April 24, 2012

Mr. Robert J. Agasie, Reactor Director
Nuclear Reactor Laboratory
University of Wisconsin-Madison
1513 University Avenue, Room 1209
Madison, WI 53706

SUBJECT: EXAMINATION REPORT NO. 50-156/OL-12-01, UNIVERSITY OF WISCONSIN

Dear Mr. Agasie:

During the week of April 2, 2012, the NRC administered operator licensing examinations at your University of Wisconsin reactor facility. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip T. Young at (301) 415-4094 or via internet e-mail phillip.young@nrc.gov.

Sincerely,

/RA/

Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-156

Enclosures:
1. Initial Examination Report No. 50-156/OL-12-01
2. Facility comments with NRC resolution
3. Written Examination and answer key

cc w/o enclosures: See next page

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DISTRIBUTION w/ encls.:
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RidsNRRDPRPRTB Facility File (CRevelle) O-7 F-08

ADAMS ACCESSION #: ML12107S037 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung		CRevelle		JEads	
DATE	4/17/2012		4/ 16/2012		4/ 24/2012	

OFFICIAL RECORD COPY

cc:

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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

REPORT NO.: 50-156/OL-12-01

FACILITY DOCKET NO.: 50-156

FACILITY LICENSE NO.: R-74

FACILITY: University of Wisconsin

EXAMINATION DATES: April 3 and 4, 2012

SUBMITTED BY: **/RA/** 4/12/2012
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of April 2, 2012 the NRC administered a licensing examination to two Reactor Operator applicants. Both applicants passed all portions of the the examination.

REPORT DETAILS

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

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	2/0	0/0	2/0
Operating Tests	2/0	0/0	2/0
Overall	2/0	0/0	2/0

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

At the conclusion of the examinations the chief examiner thanked the facility for their support during the examinations. The Reactor Director provided preliminary comments on the written examination, with final comments to be forwarded via e-mail.

ENCLOSURE 1

FACILITY COMMENTS WITH NRC RESOLUTION

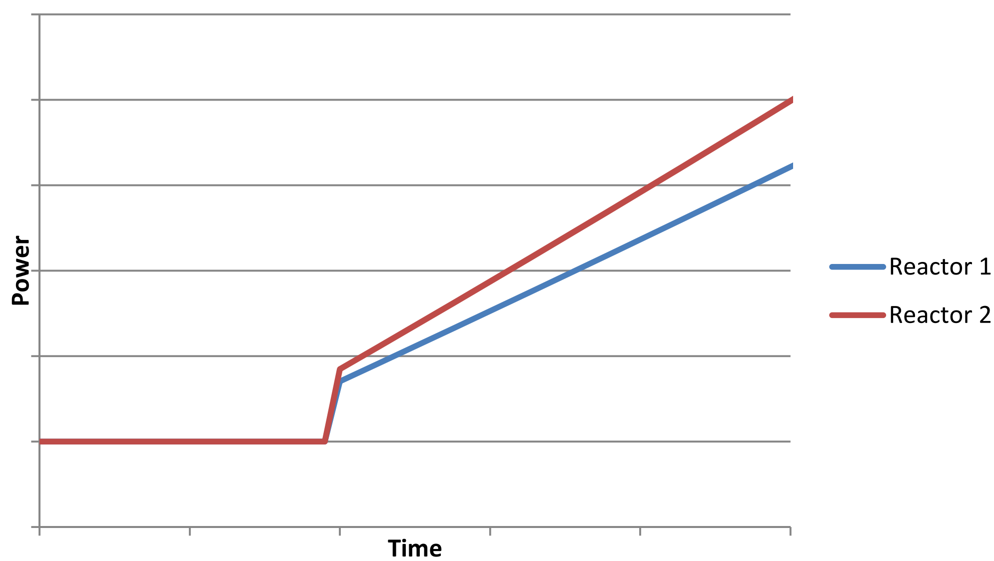
Question A.003
Comment and Justification: There are two correct answers. The answer key identifies D as the correct answer but B is also correct. Nuclear Reactor Analysis by James J. Duderstadt and Louis J. Hamilton, published by John Wiley & Sons, 1976, page 250-251, describes the prompt jump approximation to a step change in reactivity. The response of a reactor to a step change in reactivity will be an initial rapid transient on a time scale characteristic of the prompt neutron lifetime followed by a more slowly varying response governed by the delayed neutron behavior. Since the delayed neutron production cannot respond immediately to a step change of reactivity, the prompt jump approximation predicts that a reactivity jump from ρ_1 to ρ_2 causes an instantaneous change in reactor power from P_1 to P_2 given by

$$\frac{P_2}{P_1} = \frac{\beta - \rho_1}{\beta - \rho_2}$$

Assuming the reactor is exactly critical at P_1 then $\rho_1 = 0$ and the expression is simplified to

$$\frac{P_2}{P_1} = \frac{\beta}{\beta - \rho}$$

As a result, not only will Reactor 2 will have a shorter period and increase reactor power more quickly, but its prompt jump will be greater. Therefore at any point in time Reactor 2's power will be higher.



NRC Resolution: Comment accepted. The answer key is changed to reflect either answer 'b' or 'd' as correct answers.

ENCLOSURE 2

Question A.009
Comment and Justification: The answer key is incorrect. The correct answer is C. The question indicates the primary coolant temperature coefficient is positive. As a result, an increase in coolant temperature will add positive reactivity. Therefore the rod must add negative compensating reactivity or insert.

NRC Resolution: Comment accepted. The answer key is changed to reflect answer 'c' as the correct answer.

Question B.004
Comment and Justification: The units are incorrect. The correct units should be mrem.

NRC Resolution: Comment accepted. The answer key is changed to reflect the correct units.

Question B.006
Comment and Justification: There are no correct answers. Answers a, b, and c are permissible. There is no technical specification governing the reactivity worth of a single experiment. There is a technical specification that governs the worth of any single secured experiment and the sum of the absolute values of the reactivity worths of all non-secured experiments.

NRC Resolution: Comment accepted. The answer key is changed to reflect this question as deleted from this examination.

Question B.009
Comment and Justification: The facility objects to the use of the term "cognizance tags" as this term in not used in any facility procedure including the referenced UWNR 001 Standing Operating Instructions.

NRC Resolution: Comment accepted. The term "cognizance tags" was used in an attempt to differentiate between "SRO Only" tags and "Non-SRO Only" tags. The question will be re-written prior to next use.

Question B.011
Comment and Justification: There are no correct answers. According to technical specifications the term "cold critical condition" means that the reactor is critical in the reference core condition. The reference core condition is defined as when the fuel and bulk water temperature are at ambient conditions and the reactor is xenon free.

NRC Resolution: Comment accepted. The answer key is changed to reflect this question as deleted from this examination.

Question B.013
Comment and Justification: In accordance with the UWNR 004 University of Wisconsin Nuclear Reactor Operator Proficiency Maintenance Program, the written requalification exam is required annually and the operating requalification exam is required quarterly. Because the UWNR 004 University of Wisconsin Nuclear Reactor Operator Proficiency Maintenance Program is an NRC approved program in accordance with 10 CFR 55 the candidates are expected to know and comply with it. Therefore, the following considerations should be given. There are two correct answers to question Column A.c, either Column B.1, 1 year, reference UWNR 004 or B.2, 2 years, reference 10 CFR 55. Consideration to deleting question Column A.d should be given, for no correct answer, reference UWNR 004.

NRC Resolution: Comment accepted. Answer B.013A.c is changed to reflect either '1' or '2' as correct answers and section B.013d is deleted from the examination.

Question B.020
Comment and Justification: The facility objects to this question in that it requires memorization of procedures. The basis of this question is to determine the candidate's knowledge of thermodynamics and the concept of volumetric expansion of water. However, memorization of procedural guidance of 1 inch +/- 0.5 inches is inappropriate.

NRC Resolution: NRC agrees that the banding of the answer choices is to tightly grouped. The question is designed to probe general knowledge of the subject area not specific details at this level. The question will be reworded prior to reuse.

Question C.006
Comment and Justification: This question uses terminology that is inconsistent with the ventilation system. The ventilation system consists of one operating exhaust fan in NORMAL MODE and two operating exhaust fans in EMERGENCY VENTING MODE (EVM). The use of the terms room exhaust fan and emergency exhaust fan are inconsistent with the description of the facility.

NRC Resolution: NRC agrees that the choice of wording was not accurate. The question will be reworded prior to reuse.

Question C.009
Comment and Justification: Following a facility modification, the automatic sounding of the evacuation alarm now occurs after 180 seconds after an area radiation monitor reaches the high setpoint.

NRC Resolution: NRC agrees that the question does not reflect the latest delay time interval. The question will be reworded prior to reuse.

Question C.011
Comment and Justification: Delete question. This question does not describe our facility.

NRC Resolution: NRC agrees. The question is deleted from this and future examinations.

Question C.014
Comment and Justification: Delete question. This question does not describe our facility.

NRC Resolution: NRC agrees. The question is deleted from this and future examinations.

Question C.016
Comment and Justification: To be precise, the “magnet engaged” light will illuminate only if the limit switch within the scram magnet closes AND current is provided to the electromagnet. Closure of the switch alone is insufficient to illuminate the “magnet engaged” light.

NRC Resolution: NRC agrees that the choice of wording was not accurate. The question will be reworded prior to reuse.

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER INITIAL REACTOR LICENSE EXAMINATION

FACILITY: University of Wisconsin

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 04/03/2012

CANDIDATE: ______________________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	% of Candidates Score	Category Value		Category
20.00	33.3	______	____	A.	Reactor Theory, Thermodynamics and Facility Operating Characteristics
18.75	33.3	______	____	B.	Normal and Emergency Operating Procedures and Radiological Controls
16.00	33.3	______	____	C.	Facility and Radiation Monitoring Systems
54.75		______	____% FINAL GRADE		TOTALS

All work done on this examination is my own. I have neither given nor received aid.

____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil <u>only</u> to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

EQUATION SHEET's

$$\dot{Q} = \dot{m}c_p\,\Delta T = \dot{m}\,\Delta H = UA\,\Delta T$$

$$P_{\max} = \frac{(\rho-\beta)^2}{2\alpha(k)\ell}$$

$$\ell^* = 1\ x\ 10^{-4}\ seconds$$

$$\lambda_{eff} = 0.1\ seconds^{-1}$$

$$SCR = \frac{S}{-\rho} \approx \frac{S}{1-K_{eff}}$$

$$CR_1(1-K_{eff_1}) = CR_2(1-K_{eff_2})$$
$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

$$SUR = 26.06\left[\frac{\lambda_{eff}\rho}{\beta-\rho}\right]$$

$$M = \frac{1-K_{eff_0}}{1-K_{eff_1}}$$

$$M = \frac{1}{1-K_{eff}} = \frac{CR_1}{CR_2}$$

$$P = P_0\ 10^{SUR(t)}$$

$$P = P_0\ e^{\frac{t}{T}}$$

$$P = \frac{\beta(1-\rho)}{\beta-\rho}\ P_0$$

$$SDM = \frac{(1-K_{eff})}{K_{eff}}$$

EQUATION SHEET's

$$T = \frac{\ell^*}{\rho - \bar{\beta}}$$

$$T = \frac{\ell^*}{\rho} + \left[\frac{\bar{\beta} - \rho}{\lambda_{eff}\rho}\right]$$

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1} \times K_{eff_2}}$$

$$T_{½} = \frac{0.693}{\lambda}$$

$$\rho = \frac{(K_{eff} - 1)}{K_{eff}}$$

$$DR = DR_0 \; e^{-\lambda t}$$

$$DR = \frac{6CiE(n)}{R^2}$$

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

EQUATION SHEET's

DR – Rem, Ci – curies, E – Mev, R – feet

1 Curie = 3.7×10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54×10^{3} BTU/hr

1 Mw = 3.41×10^{6} BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5°C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_P = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.001 [1.0 point] {1.0}

A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur with the same number of elements loaded as if there were no change in the initial count rate.

b. criticality will occur earlier (i.e., with fewer elements loaded.)

c. criticality will occur later (i.e., with more elements loaded.)

d. criticality will be completely unpredictable.

Answer: A.01 a.
Reference: UWNR Operator Training Manual, Reactor Physics IV, Critical Experiment.

Question: A.002 [1.0 point] {2.0}

A reactor is critical at 18.1 inches on a controlling rod. The controlling rod is withdrawn to 18.4 inches. The reactivity inserted is 14.4 cents. What is the differential rod worth?

a. 14.4 cents/inch at 18.25 inches.

b. 48 cents/inch at 18.25 inches.

c. 48 cents/inch at 18.4 inches.

d. 14.4 cents/inch only between 18.1 and 18.4 inches.

Answer: A.02 b.
Reference: UWNR Operator Training Manual, Reactor Physics IV, Control Rod Calibration. $\Delta\rho$ = 14.4 cents; Δx = 18.4 - 18.1 = 0.3 inches; $\Delta\rho/\Delta x$ = 48 cents/inch at the midpoint (18.25 inches).

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.003 [1.0 point] {3.0}

Two critical reactors at low power are identical except that Reactor 1 has a beta fraction of 0.0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors. Which ONE of the following will be the response of Reactor 2 compared to Reactor 1?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be longer.

d. The resulting period will be shorter.

Answer: A.03 b. or d. Answer b. added per facility comment
Reference: Equation Sheet. $\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$

Question: A.004 [1.0 point] {4.0}

Which ONE of the following describes the response of the subcritical reactor to equal insertions of positive reactivity as the reactor approaches critical? Each reactivity insertion causes:

a. a SMALLER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

b. a LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

c. a SMALLER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

d. a LARGER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

Answer: A.04 b.
Reference: UWNR Operator Training Manual, Reactor Physics IV, Critical Experiment.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.005 [1.0 point] {5.0}
During the neutron cycle from one generation to the next, several processes occur that may increase or decrease the available number of neutrons. Which ONE of the following factors describes an INCREASE in the number of neutrons during the cycle?

a. Thermal utilization factor.

b. Fast fission factor.

c. Thermal non-leakage probability.

d. Resonance escape probability.

Answer: A.05 b.
Reference: UWNR Operator Training Manual, Reactor Physics I.

Question: A.006 [1.0 point] {6.0}
The effective neutron multiplication factor, K_{eff}, is defined as:

a. absorption/(production + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. production/(absorption + leakage)

Answer: A.06 d.
Reference: UWNR Operator Training Manual, Reactor Physics I.

Question: A.007 [1.0 point] {7.0}
Which ONE of the following parameter changes will require control rod INSERTION to maintain constant power level following the change?

a. Removal of an experiment containing cadmium.

b. Insertion of a void into the core.

c. Pool water temperature decrease.

d. Buildup of samarium in the core.

Answer: A.07 a.
Reference: Insertion of a control rod inserts negative reactivity to balance the positive reactivity added when removing a neutron absorber. All other answers add negative reactivity.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.008 [1.0 point] {8.0}

Which ONE of the following is the time period during which the MAXIMUM amount of Xenon-135 will be present in the core?

a. 8 to 10 hours after a startup to 100% power.

b. 8 to 10 hours after shutdown from 100% power.

c. 4 to 6 hours after a power decrease from 100% to 50%.

d. 4 to 6 hours after a power increase from 50% to 100%.

Answer: A.08 b.
Reference: UWNR Operator Training Manual, Reactor Physics I.

Question: A.009 [1.0 point] {9.0}

The reactor is operating in the automatic mode at 50% power. A problem in the secondary cooling system causes the primary coolant temperature to increase by 5 degrees F. Given that the primary coolant temperature coefficient is 7.0×10^{-5} Δ k/k/deg. F and the differential rod worth of the regulating rod is 8.75×10^{-5} Δk/k/inch, the change in the position of the regulating rod will be:

a. eight (8) inches inserted.

b. eight (8) inches withdrawn.

c. four (4) inches inserted.

d. four (4) inches withdrawn.

Answer: A.09 ~~d.~~ c. Answer changed to c.per facility comment
Reference: UWNR Operator Training Manual, Reactor Physics II. Since coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdraw. (5 deg. F)x(7×10^{-5} delta k/k/deg. F) / (8.75×10^{-5} delta k/k/inch) = 4 inches.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.010 [1.0 point] {10.0}
Reactor period is at 26 seconds. How long will it take to increase power from 10 kilowatts to 100 kilowatts?

a. 10 seconds

b. 1 minute

c. 10 minutes

d. 1 hour

Answer: A.10 b.
Reference: *Math and Physics,* p. 12

Question: A.011 [1.0 point] {11.0}
Which ONE of the following is an example of alpha (α) 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.11 a.
Reference: NEEP 234, *Physics I,* p. 23

Question: A.012 [1.0 point] {12.0}
K_{eff} for the reactor is 0.95. What is the shutdown margin for this condition? (I am NOT looking for Technical Specification definition)

a. 5.00% ΔK/K

b. 5.26% ΔK/K

c. 5.00%

d. 5.26%

Answer: A.12 b. $SDM = (1 - K_{eff})/K_{eff} = (1 - 0.95)/0.95 = 0.05/0.95 = 0.0526$
Reference: NEEP 234, *Reactor Physics II,* p. 102

Question: A.013 [1.0 point] {13.0}
The reactor had a shutdown margin of 1.75% Δk/k, and a source range count rate of 15 counts per minute. After placing samples in the reactor the count rate increased to 30 counts per minute. What is the worth of the sample?

a. -0.44%Δk/k

b. +0.44%Δk/k

c. -0.88%Δk/k

d. +0.88%Δk/k

Answer: A.13 d.
Reference: SDM = 1.75% Δk/k = 0.0175 Δk/k K_{eff} = 1/(1.0175) = 0.9828
$1 - K_{eff2} = (1 - K_{eff1}) \times CR_1/CR_2 \rightarrow K_{eff2} = 1 - [(1 - K_{eff1})CR_1/CR_2]$
$K_{eff2} = 1 - [(1 - 0.9828) \times ½] = 1 - [0.0172 \times 0.5] = 1 - 0.0086 = 0.9914$
$\rho = (0.9828 - 0.9914)/(0.9828 \times 0.9914) = 0.008826$ Δk/k = +0.883% Δk/k

Question: A.014 [1.0 point] {14.0}
The main source of heat in the reactor one hour after shutdown is due to:

a. Decay of fission products

b. Fission due to delayed neutrons

c. Spontaneous fission within the core

d. Decay of radioactive structural materials

Answer: A.14 a.
Reference: NEEP 234, *Reactor Physics III,* p. 113.

Question: A.015 [1.0 point] {15.0}
For U^{235}, the thermal fission cross-section is 582 barns, and the capture cross-section is 99 barns. When a thermal neutron is absorbed by U^{235}, the probability that a fission will occur is:

a. 0.146

b. 0.170

c. 0.830

d. 0.855

Answer: A.15 d.
Reference: NEEP 234, p. 86 (Scope)

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.016 [1.0 point] {16.0}
Which ONE of the following factors is the most significant in determining the differential worth of a control rod?

a. The rod speed.

b. Reactor power.

c. The flux shape.

d. The amount of fuel in the core.

Answer: A.16 c.
Reference: Standard NRC Question.

Question: A.017 [1.0 point] {17.0}
When performing rod calibrations, many facilities pull the rod out a given increment, then measure the time for reactor power to double (doubling time), then calculate the reactor period. If the doubling time is 42 seconds, what is the reactor period?

a. 29 sec

b. 42 sec

c. 61 sec

d. 84 sec

Answer: A.17 c.
Reference: NEEP 234, *Reactor Physics III,* p. 103

Question: A.018 [1.0 point, 0.25 each] {18.0}
Match each type of neutron 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.18 a. = 2; b. = 4; c. = 1; d. = 3
Reference: NEEP 234, p. 87.

Question: A.019 [1.0 point] {19.0}
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.19 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.020 [1.0 point] {20.0}
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.20 d.
Reference: NEEP 234, pp. 112−114.

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.001 [1.00 point] {1.0}
Which ONE of the following would be classified as an UNUSUAL EVENT in accordance with the Emergency Plan?

a. Sample spill
b. Bomb threat over the telephone
c. Personnel injury with involvement of radiation
d. Severe fuel clad leak approaching MCA size, with pool near empty and ventilation system inoperative

Answer: B.01 b.
Reference: UWNR Procedure 006 Rev. 7, Table 2

Question: B.002 [1.00 point] {2.0}
Which ONE statement below describes the reason for the Safety Limit applicable to fuel temperature?

a. High fuel temperature could result in clad melt.
b. Excessive gas pressure may result in loss of fuel cladding integrity.
c. High fuel temperature combined with lack of adequate cooling could result in fuel melt.
d. Excessive hydrogen produced as a result of the zirconium-water reaction is potentially explosive.

Answer: A.02 b.
Reference: UWNR Technical Specifications, Section 2.1.

Question: B.003 [1.00 point] {3.0}
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.03 b.
Reference: UWNR 006 - Section 8.0 par #1, page #6, and UWNR 150 Section E.4 pg #3

Question: B.004 [1.00 point] {4.0}
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.04 c. Units of measure in answer choices changed per facility comment.
Reference: UWNR OTM, Misc III, Section B, "Distance - Point Source"

Question: B.005 [1.00 point] {5.0}
In accordance with the Technical Specifications, when is the reactor shutdown?

a. When it is subcritical by at least 0.7% delta k/k
b. When it is subcritical by at least 0.7% delta k/k with the highest worth rod withdrawn
c. When it is subcritical by at least 0.2% delta k/k
d. When it is subcritical by at least 0.2% delta k/k with the highest worth rod withdrawn

Answer: B.05 a.
Reference: UWNR Technical Specifications, Section 1.1

Question deleted per facility comment.
~~**Question**: B.006 [1.00 point] {6.0}~~
~~In accordance with the Technical Specifications, which ONE situation below is NOT permissible when the reactor is operating?~~
~~a. Scram time of a control rod = 1 second~~
~~b. A reactivity insertion during pulse operation = 1.3% delta k/k~~
~~c. An experiment containing 15 milligrams of explosive material.~~
~~d. Reactivity worth of a single experiment = 1.4% delta k/k~~
~~Answer: B.06 d.~~
~~Reference: UWNR Technical Specifications, Section 3.6.b~~

Question: B.007 [1.00 point] {7.0}
Which Safety System channels are required to be operable in all modes of operation?

a. fuel element temperature, reactor power level, manual pushbutton

b. log count rate, fuel element temperature, reactor power level

c. fuel element temperature, pool water level, high voltage monitor

d. manual pushbutton, pool water level, reactor power level

Answer: B.07 c.
Reference: UWNR Technical Specifications, Section 3.2.4, Table 3.2.4

Question: B.008 [1.00 point] {8.0}
In the event of an evacuation, where should personnel (**non** reactor staff/emergency response personnel) be directed to proceed?

a. Emergency Support Center (Reactor Director's office)

b. Mechanical Engineering Building lobby

c. Mechanical Engineering Central Shop

d. Parking Lot 17

Answer: B.08 b.
Reference: UWNR Procedure 006, Page 6.

Question: B.009 [1.00 point] {9.0}
Equipment that is tagged with “Do Not Operate” tags (~~other than cognizance tags~~ prior to next use find other words to differentiate from “SRO Only” tags) may be operated with the approval of the:

a. Reactor Director.

b. Reactor Operator.

c. Reactor Supervisor.

d. Individual who signed the tag.

Answer: B.09 d.
Reference: UWNR 001 – Standing Operating Instructions – Rev 14

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.010 [1.00 point] {10.0}
There is indication that the pool may be leaking. The reactor operator should immediately:

a. secure the reactor.

b. sound the evacuation alarm.

c. attempt to locate and seal the leak.

d. attempt to maintain level by auxiliary fill means.

Answer: B.10 a.
Reference: UWNR Procedure 151, Page 2.

Question deleted per facility comment.

~~**Question**: B.011 [1.00 point] {11.0}~~
~~In accordance with the Technical Specifications, the term "cold critical condition" means that:~~

~~a. the reactor is critical and xenon-free.~~
~~b. the reactor is critical and the core does not contain any experiments.~~
~~c. the reactor is xenon-free and both fuel and bulk water temperatures are below 125 degrees F.~~
~~d. the reactor is critical, xenon free and both fuel and bulk water temperatures are below 125 degrees F.~~

~~Answer: B.11 d.~~
~~Reference: UWNR Technical Specifications, Section 1.3.~~

Question: B.012 [1.00 point] {12.0}
A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. There is, however, a small source which results in 10 mrem/hr at one (1) meter. Which ONE of the following defines the posting requirements for the area in accordance with 10CFR20?

a. Caution - Airborne Radioactive Area.

b. Caution - Radiation Area.

c. Caution - High Radiation Area.

d. Caution - Radioactive Materials.

Answer: B.12 c.
Reference: UWNR Operator Training Manual, Health Physics I & II.
10 mrem/hr. at 100 cm. -> 111.1 mrem/hr. at 30 cm.

Question: B.013 [1.00 point, ~~0.25~~ 0.333 each] {13.0}
For an actively licensed operator, match the requirements listed in Column A with the correct time period from Column B. Column B answers may be used once, more than once, or not at all.

Column A	Column B
a. License expiration.	1. 1 year
b. Medical examination.	2. 2 years
c. Requalification written examination.	3. 4 years
d. Requalification operating test.	4. 6 years

Answer: B.13 a, = 4; b, = 2; c, = 2 or 1; ~~d, = 1~~ answers key changed to reflect facility comments
Reference: 10 CFR Part 55.

Question: B.014 [1.00 point] {14.0}
Two point sources have the same curie strength. Source A's gammas have an energy of 1 Mev, whereas Source B's gammas have an energy of 2 Mev. You obtain a reading from the same GM tube 10 feet from each source. Concerning the two readings, which ONE of the following statements is correct?

a. The reading from source B is four times that of Source A.
b. The reading from Source B is twice that of Source A.
c. Both readings are the same.
d. The reading from Source B is half that of Source A.

Answer: B.14 c.
Reference: UWNR Operator Training Manual, Health Physics III.

Question: B.015 [1.00 point] {15.0}
Which ONE of the following is the 10 CFR 20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)**?

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.15 a.
Reference: 10 CFR 20.1003 *Definititions*

Question: B.016 [1.00 point] {16.0}
Which ONE of the following operations requires the presence of a licensed SENIOR reactor operator?

a. operation for a planned shutdown.
b. any time a key is in the key switch.
c. recovery from an unplanned shutdown.
d. irradiation of an approved modified routine experiment.

Answer: B.16 c.
Reference: UWNR 001, page 1, items 1 & 2.

Question: B.017 [1.00 point] {17.0}
During an emergency, the lowest level of staff, by title, who may authorize receipt of radiation exposures, including delegation of responsibility if applicable, in excess of 10 CFR 20 occupational limits (according to the Emergency Plan) is the …

a. Reactor Director.
b. Reactor Supervisor.
c. most senior Senior Operator licensed individual present.
d. most senior Operator licensed individual present.

Answer: B.17 d.
Reference: UWNR 006 Section 3.1 & Table 1

Question: B.018 [1.00 point] {18.0}
An Emergency Action Level is:

a. a condition which calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

b. a class of accidents for which predetermined emergency measures should be taken or considered.

c. a procedure that details the implementation actions and methods required to achieve the objectives of the emergency plan.

d. a specific instrument reading or observation which may be used as a threshold for initiating appropriate emergency procedures.

Answer: B.018 d.
Reference: UWNR Procedure 006.

Question: B.019 [1.00 point] {19.0}
According to UWNR Standing Orders, which of the following is a responsibility of a Reactor Operator?

a. Evaluating initial experiments

b. SCRAM or evacuate the area without waiting for supervisor approval

c. Placing the reactor control system in Automatic when making major changes in reactor power level

d. Performing reactor building (e.g., reactor bridge) checks every 4 hours for reactor operations extending more than 8 hours

Answer: B.19 b.
Reference: UWNR 001, pg. 2

Question: B.020 [1.00 point] {20.0}
The pool level is low and the pools need to have water added. According to UWNR Procedure 105, Procedure for Filling Pool From Storage Tanks, how much room should be reserved for expansion of the pool water during reactor operation?

a. ½ inch

b. ¾ inch

c. 1 inch

d. 1½ inches

Answer: B.20 c.
Reference: UWNR Procedure 105 Rev. 9
Per facility comment banding of answers is too close together, requiring memory of specific procedure steps rather than knowledge of the impact of pool swell due to heat. Enlarge the range of answer choices.

Section C Facility and Radiation Monitoring Systems

Question: C.001 [1.0 point] {1.0}
The output of the Log Count Rate Channel provides the signal:

a. for the period circuit

b. for the Safety Channels

c. to the Automatic Control Channel

d. for Safety Blade interlocks

Answer: C.01 d.
Reference: UWNR Operator Training Manual, Controls and Instrumentation I and II.

Question: C.002 [1.0 point] {2.0}
When the Stack Air Monitor alarms, which ONE of the following occurs?

a. The reactor scrams

b. The building exhaust fans are turned off

c. Building evacuation alarm sounds after 20 second delay

d. No action occurs

Answer: C.02 d.
Reference: UWNR Operator Training Manual, Controls and Instrumentation VI.

Question: C.003 [1.0 point] {3.0}
Why are holes drilled into the suction and discharge piping, in the pool, of the primary coolant system are designed to ______________ ?

a. prevent scum buildup on the pool surface.

b. delay N^{16} isotope rise to the surface of the pool.

c. prevent a loss of pool inventory upon a primary loop pipe break.

d. provide a homogeneous mixture for circulation through the heat exchanger.

Answer: C.03 c.
Reference: NEEP 234 pages 160 - 162 & SAR pages 5-1 to 5-5

Section C Facility and Radiation Monitoring Systems

Question: C.004 [1.0 point] {4.0}
Which ONE of the following will result in a transient rod fire inhibit?

a. Fission chamber count rate < 2 CPS

b. Reactor power = 500 watts

c. Fission chamber in motion

d. Picoammeter on 1000 watt range

Answer: C.04 D.
Reference: UWNR Operator Training Manual, Controls and Instrumentation V.

Question: C.005 [1.0 point] {5.0}
Which statement is true when operating the Pneumatic Tube in the Manual mode?

a. Two rabbits may be run in the tube, whereas only one rabbit may be run in the Automatic mode

b. The rabbit will automatically return after 20 minutes

c. The rabbit will remain in the core indefinitely

d. The "Emergency Return" will initiate after 30 minutes

Answer: C.05 c.
Reference: UWNR Procedure 132

Question: C.006 [1.0 point] {6.0}
How does the ventilation system respond upon receipt of a high radiation alarm from the Stack Air Monitor?

a. The room exhaust fan continues to operate, while the emergency exhaust fan must be manually started.

b. The room exhaust fan stops and the emergency exhaust fan automatically starts, taking a suction on the Reactor Laboratory.

c. The room exhaust fan stops and the emergency exhaust fan automatically starts, taking a suction on outside air to dilute the stack exhaust.

d. The room exhaust fan stops, while the emergency exhaust fan must be manually started.

Answer: C.06 a.
Reference: UWNR SAR, Page 3-32
Prior to next use reword to reflect correct terminology.

Question: C.007 [1.0 point, 0.25 EACH] {7.0}
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.07 a. = 3; b. = 4; c. = 2; d. = 1
Reference: SAR 7.6 page 7-12

Question: C.008 [1.0 point] {8.0}
Which ONE of the following conditions will NOT result in a reactor scram (either relay or electronic)?

a. Pool water level 18 feet above top of core
b. Loss of high voltage supply power to gamma power level detector
c. Fuel temperature = 400 deg Fahrenheit
d. Power = 125%

Answer: C.08 c.
Reference: UWNR Technical Specifications, Section 3.3.3

Question: C.009 [1.0 point] {9.0}
When the Pool Top area radiation monitor reaches the HIGH setpoint, which ONE of following occurs (assuming no operator action)?

a. An evacuation alarm sounds after ~~20~~ 180 seconds.
b. The reactor scrams.
c. The building exhaust fan is turned off.
d. The emergency exhaust fan is turned on.

Answer: C.09 a.
Reference: UWNR Operator Training Manual, Controls and Instrumentation VI.
Choice a. changed to reflect current time delay per recent modification.

Question: C.010 [1.0 point] {10.0}
Primary system flow rate is measured using an orifice plate installed:

a. at the suction of the primary cooling pump.

b. at the outlet of the heat exchanger.

c. at the discharge of the primary cooling pump.

d. at the inlet to the heat exchanger.

Answer: C.10 b.
Reference: UWNR Operator Training Manual, Reactor Water Systems IV.

Question deleted per facility comment.

~~**Question**: C.011 [1.0 point] {11.0}~~
~~When 18 pounds of air pressure is applied to the heat exchanger control valve actuator, the valve:~~

~~a. moves to full open, providing full flow to the heat exchanger.~~
~~b. moves to full open, with flow bypassing the heat exchanger.~~
~~c. moves to full closed, providing full flow to the heat exchanger.~~
~~d. moves to full closed, with flow bypassing the heat exchanger.~~

~~Answer: C.11 a.~~
~~Reference: UWNR Operator Training Manual, Reactor Water Systems IV.~~

Question: C.012 [1.0 point] {12.0}
Which ONE of the following statements is true regarding the Stack Air Monitor (SAM) and the Continuous Air Monitor (CAM)?

a. The SAM measures only gaseous activity, while the CAM measures only particulate activity.

b. The SAM measures both gaseous and particulate activity, while the CAM only measures gaseous activity.

c. The SAM measures only gaseous activity, while the CAM measures both gaseous and particulate activity.

d. The SAM and the CAM each measure both gaseous and particulate activity.

Answer: C.12 d.
Reference: UWNR Operator training Manual, Controls and Instrumentation VI.

Question: C.013 [1.0 point] {13.0}

The Safety Channels (picoammeters):

a. supply a period signal for use in the Automatic mode.

b. provide a 1 kW inhibit for the pulse or square wave modes.

c. provide a scram at 115% power.

d. are disconnected during pulsing operation.

Answer: C.13 d.

Reference: UWNR Operator Training Manual, Controls and Instrumentation V.

Question deleted per facility comment.

~~**Question**: C.014 [1.0 point] {14.0}~~

~~With reference to the cooling tower control valve:~~

~~a. when sump tank temperature drops to about 45 degrees F, the valve opens fully to allow water to be pumped to the cooling tower.~~

~~b. when air pressure to the valve actuator is lost, the valve moves to the fully open position.~~

~~c. the valve is either fully open or fully closed depending on sump tank temperature.~~

~~d. the valve may be partially opened by varying the air pressure to the controller.~~

~~Answer: C.14 c.~~

~~Reference: UWNR Operator Training Manual, Reactor Water Systems IV.~~

Question: C.015 [1.0 point] {15.0}

The reactor is in the Automatic mode at a power level of 500 kW, with the transient rod selected as the controlled element. The neutron detector from which the control system receives its input suddenly drops to 100 kW as a result of an electronics problem. As a result:

a. the control system inserts the transient rod to reduce power to try to match the power of the failed detector.

b. the control system drops out of the Automatic mode into the steady-state manual mode.

c. the control system withdraws the transient rod to increase power to try to meet the demand of the power schedule.

d. the reactor scrams.

Answer: C.15 c.

Reference: UWNR Operator Training Manual, Controls and Instrumentation III.

Section C Facility and Radiation Monitoring Systems

Question: C.016 [1.0 point] {16.0}
For a safety blade, the "magnet engaged" light is illuminated when:

a. current is provided to the electromagnet.

b. a limit switch within the scram magnet closes.

c. the blade "out" limit light is illuminated.

d. all scrams are reset.

Answer: C.16 b.
Reference: UWNR SAR, Section 2.2.1.
Reword prior to next use per facility comment. "the "magnet engaged" light will illuminate only if the limit switch within the scram magnet closes AND current is provided to the electromagnet. Closure of the switch alone is insufficient to illuminate the "magnet engaged" light."

Question: C.017 [1.0 point] {17.0}
The fission counter is moveable so that it can be withdrawn from high neutron flux. While the counter is moving (either in or out):

a. the reactor cannot be placed in the Automatic Control mode.

b. safety blades cannot be withdrawn.

c. safety blades cannot be inserted.

d. period indication will change.

Answer: C.17 b.
Reference: UWNR Operator Training Manual, Controls and Instrumentation I & II.

Question: C.018 [1.0 point] {18.0}
When the Master Switch (Key Switch) is in the TEST position:

a. current is not available to the drive magnets.

b. safety blades can be withdrawn.

c. scrams cannot be reset.

d. safety blade drives will run in if a relay scram is present.

Answer: C.18 a.
Reference: UWNR Operator Training Manual, Controls and Instrumentation V.

Section C Facility and Radiation Monitoring Systems

Question: C.019 [1.0 point] {19.0}
Which ONE of the following combinations of Mode switch position, power, and transient rod drive positions permits firing of the transient rod?

a. Manual mode, 300 watts, transient rod at 12.34 inches.

b. Pulse mode, 300 watts, transient rod at 12.34 inches.

c. Manual mode, 200 kilowatts, transient rod at 11.00 inches.

d. Square Wave mode, 200 kilowatts, transient rod at 11.00 inches.

Answer: C.19 b.
Reference: UWNR Operator Training Manual, Controls and Instrumentation V.

Question: C.020 [1.0 point] {20.0}
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.20 c.
Reference: SAR 2.4.4, 1st ¶, p. 2-41