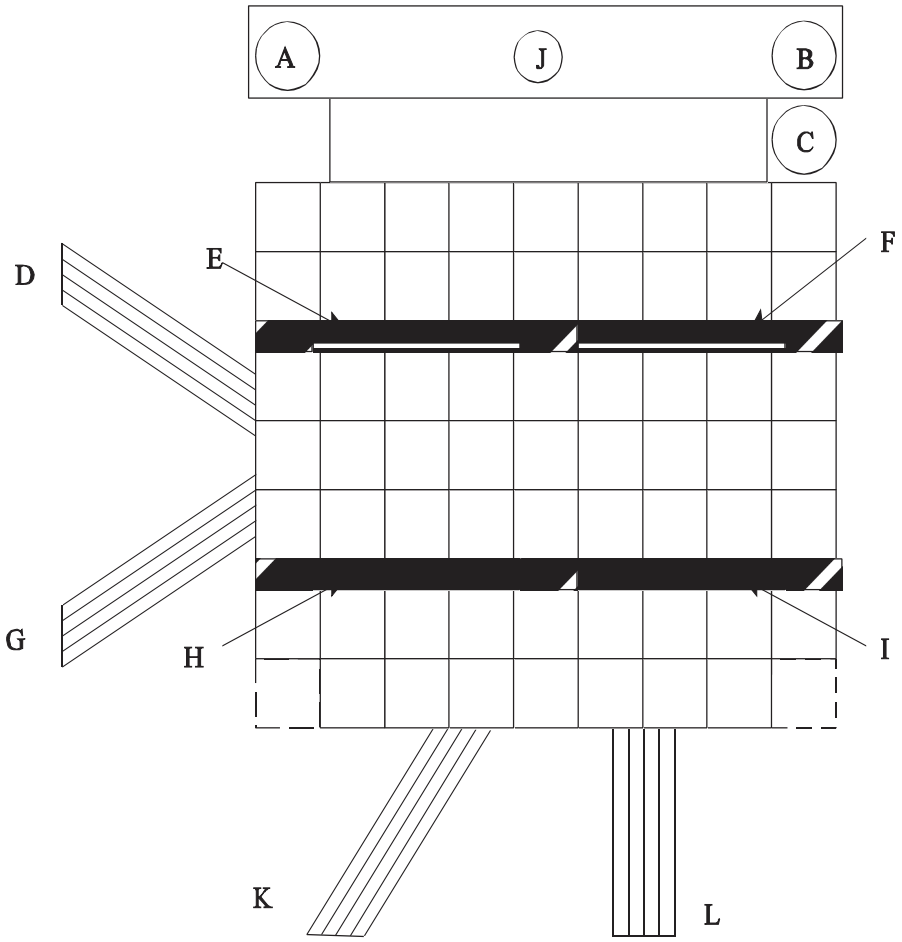

Figure 1