September 2, 2010

Mr. R. J. Agasie, Reactor Director
Nuclear Reactor Laboratory
University of Wisconsin - Madison
1513 University Avenue, Room 1215
Madison, WI 53706-1687

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-156/OL-10-01, UNIVERSITY OF WISCONSIN

Dear Mr. Agasie :

During the week of July 12, 2010, the U. S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at the University of Wisconsin Nuclear Reactor. The examination was 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 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-10-01
2. Facility Comments with NRC Resolution
3. Written examination with facility comments incorporated

cc without enclosures: See next page

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DISTRIBUTION w/ encls.:
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RidsNRRDPRPROB Facility File (CRevelle) O-7 G-13

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

OFFICE	PROB:CE		IOLB:LA	E	PROB:SC	
NAME	PYoung		CRevelle		JEads	
DATE	8/24/2010		8/24/2010		9/2/2010	

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-10-01

FACILITY DOCKET NO.: 50-156

FACILITY LICENSE NO.: R-74

FACILITY: University of Wisconsin

EXAMINATION DATES: July 12-15, 2010

SUBMITTED BY: ***/RA by Paul Doyle for/*** 8/12/2010
Philip T. Young, Chief Examiner Date

SUMMARY:

During the week of July 12, 2010, the NRC administered operator licensing examinations to five Reactor Operator candidates. Five candidates passed the written examination and five candidates passed the operating test.

REPORT DETAILS

1. Examiners:
   Gregory Schoenebeck, NRC, Examiner (In Training)
   Phillip T. Young, NRC, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	5/0	0/0	5/0
Operating Tests	5/0	0/0	5/0
Overall	5/0	0/0	5/0

3. Exit Meeting:
   Gregory Schoenebeck, NRC, Examiner (In Training)
   Phillip T. Young, NRC, Chief Examiner
   Robert J. Agasie, Reactor Director

The NRC examiner thanked the facility staff for their prompt submission of written examination comments (incorporated in enclosure two to this report). The examiner reported the following generic weaknesses:

- There was a lack of a basic understanding for the purpose of 10 CFR 50.59 and how it pertains to reactor safety.

- There was a weak understanding of the prompt negative coefficient from the zirconium-hydride matrix, a unique feature associated with TRIGA fuel
- There was a weak understanding of what the function of the emergency return button does in the event of a pneumatic sample being stuck in the in-core position.

Facility Comments with NRC Resolution

Question A.5
Comment: The answer key was wrong. The correct answer is b.
NRC Resolution: Comment Accepted; corrected the answer key and accepted the correct answer.

Question A.14
Comment: There is no correct answer.
Justification: Po should have been equal to the power at the scram setpoint (1.2 MW) at which point the rod insertion would provide a step insertion of negative reactivity. Therefore,

$$P_f = P_0 e^{\frac{t}{T}} = 1.2e^{\frac{50}{30}} = 6.35MW$$

NRC Resolution: Comment accepted; question deleted.

Question A.16
Comment: There are two correct answers as prompt critical and prompt super critical are used interchangeably at the facility.

Justification: The facility contends that the language in Lamarsh, Introduction to Nuclear Engineering, 2nd edition, 1983, pg. 286, can be contradictory when making the assumption when the reactor is precisely critical on prompt neutrons alone with a very short period.

NRC Resolution: Comment accepted; question modified to recognize as 2 correct answers.

Question B.3
Comment: Correct answer, per facility TS is incomplete.

Justification: per UWNR TS, "All control rods are fully inserted, the Reactor Keyswitch in 'OFF', console key is in possession of a reactor operator or locked in the key box, and fuel is being rearranged within the fuel storage racks."

NRC Resolution: Comment accepted; question deleted

Question B.7
Comment: The facility contended that the question's answers could have several correct answers based on the reference source you would use.

NRC Resolution: The NRC examiner did not agree with the facilities' contention regarding the dose thresholds as: 1) they are the most current standards provided by the Centers for Disease Control (CDC website http://www.bt.cdc.gov/radiation/arsphysicianfactsheet.asp) and 2) it is information provided by the facility training manual (NEEP 234 Health Physics I, pg. 10). However, resolution was based on the performance of this particular question, as it was apparent that the facility does not cover this type of material to the degree necessary to prepare

the candidate for this question. Therefore, the decision was made by the NRC examiner to withdrawal this question.

Question B.10

Comment: The facility provided a generic comment that the question was too obscure and did not test an RO's ability for understanding of radiation health and safety as a question such as dose requirements, stay time, and limited dose requirements.

NRC Resolution: The NRC Examiner did not agree with the facilities' contention that this question did not test the ability and understanding of dose limit requirements. This particular question tests several concepts (DDE, CEDE limits, etc.) from 10 CFR Part 20 for occupational dose exposure. However, resolution was based on the performance of this particular question, as it was apparent that the facility does not cover this type of material to the degree necessary to prepare the candidate for this question. Therefore, the decision was made by the NRC examiner to withdrawal this question.

Question C.11

Comment: This question does not pertain to the reactor facility.
Justification: There is no "gang drive switch" for a reactor control system at the facility.
NRC Resolution: Question deleted.

Question C.14

Comment: The facility provided a verbal comment that this particular question was inappropriate as it expected a reactor operator to memorize procedure steps.

NRC Resolution: During exam preparation, certain precautions (e.g., sample size, weight, no. of capsules, etc.) were extracted from the pneumatic sample procedure as the examiner assumed they were pertinent to safe operation of the system and averted a scenario of a stuck sample in the reactor core. Upon clarification with the facility during the exit interview, it was determined that the precautions were not related to safety and were general guidance to be used during operation using the procedure. Based on this fact, the decision was made by the NRC examiner to delete the question

Question C.18

Comment: The facility provided a verbal comment that this particular question was inappropriate for the level of knowledge that an RO would be expected to know.

NRC Resolution: The NRC Examiner reviewed the question and reference/training material and agreed that this question would be more suitable for an SRO candidate; Question deleted.

University of Wisconsin

NRC License Examination

Written Examination
with Answer Key

7/12/2010

Enclosure 3

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

FACILITY: UNIVERSITY OF WISCONSIN

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 7/12/2010

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 parentheses for each question. A 70% overall is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
19.00	33.3	_____	_____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTISTICS
17.00	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
17.00	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
53.00		_____ **FINAL GRADE**		TOTALS

ALL THE WORK DONE ON THIS EXAMINATION IS MY OWN. I HAVE NEITHER GIVEN NOR RECEIVED AID.

_____
CANDIDATE'S SIGNATURE

Section A: ReactorTheory, Thermodynamics & Facility Operating Characteristics

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d __
002 a b c d __
003 a b c d __
004 a b c d __
005 a b c d __
006 a b c d __
007 a b c d __
008 a b c d __
009 a b c d __
010 a b c d __

011 a b c d __
012 a b c d __
013 a b c d __
014 a b c d __
015 a b c d __
016 a b c d __
017 a b c d __
018 a b c d __
019 a b c d __
020 a b c d __

(***** END OF CATEGORY A *****)

Section B Normal, Emergency and Radiological Control Procedures

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d __
002 a b c d __
003 a b c d __
004 a b c d __
005 a b c d __
006 a b c d __
007 a b c d __
008 a b c d __
009 a b c d __
010 a b c d __

011 a b c d __
012 a b c d __
013 a b c d __
014 a b c d __
015 a b c d __
016 a b c d __
017 a b c d __
018 a b c d __
019 a b c d __
020 a b c d __

(***** END OF CATEGORY B *****)

Section C Facility and Radiation Monitoring Systems

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d __
002 a b c d __
003 a b c d __
004 a b c d __
005 a b c d __
006 a b c d __
007 a b c d __
008 a b c d __
009 a b c d __
010 a b c d __

011 a b c d __
012 a b c d __
013 a b c d __
014 a b c d __
015 a b c d __
016 a b c d __
017 a b c d __
018 a b c d __
019 a b c d __
020 a b c d __

(********** END OF EXAMINATION **********)

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 not received or 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 only to facilitate legible reproductions.

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

6. Fill in the date on the cover sheet of the examination (if necessary).

7. Print your name in the upper right-hand corner of the first page of each section of your answer sheets.

8. The point value for each question is indicated in parentheses after the question.

9. Partial credit will NOT be given.

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

11. When you are done and have turned in your examination, leave the examination area as defined by the examiner.

EQUATION SHEET

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

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

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

$$P = P_0 \; e^{t/\mathrm{T}}$$

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

$$\ell^* = 1 \times 10^{-4} \sec$$

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

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

$$CR_1 (-\rho_1) = CR_2 (-\rho_2)$$

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

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

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

$$M = \frac{1 - K_{eff_1}}{1 - K_{eff\,2}}$$

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

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

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

$$T_{\frac{1}{2}} = \frac{0.693}{\lambda}$$

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

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

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

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

$$DR = \frac{6 Ci \, E(n)}{R^2}$$

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

DR – Rem(/hr, facility comment for “dose rate”), Ci – curies, E – Mev, R – feet

1 Curie = 3.7 x 10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54 x 10^3 BTU/hr

1 Mw = 3.41 x 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

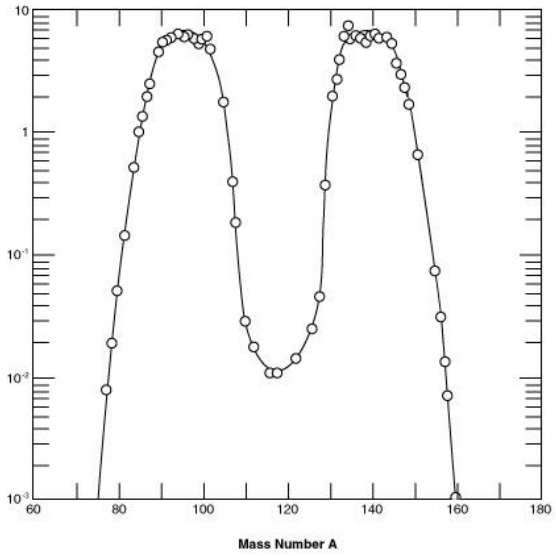


Figure 1-Question A.2

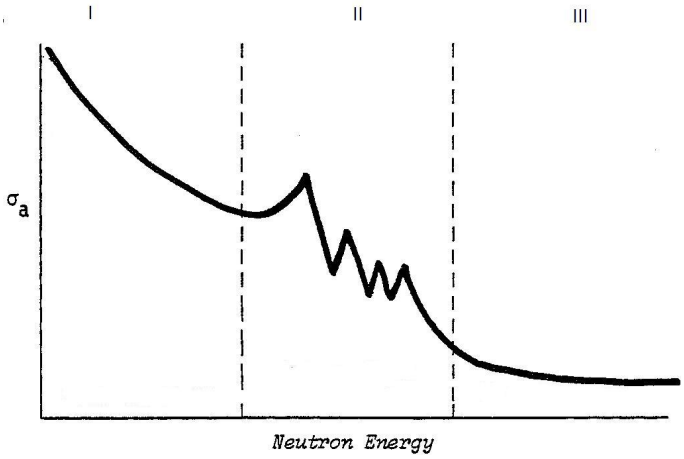


Figure 2-Question A.6

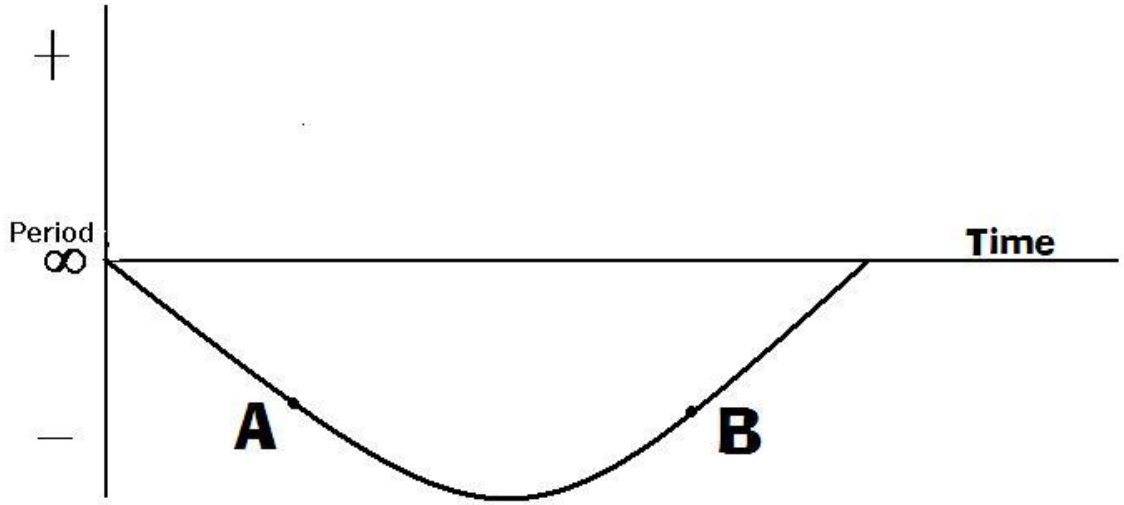


Figure 3-Question A.9

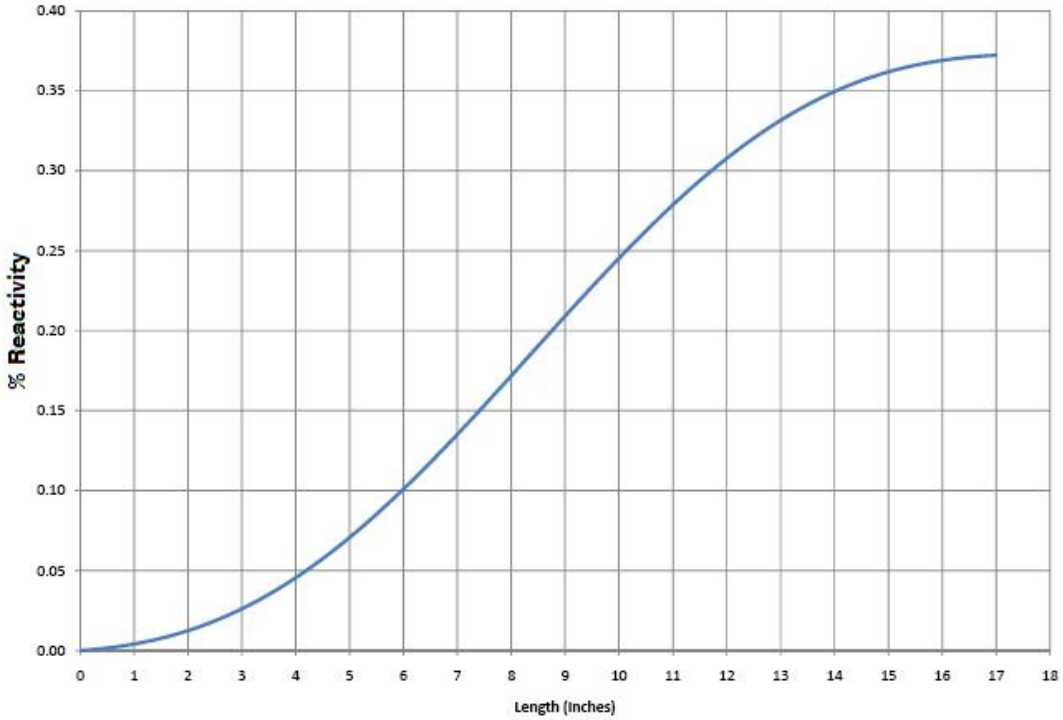


Figure 4-Question A.12

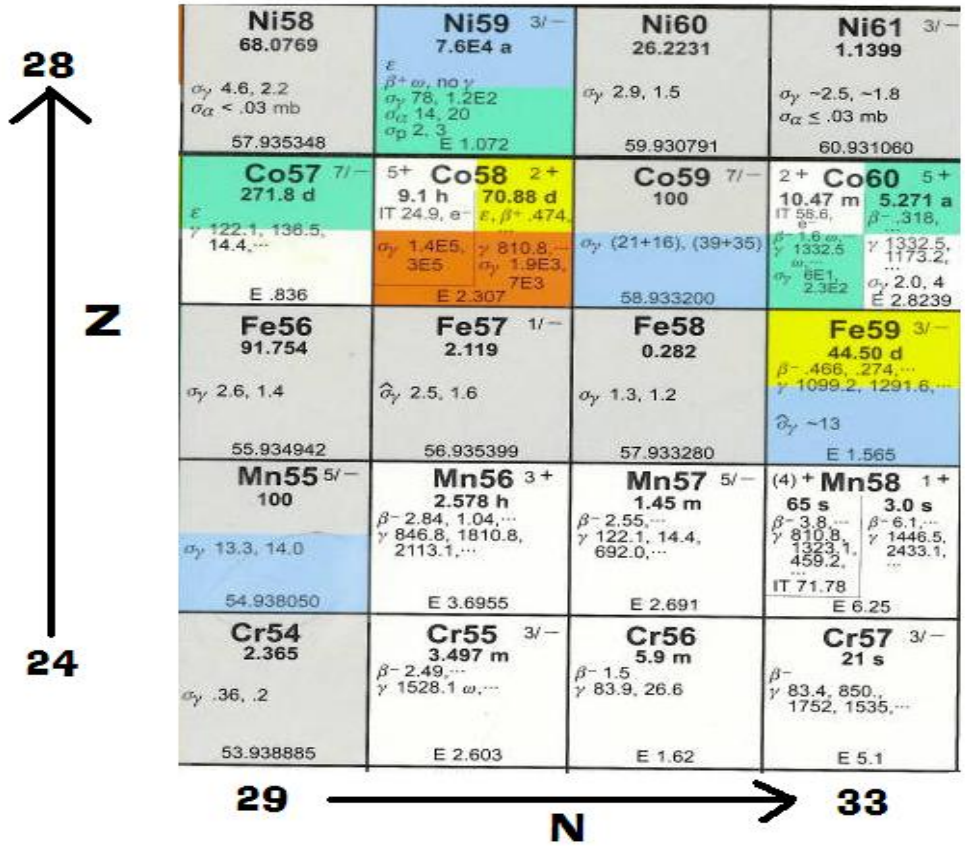


Figure 5-Question A.15

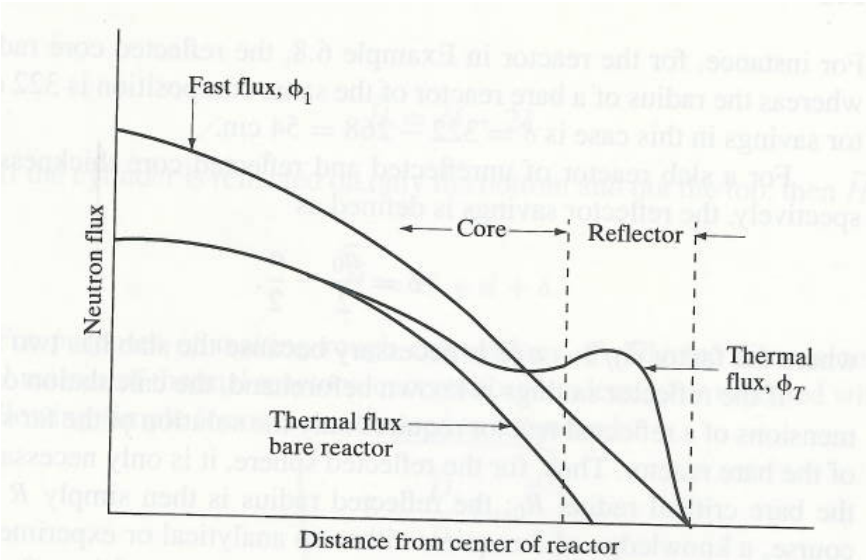


Figure 6-Question A.18

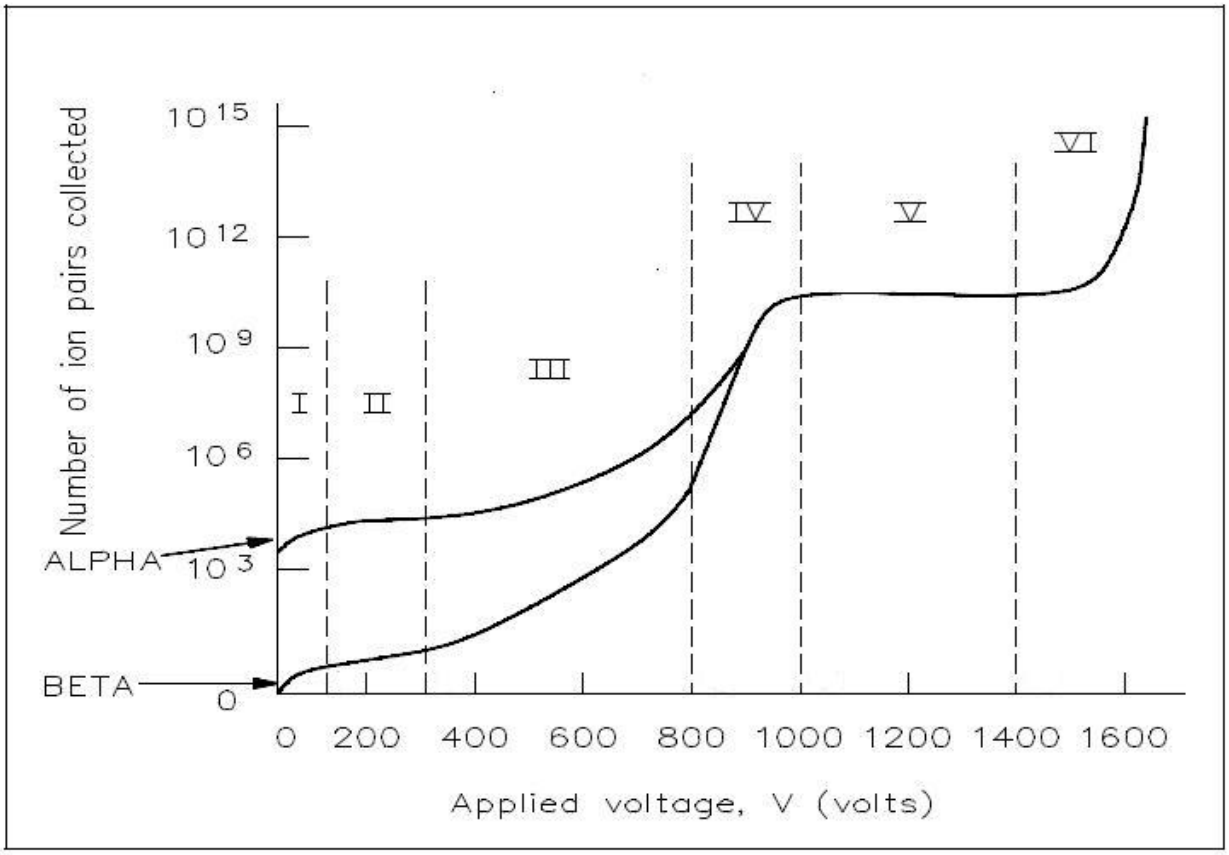


Figure 7-Question B.9

QUESTION A.1 [1.0 point]
Which ONE of the following isotopes has the largest microscopic cross-section for absorption for thermal neutrons?

a. Sm^{149}

b. U^{235}

c. Xe^{135}

d. B^{10}

QUESTION A.2 [1.0 point]
The graph depicted in **Figure-1** for U-235 depicts……

a. neutron energy distribution in the moderator

b. axial flux distribution in the core

c. radial flux distribution in the core

d. fission product yield distribution

QUESTION A.3 [1.0 point]
Which factors of the six factor formula are affected by an **INCREASE** in core temperature and how are they affected?

a. $\downarrow \boldsymbol{Lf}, \downarrow \mathbf{p}, \uparrow \boldsymbol{f}$

b. $\uparrow \boldsymbol{\varepsilon}, \uparrow \boldsymbol{Lf}, \downarrow \boldsymbol{L_t}, \uparrow \mathbf{p}$

c. $\uparrow \boldsymbol{\varepsilon}, \downarrow \boldsymbol{Lf}, \downarrow \boldsymbol{L_t}, \downarrow \mathbf{p}, \uparrow \boldsymbol{\eta}, \uparrow \boldsymbol{f}$

d. $\uparrow \boldsymbol{\varepsilon}, \uparrow \boldsymbol{Lf}, \downarrow \boldsymbol{L_t}, \uparrow \mathbf{p}, \downarrow \boldsymbol{\eta}, \downarrow \boldsymbol{f}$

QUESTION A.4 [1.0 point]
You are conducting a reactor startup after installing 2 new fuel assemblies in the core. Given the following rod withdrawal data, estimate the rod position when criticality would occur. The initial count rate on the nuclear instrumentation prior to rod withdrawal is 55 cps.

a. 11 in

b. 12 in

c. 13 in

d. 15 in

Rod Withdrawal (Inches)	Count Rate (cps)
0	55
2	63
4	71
6	85
8	103
10	300

QUESTION A.5 [1.0 point]
What is β_{eff}?

a. The time required for the reactor to change by a power of e

b. The fraction of all fission neutrons that are born as delayed neutrons

c. The fraction of all delayed neutrons which reach thermal energy

d. The fractional change in neutron population per generation

QUESTION A.6 [1.0 point]
Given **Figure-2**, which answer best describes neutron behavior within Region II.

a. The neutron cross section is inversely proportional to the neutron velocity (1/V)

b. The neutron cross section decreases steadily with increasing neutron energy (1/E).

c. Neutrons of specific energy levels (e.g., 50 ev, 100 kev) are less likely to be readily absorbed than neutrons at other energy levels.

d. Neutrons of specific energy levels (e.g., 50 ev, 100 kev) are more likely to be readily absorbed than neutrons at other energy levels.

QUESTION A.7 [1.0 point]
Which of the following types of neutrons has a mean neutron generation lifetime of 12.7 seconds?

a. Prompt

b. Delayed

c. Fast

d. Thermal

QUESTION A.8 [1.0 point]
Which of the following statements is true about Xenon following a reactor scram?

a. The concentration of ^{135}Xe will decrease due to reduced nuclear flux

b. The concentration of ^{135}Xe will increase due to the decay of the ^{135}I inventory.

c. The concentration of ^{135}Xe will increase by natural decay into ^{135}I

d. The concentration of ^{135}Xe will remain constant until it is removed via neutron burnout during the subsequent reactor startup.

QUESTION A.9 [1.0 point]
Figure-3 depicts a plot of reactor period as a function of time. What best describes the behavior of **REACTOR POWER** between points A and B:

a. Constant

b. Decreasing then increasing

c. Continually increasing

d. Continually decreasing

QUESTION A.10 [1.0 point]
A reactor that has a reactivity of -1671 pcm has a count rate of 50 cps on nuclear instrumentation. Calculate what the neutron level (i.e., count rate) should be after a reactivity insertion of 850 pcm from the withdrawal of the control rods.

a. 25 cps

b. 50 cps

c. 100 cps

d. 200 cps

QUESTION A.11 [1.0 point]
During the time following a reactor scram, reactor power decreases on an 80 second period, which corresponds to the half-life of the longest-lived delayed neutron precursors, which is approximately

a. 80 seconds

b. 55 seconds

c. 40 seconds

d. 20 seconds

QUESTION A.12 [1.0 point]
The reactor is operating in the automatic mode at 750 kW, with the regulating rod at 10 inches. A malfunction of equipment in the secondary cooling system has caused primary temperature to decrease by 8 ° C. Disregarding any other automated system design features, find the new the position of the regulating rod using the following and **Figure-4**:

Temperature Coefficient= -1.26×10^{-4} ΔK/C

a. 13.5 inches

b. 11 inches

c. 9.5 inches

d. 7 inches

QUESTION A.13 [1.0 point]
Which ONE of the following is a correct statement of why delayed neutrons enhance the ability to control reactor power?

a. There are more delayed neutrons than prompt neutrons

b. Delayed neutrons are born at higher energy levels than prompt neutrons

c. Delayed neutrons increase the average neutron lifetime

d. Delayed neutrons readily fission in U-238

~~QUESTION A.14 [1.0 point]~~ (Deleted per facility comment, see answer key)
~~An experimenter had made an calculation error prior to loading a pneumatic sample into the core at a reactor power of 500 KW. Instead of a sample with a worth of 10¢, the experiment actually had a worth of $1. The scram delay time for the reactor is 50 milliseconds. If the scram setpoint is 1.2 MW, what is the **peak reactor power** at the time of rod insertion, given the following reactor parameters?~~

~~β_{eff} = 0.0070~~
~~λ_{eff} = 0.1 sec^{-1}~~
~~Effective neutron generation lifetime: 2.1 x 10^{-4} sec~~

a. 1.2 MW

b. 10 MW

c. 2.65 MW

d. 28.5 MW

QUESTION A.15 [1.0 point]
Using the applicable portion from the chart of the nuclides **(Figure-5)**, what isotope will Mn-56 decay into?

a. Mn-55

b. Co-60

c. Fe-56

d. Fe-58

QUESTION A.16 [1.0 point]

What is the condition of the reactor when $k = \frac{1}{1-\beta}$?

a. subcritical

b. critical

c. prompt critical

d. prompt supercritical

QUESTION A.17 [1.0 point]

Inelastic scattering can be described as a process whereby a neutron collides with a nucleus and:

a. recoils with a lower kinetic energy, with the nucleus emitting a gamma ray.

b. recoils with the same kinetic energy it had prior to the collision.

c. is absorbed by the nucleus, with the nucleus emitting a gamma ray.

d. recoils with a higher kinetic energy, with the nucleus absorbing a gamma ray.

QUESTION A.18 [1.0 point]

Figure-6 depicts fast and thermal fluxes in a reflected and non-reflected thermal reactor. Which of the following statements is true regarding a typical reflector?

a. A reflector has a high cross section for absorption which **increases** the peak power to average power ratio.

b. A reflector has a high cross section for scattering, which **increases** the peak to average power ratio

c. Thermal neutrons tend to accumulate in the reflector until they leak back into the core, escape, or become absorbed, which **reduces** the peak to average power ratio.

d. Fast neutrons become absorbed in the reflector fuel, which raises the thermal flux and **reduces** the peak to average power ratio.

QUESTION A.19 [1.0 point]
A reactor is critical at 650 kW. Given the following data, calculate the MINIMUM Shutdown Margin for this reactor.

Total Rod Worth	
Safety Blade #1:	$3.43
Safety Blade #2:	$2.84
Safety Blade #3:	$3.36
Regulating Rod:	$0.53
Transient Rod:	$2.02

Control Rod Worth Remaining in Core:	
Safety Blade #1:	$0.46
Safety Blade #2:	$0.38
Safety Blade #3:	$0.51
Regulating Rod:	$0.06
Transient Rod:	$2.02

a. $12.18

b. $10.77

c. $7.34

d. $5.32

QUESTION A.20 [1.0 point]
During the conversion of the UWNR's fuel from HEU to LEU, safety analyses were performed to determine a "MDNBR of a hot rod as a function of power." Which of the following statements of MDNBR is true?

a. It is the point at which a release from a failed fuel element will result in personnel exposure which exceeds Federal limits

b. It is the point which a release from a failed fuel element will result in the inhalation of airborne activity which exceeds Federal limits

c. It is the point at which heat transfer from a fuel element rapidly increases due to increased convection from air currents

d. It is the point which heat transfer from a fuel element rapidly decreases due to insulating effects of a steam blanket

QUESTION B.1 [1.0 point]
What is the Standard Emergency Classification for a reactivity accident with a 1.2% step change when operating at 1 MW?

a. Unusual Event

b. Alert

c. Site Area Emergency

d. None

QUESTION B.2 [1.0 point]
Which of the following is correct regarding NRC Form 3 "Notice to Employees"?

a. It provides guidance for filing a discrimination report

b. It provides guidance for how to report safety concerns

c. It informs you for how to get a record of your radiation exposure

d. All of the above

~~QUESTION B.3~~ [1.0 point] (Question Deleted per facility comment, b answer is incomplete per TS)
~~Which of the following conditions meets the Technical Specification definition for "Reactor Secured" at the UWNR?~~

~~a. An experiment with a reactivity of < $1 is being installed in the reactor with all control rods fully inserted, Keyswitch is in OFF, and the console key is removed~~

~~b. All control rods are fully inserted and the Reactor Keyswitch in "OFF", console key is not removed~~

~~c. All control rods are fully inserted, the Reactor Keyswitch in "OFF", console key is **(in possession of a reactor operator or locked in the key box**), and fuel is being rearranged within the fuel storage racks.~~

~~d. One control rod drive is removed for inspection; the rod is decoupled and is fully inserted into the core, all other rods are fully inserted with the Reactor Keyswitch in "OFF" and console key is removed.~~

QUESTION B.4 [1.0 point]
Which one of the following **DOES NOT** require the presence of a Senior Reactor Operator (SRO)?

a. The relocation of an in-core experiment with worth greater than β_{eff}

b. The manipulation of reactor console controls by a student in training

c. Recovery from an unplanned shutdown whose cause is unknown

d. The reactor secured, with fuel being rearranged in the storage racks

QUESTION B.5 [1.0 point]
The special unit for absorbed dose "Rem" is defined in 10 CFR Part 20 in terms of a dose equivalent. What does the term dose equivalent relate to?

a. It is derived by accounting for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in one year

b. It is equal to the absorbed dose (rad) multiplied by the quality factor (Q) of the radiation

c. It is equal to the absorbed dose (rad) divided by the quality factor (Q) of the radiation

d. It is the equivalent dose one would receive during the 50-year period following intake

QUESTION B.6 [1.0 point]
An example of Byproduct Material would be….

a. Pu-239

b. U-233

c. U-235

d. Co-60

~~QUESTION B.7~~ [1.0 point] (Question deleted per facility comment. The facility argued that question answers could have several correct answers based on the reference source. Additionally, the NRC examiner determined that the facility does not cover this type of material to the degree necessary to answer this question.)

~~If an average person were to receive 350 rads of radiation, what would be the most likely symptom/outcome for this stage of Acute Radiation Sickness (ACRS)?~~

a. Death

b. GI tract damage

c. Central Nervous System damage

d. Nausea and vomiting

QUESTION B.8 [1.0 point]
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

QUESTION B.9 [1.0 point]
You are performing a periodic contamination survey with a Geiger-Mueller type instrument. Using **Figure-7**, which region of the gas amplification curve does this type of meter belong to and which statement best describes this region?

a. Region V. The number of electrons produced through ionizations is **independent** of the applied detector voltage, therefore pulses **cannot** be differentiated to distinguish radiation of different energy types.

b. Region IV. The number of electrons produced through ionizations is **dependent** on the applied detector voltage, therefore pulses **can** be differentiated to distinguish radiation of different energy types.

c. Region III. Radiation interacts with a crystal center which causes electrons to be raised to an excited state. When crystal de-excites, the electron returns to ground state emitting a photon which is proportional to the intensity of the radiation.

d. Region II. The inner surface of the detector probe is covered with a thin coating of boron which aids with the detection of neutron radiation.

~~QUESTION B.10 [1.0 point]~~ (Deleted per discussion with the facility. The NRC examiner determined that the facility does not cover this type of material to the degree necessary to answer this question)

~~The staff of a reactor facility is performing an extensive maintenance overhaul of several core components which will involve significant radiation exposure. Given that your current whole body exposure is 2 Rem, you unexpectedly received 50 Rem to the thyroid during the overhaul period. Using the following table, have you violated your 10 CFR 20 exposure limits?~~

ORGAN DOSE WEIGHTING FACTORS

Organ or tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	[1] 0.30
Whole Body	[2] 1.00

a. The Organ Dose limit was exceeded

b. The TEDE limit was exceeded

c. Both the Organ Dose and TEDE limits were exceeded

d. No limits were exceeded

QUESTION B.11 [1.0 point]
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

QUESTION B.12 [1.0 point]
The limit of 1.5 MW for steady state reactor power under any condition of operation provided in the UWNR Technical Specifications is an example of a (an)….

a. Limiting safety system setting (LSS)

b. Safety limit

c. Limiting condition for operation (LCO)

d. Administrative Control

QUESTION B.13 [1.0 point]
According to the Technical Specifications, if the ventilation system is down for maintenance, the reactor may be operated for a maximum of _____ before shutdown.

a. 8 hours

b. 12 hours

c. 24 hours

d. 48 hours

QUESTION B.14 [1.0 point]
Which of the following statements is TRUE regarding the limitations of a non-secured experiment at the UWNR?

a. < 0.7% Δk/k

b. < 1.2% Δk/k

c. < 1.4% Δk/k

d. < 2.0% Δk/k

QUESTION B.15 [1.0 point]
Which of the following is considered an abnormal occurrence?

a. An unanticipated change in power, resulting from a $0.75 reactivity excursion

b. Performing reactor operations at 1 MW with the N-16 diffuser out of service

c. Operating the reactor at steady state with a loss of the Pulsing Power Level measuring channel

d. Performing reactor operations with Safety Rod #1 having a 3 second scram insertion time, with the rod drop surveillance performed 12 months from its previous test.

QUESTION B.16 [1.0 point]
Which of the following is a TRUE statement regarding a reactor tour for visitors?

a. Total radiation dose received may not exceed 0.5 mrem for a member of the public

b. The maximum size for a tour group is 20 individuals

c. Each tour group must have 2 individuals wearing dosimetry to average the accumulated dose

d. Visitors may have authorized unescorted access throughout the facility without prior approval

QUESTION B.17 [1.0 point]
You are performing a periodic radiation survey when you find a streaming source of radiation which the detector display reads 50 mr/hr on contact from a cabinet that is not posted for radiological safety. How would this area be posted in accordance with the requirements of 10 CFR 20?

a. High Radiation Area @ 30 cm from the source

b. High Radiation Area on contact w/ the cabinet

c. Radiation Area @ 30 cm from the source

d. Radiation Area on contact w/ the cabinet

QUESTION B.18 [1.0 point]
In the event of a suspected fuel leak from a 30/20 TRIGA element, which of the following nuclides would most likely be found in an **Air Particulate** Sample when performing the immediate actions of UWNR 152?

a. Co-60

b. Rn-226

c. Xe-133

d. Cs-138

QUESTION B.19 [1.0 point]
During in-core fuel loading operations, which of the following is a requirement by UWNR procedures and technical specifications?

a. Safety Rod #1 is installed in the central fuel bundle as soon as the fuel is loaded

b. At a minimum, an SRO may act as the console operator while supervising the fuel loader

c. Pre-startup checklists are performed at the conclusion of each days' operation

d. If the result of the 1/M plot is inconclusive, only one fuel bundle may be loaded

QUESTION B.20 [1.0 point]
Immediately following the firing of the transient rod for a pulsing evolution you……..

a. Manually scram the reactor after 15 seconds

b. Check that the transient rod drops in 15 sec or less

c. Switch the mode switch to manual

d. Switch to square wave mode and wait until LOG N indication returns

QUESTION C.1 [1.0 point]
If the Intermediate Loop Cooling System pressure reaches 27 psig, what is the expected system response?

a. A signal is sent to the intermediate loop pump variable speed drive to increase flow rate output

b. The intermediate loop pressure annunciator alarm sounds and indicator light goes out on system mimic board

c. The primary pump will automatically de-energize on low intermediate loop pressure to prevent the potential for a primary to intermediate loop leak

d. The intermediate loop pressure switch energizes the charging pump to raise pressure

QUESTION C.2 [1.0 point]
When in AUTO, the diffuser pump will start when reactor power reaches…..

a. 100 kW

b. 150 kW

c. 250 kW

d. 1 MW

QUESTION C.3 [1.0 point]
What is the basis for the safety limit “a standard TRIGA fuel element shall not exceed 1000°C under any condition of operation”?

a. This limit is set to prevent exceeding conditions for fuel melt

b. Prevents the formation of stress fractures which can form and cause fuel element failure during pulsing operations

c. Avoids “ballooning” effects and possible failure of the fuel element cladding from hydrogen gas during the dissociation of zirconium hydride

d. Precludes temperatures which are favorable for hydrogen embrittlement of the fuel cladding

QUESTION C.4 [1.0 point]
You are about to perform a reactor pulse. When referencing the procedure to determine factors for reactivity effects, which of the following contributes the largest magnitude of %ρ?

a. Flooding the pneumatic tube

b. Flooding all 4 beam tubes

c. Adding a fuel element on the side of the core

d. Adding 2 graphite reflectors on Center of one side of the core

QUESTION C.5 [1.0 point]
What is the composition of the regulating rod?

a. Stainless Steel

b. Boron Carbide (BC)

c. Boral Plate

d. Borated graphite in a stainless steel clad

QUESTION C.6 [1.0 point]
The following is a picture of the LOG Count Rate Meter. Which of the Roman Numerals (I-IV) indicates the value for an alarm associated with this channel? (Disregard the pointer for the meter)

a. I

b. II

c. III

d. IV

QUESTION C.7 [1.0 point]
The following is a picture of the LOG N. Which of the Roman Numerals (I-IV) indicates the value for the power level associated with the pulse permissive interlock? (Disregard the pointer for the meter)

a. I

b. II

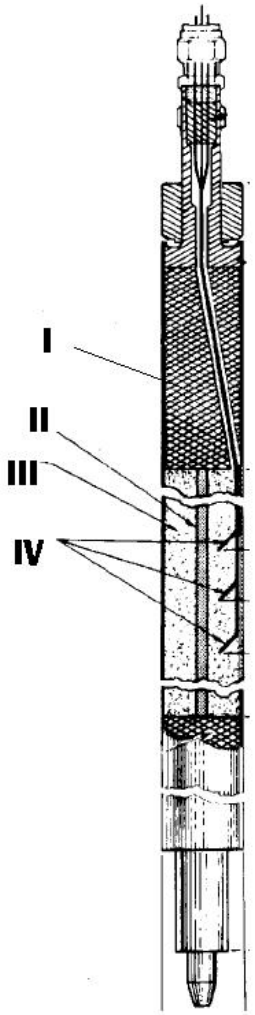
c. III

d. IV

QUESTION C.8 [1.0 point]
Using the following diagram of an instrumented fuel element match the correct position locator (Column A) to the correct component (Column B).

Column A
I
II
III
IV

Column B
A. Zirconium Hydride-Uranium
B. Stainless steel
C. Erbium Burnable Poison
D. Graphite Reflector
E. Zirconium Rod
F. Spacer
G. Thermocouples



a. I.A, II.E, III.C, IV.G

b. I.D, II.G, III.A, IV.F

c. I.D, II.E, III.A, IV.G

d. I.C, II.A, III.B, IV.G

QUESTION C.9 [1.0 point]
When in AUTO mode, what is the period limited to with regulating rod motion?

a. 20 seconds

b. 25 seconds

c. 30 seconds

d. 45 seconds

QUESTION C.10 [1.0 point]
During UWNR operation at 500 kW, if the Stack Air Monitor fails……?

a. A portable air sample is taken every 4 hrs for up to 24 hrs before the reactor must be shutdown

b. The continuous air monitor can be connected to the stack monitor flow path

c. A portable alpha sensitive monitor with an audible alarm can be used to monitor for a fuel element failure to allow for maintenance on the Stack Air Monitor

d. The radiation monitor above the reactor bridge is a sufficient monitor for continued operations

~~QUESTION C.11 [1.0 point]~~ (Deleted per facility comment. This question does not pertain to the ~~UWNR facility)~~
~~Which of the following is a correct statement regarding interlocks which restrict Fission Chamber movement? Movement is allowed only if……~~

~~a. The Gang Drive switch is in the mid position~~

~~b. No Source Channel or Inhibit present~~

~~c. The Ganged Insert switch be in the OUT position~~

~~d. The LOG N OPERATIVE is depressed after reaching 4 Watts.~~

QUESTION C.12 [1.0 point]
What prevents the following system designs prevents siphon action in the event a break occurred in the pneumatic system ?

a. The elevation of the pneumatic system tubing is higher than that of the reactor pool

b. Check valves admit air into the system if siphon action occurs

c. Solenoid valves shut when pneumatic system operation is secured

d. Blind flanges are installed in the pneumatic system when not in use

QUESTION C.13 [1.0 point]
To regenerate the cation resin bed in the demineralizer _____ after resin exhaustion?

a. Water from the barnstead still is recirculated through the demineralizer for 24 hrs

b. The cation resin is washed with a muriatic acid solution

c. The cation resin is washed with a sodium hydroxide solution

d. Pool water flow is reversed through the demineralizer to remove impurities

QUESTION C.14 [1.0 point] (Question deleted per facility comment. The NRC examiner assumed that the limit on the pneumatic samples was related to safety (e.g., prevent pneumatic sample from being stuck in the tube). When talking with the facility director it was determined that this was not the case and it was apparent that this question would have been difficult to answer without having the procedure as a reference.)

~~By procedure, at the UWNR, which of the following is a CORRECT statement regarding pneumatic tube operations?~~

~~a. 2 pneumatic sample tubes may be sent at one time with SRO approval~~

~~b. Samples must not exceed 16 oz~~

~~c. Use the CO_2 Purge button as necessary until the CO_2 monitor indicates at least 90% prior to securing purge operations.~~

~~d. When AUTO SINGLE mode is selected for the pneumatic tube, only the exposure timer is used~~

QUESTION C.15 [1.0 point]
You are performing a reactor startup on the UWNR. When you go to start the primary pump, it does not start. Which of the following is a correct reason for this unexpected response?

a. The chilled water pump is not running

b. The whale and diffuser pump is in the OFF position

c. Reactor pool water level is at 20”

d. Primary coolant temperature is 130˚F

QUESTION C.16 [1.0 point]
If a reactor is operating at low power levels (e.g., 100 W), what is a potential consequence for applying too much compensating voltage to the Safety Channel?

a. Actual core power may be **higher** than indicated power level

b. Actual core power may be **lower** than indicated power level

c. There will be no effect, as the neutron flux signal will dominate the gamma flux signal at this power level

e. There will be no effect, the Safety Channel detector is an uncompensated ion chamber.

QUESTION C.17 [1.0 point]
With regards to the transient rod, what does it mean when the “ENG’D/AIR” indicator/switch is illuminated?

a. The permissives for firing are met and the rod has not been fired

b. Air pressure is at the level ready to engage the transient rod for square wave operations

c. Air pressure has been applied indicating movement of the transient rod from the full-in rest position

d. Air pressure has been removed from the drive, causing the transient rod to drop to the full-in rest position.

~~QUESTION C.18 [1.0 point]~~ (Question deleted per facility comment. This question is more applicable to the knowledge of an SRO)
~~When the key-operated console MASTER switch is placed in the "ON" position, ____ contacts are closed in order to reset the scram relays and apply power to the trip amplifier.~~

~~a. 2~~

~~b. 4~~

~~c. 6~~

~~d. 8~~

QUESTION C.19 [1.0 point]
Which of the following is the maximum credible accident for an excursion type accident associated with the UWNR?

a. A sheared beam port which drains the pool with power level at 1 MW

b. A fuel element failure with continuous operation at 125% of full power

c. Continuous rod withdrawal of all three control rods from a subcritical core through criticality up to shutdown by the high level neutron flux SCRAMs

d. A slug of primary coolant < 27°F injected into the reactor core which is operating at < 150 kW

QUESTION C.20 [1.0 point]
WHICH ONE of the following colors designates the piping associated with softened water?

a. Red

b. Green

c Blue

d. Black

Section A: Reactor Theory, Thermodynamics, and Facility Operating Characteristics

Question:

A.1
Answer: c
Sm^{149} (41,000 b); U^{235} (687 b); Xe^{135} (2.65×10^6 b); B^{10} (3840 b)
Reference: Lamarsh, J. "Introduction to Nuclear Engineering" p. 738

A.2
Answer: d
Reference: DOE Manual Vol. 1, pg. 57, NEEP 234 "Reactor Physics Part I", pg.2

A.3
Answer: a
Reference:

As reactor core temperature increases, the moderator to fuel ratio will decrease due to the decrease in density of the water. Therefore, due to this fact:

↓*Lf (Fast Non-Leakage Factor):* is the probability that neutrons will not leak out while still fast. Therefore, with less moderator in the core, the probability that they will not leak out decreases.

↓p*(Resonance Escape Probability)*: is the probability that a neutron will be reduced to thermal energy levels without being absorbed by U-238. Due to the increase in temperature and Doppler Broadening effects, the probability of escape decreases.

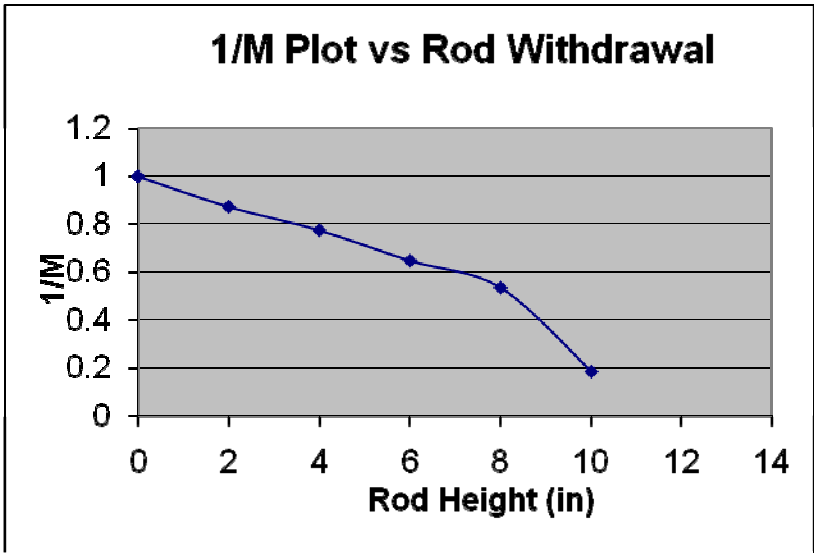
↑***f*** *(Thermal Utilization Factor)*: is the ratio of absorption in fuel to the amount absorbed in the core (e.g., fuel, moderator, control rods, etc.). When the temperature rises, the water moderator expands, and a significant amount of it will be forced out of the reactor core. This means that N_m, the number of moderator atoms per cm^3, will be reduced, making it less likely for a neutron to be absorbed by a moderator atom. This reduction in N_m results in an increase in thermal utilization as moderator temperature increases because a neutron now has a better chance of hitting a fuel atom.

DOE Manual Vol 2, Section 1.0

A.4
Answer: a

Reference:

$\frac{CR_1}{CR_2} = \frac{1}{M}$, Where CR_1= reference count rate (i.e., 55 cps) and CR_2= current count rate.



DOE Handbook Vol. 2, NEEP 234

A.5
Answer: ~~c~~ b (Facility Comment: Answer Key should be b)
Reference.
Effective delayed neutron fraction is the fraction of all delayed neutrons which reach thermal energy.
DOE Handbook, Vol 2, Section 2.0

A.6
Answer: d.
Reference: Resonance Escape Region
DOE Manual Vol 1, Section 2, and NEEP 234 "Reactor Physics III" pg. 2

A.7
Answer: b
Reference: NEEP 234 "Reactor Physics II" pg. 2

A.8
Answer: b
Reference: Following a reactor shutdown, xenon-135 concentration will increase due to the decay of the iodine inventory of the core.
DOE Handbook, Vol 2, Section 4 and NEEP 234 "Reactor Physics I" pg. 9

A.9
Answer: d

Ref: From point A to B, reactor period is negative, and since Pf=Poe$^{\frac{t}{T}}$, power will continue to decrease.
DOE Manual Vol. 1, Section 2

A.10
Answer: c
Ref: This question can be answered in two ways. One way is through the equations as shown below, or two, use a rule of thumb that if the reactor moves halfway from its subcritical state towards criticality, the count rate will double.

$$\frac{CR_1}{CR_2} = \frac{1-k_2}{1-k_1} \text{ --> } CR_2 = CR_1 \frac{1-k_1}{1-k_2} = 50 \text{ cps} \left(\frac{1-0.984}{1-0.992}\right) = 100$$

Where,

1 pcm= $0.00001 \frac{\Delta K}{K}$

p_1= -0.01671, p_2= -1671+850= 821 pcm--> -0.00821

$$k_1 = \frac{1}{1-p_1} = \frac{1}{1+0.01671} = 0.984$$

$$k_2 = \frac{1}{1-p_2} = \frac{1}{1+0.00821} = 0.9919$$

DOE Manual Vol. 2, Section 1

A.11
Answer: b
Reference: Group 1 is the longest-lived delayed neutron precursor for thermal fission in U-235, with a half-life of 55.72 sec.
Lamarsh, J. "Introduction to Nuclear Engineering" p. 88

A.12
Answer: d
Reference:
The decrease in temperature has added 0.101 %ρ of reactivity which must be accounted for by the regulating rod to maintain 750 kW. Therefore, the reg rod must be inserted -0.101 %ρ worth. Using the integral rod worth curve, with the reg rod initially at 10 in (≈0.24 %ρ), the new rod height at 0.24 – 0.101=0.14 %ρ is ≈7 in.
DOE Manual Vol. 2 Section 3, UWNR Operator Information Handbook

A.13
Answer: c
Reference: DOE Manual, Section 3

~~**A.14 (Deleted)**~~
~~Answer: c~~
~~Reference:~~
~~The candidate should recognize that reactivity has approached $\beta_{eff,}$ therefore the delayed term cancels from the period equation, with only the prompt term dominating.~~

~~$T=\frac{l^*}{p}+\frac{\bar{\beta}_{eff}-p}{\lambda_{eff}p-p}\rightarrow\frac{l^*}{p}=\frac{2.1x10^{-4}}{.0073}$ = 30 millisecond~~

~~$P_f=P_0e^{\frac{t}{T}}=0.5e^{\frac{50}{30}}$ = 2.65 MW (Facility Comment: There is no correct answer as Po should have been equal to the power at the scram setpoint (1.2 MW) at which point the rod insertion would provide a step insertion of negative reactivity. Therefore,~~
~~$P_f=P_0e^{\frac{t}{T}}=1.2e^{\frac{50}{30}}=6.35MW$~~

~~Lamarsh, J. 2001. Introduction to Nuclear Engineering 3rd Ed.. P. 331, DOE Fundamentals Handbook.Vol.2 Section 4, and Pulstar Reactor Trainee Manual Chapter 2~~

A.15
Answer: c
Reference:
Mn-56 is beta decay, which is the conversion of a neutron into a proton and electron.
Baum, E., Knox, H., and Miller, T. 2002. Nuclides and Isotopes 16th Ed. p. 28

A.16
Answer: c and d 2nd correct answer added per facility comment.
Reference: The multiplication factor (k) is proportional to the total number of neutrons, prompt and delayed, emitted per fission. However, since only the fraction (1-β) of the fission neutrons are prompt, the fraction of prompt neutrons from with regards to the multiplication factor is (1-β)k. Therefore, when (1-β)k=1, the reactor is critical on prompt neutrons alone, and the reactor is said to be prompt critical. If you rearrange (1-β)k=1 it will read $k=\frac{1}{1-\beta}$.
Lamarsh, J. 2001. Introduction to Nuclear Engineering 3rd Ed.. pp.340-341

A.17
Answer: a
Reference: DOE Handbook Vol I, pg. 45, UWNR OTM “Physics I”

A.18
Answer: c.
Reference: The thermalized neutrons are not absorbed as quickly in the reflector as neutrons thermalized in the core since the reflector, being unfueled, has a much smaller absorption cross-section. The thermal neutrons tend to accumulate in the reflector until they leak back into the core, escape from the outer surface of the reflector, or are absorbed.
Lamarsh, J. 2001. Introduction to Nuclear Engineering 3rd Ed.. p. 305.

A.19
Answer: c
Reference:
SDM: TRW-Core Excess= $3.43+$2.84+$3.36+$0.53 – ($0.46+$0.38+$0.51+$0.06)= $8.75
The Minimum SDM would be $8.75-$3.43= 5.32
DOE Manual Handbook Vol II, pg. 28

A.20
Answer: d
Reference: Definition of Departure from Nucleate Boiling.
NRC Website

Section B: Normal Emergency Procedures & Radiological Controls

Question:

B.1
Answer: d
Reference: UWNR E-Plan Rev. 7, pg. 10

B.2
Answer: d
Reference: NRC Form 3. http://www.nrc.gov/reading-rm/doc-collections/forms/form3_us.pdf

~~**B.3**~~ **(Question Deleted per facility comment; correct answer is incomplete)**
~~Answer: c~~
~~Reference: UWNR TS 1.20c states as a requirement for the reactor to be secured, "No work is in progress involving in-core fuel handling or refueling operations, maintenance of the reactor or its control mechanisms, or insertion or withdrawal of in-core experiments. "~~
~~TS for the UWNR, Amendment 17~~

B.4
Answer: b.
Reference: Under 10 CFR Part 55, The regulations in this part do not require a license for an individual who- "Under the direction and in the presence of a licensed operator or senior operator, manipulates the controls of a research or training reactor as part of the individual's training as a student"
10 CFR Part 55.13

B.5
Answer: b
Reference: 10 CFR Part 20.1003

B.6
Answer: d.
Reference: Byproduct material is radioactive material made radioactive by the process of using special nuclear material
10 CFR Part 20.1003

~~**B.7**~~ **(Deleted per facility comment)**
~~Answer d.~~
~~Reference:~~
~~Answer based on the 5 stages of Acute Radiation Syndrome~~
~~NEEP 234 Health Physics I, pg. 10~~
~~CDC website http://www.bt.cdc.gov/radiation/arsphysicianfactsheet.asp~~

B.8
Answer: b
Reference:10CFR55.53(e)

B.9
Answer: a
Reference: DOE Fundamentals Handbook-1013/2-92, pg. 42

~~**B.10 (Deleted per facility comment)**~~
~~Answer: a~~
~~Reference: The TEDE limit (5 rem) was not exceeded, however the TODE (50 rem) was exceeded~~
~~TEDE= (50 x 0.03) + 2= 3.5 rem~~
~~Total Organ Dose Equivalent (TODE) = 50 rem + 2 rem= 52 rem~~
~~10 CFR 20, NRP 234 "Health Physics I", pg. 4~~

B.11
Answer: b
Reference: UWNR 001, pg. 2

B.12
Answer: b
Reference: UWNR Tech Specs, pg. 7

B.13
Answer: d
Reference: UWNR Tech Specs, pg. 16

B.14
Answer: a
Reference: UWNR Tech Specs, pg. 17

B.15
Answer: d
Reference: UWNR TS 4.2.2a states the rod drop time shall be performed annually NTE 14 months, however LCO 3.3.1 states the scram time is <u>2 seconds</u>.

B.16
Answer: b
Reference: 10 CFR 20 and UWNR 001, pg. 4

B.17
Answer: c
Reference: 10 CFR 20.

B.18
Answer: d
Reference: UWNR 152, Table-2 "Fission Product Activities Likely to be Found in Air Particulate Samples with Fuel Leak"

B.19
Answer: d
Reference: UWNR 143 “Procedure for Fuel Handling and Core Arrangements”, pg. 2

B.20
Answer: b.
Reference: UWNR 119 A “Reactor Pulse Checkout”

Section C: Facility and Radiation Monitoring Systems

Question:

C.1
Answer: d
Reference: NEEP 234, pg. 5

C.2
Answer: a
Reference: NEEP 234, pg. 5

C.3
Answer: c
Reference: UWNR SAR, Rev.2, pg. 14-9

C.4
Answer: c
Reference: NE 234 “Reactivity Parameters of the Core and Pulsing”, pg. 3

C.5
Answer: a
Reference: UWNR TS, Section 5.5

C.6
Answer: d
Reference: NEEP 234 Math, pg. 9

C.7
Answer: c
Reference: NEEP 234 Math, pg. 9

C.8
Answer: c
Reference: UWNR SAR, Fig 4-6, NEEP 234 “Fuel and Core Arrangement”

C.9
Answer: a
Reference: NEEP 234 “Controls and Instrumentation”

C.10
Answer: b
Reference: UWNR SAR, pg. 7-16

~~**C.11**~~ **(Deleted per facility comment)**
~~Answer: a~~
~~Reference: SAR Section 7.5.1~~

C.12
Answer: b
Reference: UWNR SAR, pg. 14-25

C.13
Answer: b
Reference: NEEP 234 “Reactor Water System Make-up and Recirculation System”

~~**C.14**~~ **(Question deleted per facility comment)**
~~Answer: d~~
~~Reference: UWNR 132 “Pneumatic Tube Operations~~”

C.15
Answer: a
Reference:
In order for the primary pump to start, the intermediate pump must be running. And prior to the intermediate pump starting the chilled water pump must be operating.
UWNR SAR Section 5.0, UWNR 116 “Cooling System Operating Procedure”

C.16
Answer: a
Reference: DOE Fundamentals Handbook 1013, Section 2.4

C.17
Answer: ~~d~~ c (Answer is c not d)
Reference: UWNR SAR Section 7.3.8

~~**C.18**~~ **(Question deleted per facility comment)**
~~Answer: c~~
~~Reference: UWNR SAR, Section 7.4~~

C.19
Answer: b
Reference: SAR, Section 13.1.1

C.20
Answer: c
Reference: NEEP 234 “Reactor Water System Make-up and Recirculation System”