November 8, 2010

Dr. Ayman I. Hawari, Director
Nuclear Reactor Program
Department of Nuclear Engineering
North Carolina State University
Campus Box 7909
2500 Stinson Drive
Raleigh, NC 27695-7909

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-297/OL-11-01,
NORTH CAROLINA STATE UNIVERSITY

Dear Dr. Hawari:

During the week of October 25, 2010, the Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your North Carolina State University Pulstar reactor. 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. 50-297

Enclosures:
As stated

cc/ without enclosures: See next page

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OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung		CRevelle		JEads	
DATE	11/4/2010		11/4/2010		11/8/2010	

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cc:

Office of Intergovernmental Relations
116 West Jones Street
Raleigh, NC 27603

Dr. Yousry Azmy, Head
Nuclear Engineering Department
North Carolina State University
P.O. Box 7909
Raleigh, NC 27695-7909

Beverly Hall, Section Chief
Department of Environment and Natural Resources
Division of Environmental Health Radiation Protection Section
3825 Barrett Drive
Raleigh, NC 27609-7221

Dr. Louis Martin-Vega
Dean of Engineering
North Carolina State University
113 Page Hall
Box 7901 - NCSU
Raleigh, NC 27695-7901

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.: 50-297/OL-11-01

FACILITY DOCKET NO.: 50-297

FACILITY LICENSE NO.: R-120

FACILITY: North Carolina State University Pulstar Reactor

EXAMINATION DATES: October 25 – 27, 2010

SUBMITTED BY: _____**/RA/**_____ _____
Phillip T. Young, Chief Examiner Date

SUMMARY:

REPORT DETAILS

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

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/0	0/0	3/0
Operating Tests	3/0	0/0	3/0
Overall	3/0	0/0	3/0

3. Exit Meeting:
Phillip T. Young
Andrew Cook, Reactor Operations Manager
Kerry Kincaid, Reactor Maintenance Manager
Larry Broussard, NCSU, Chief Reactor Operator

The examiner informed the facility of the three observations from the operating examination:

1) Prior to taking the shift, after an absence from operating the reactor, the applicants could not explain how they would learn of procedure changes approved during their absence.
2) During the reactor operation portion of the examination, it was observed that some of the procedures used were not signed copies of the procedures.
3) Given a scenario of removing a very high rad sample from the pool, all applicant responded appropriately and demonstrated a very good understanding of recent RTR industry experience.

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

FACILITY: North Carolina State University

REACTOR TYPE: Pulstar

DATE ADMINISTERED: 10/25/2010

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 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
19.00	33.3	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
18.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
57.00		_____	____%	TOTALS
			FINAL GRADE	

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 only 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 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

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.001 (1.0 points) {1.0}
In a subcritical reactor, Keff is increased from 0.861 to 0.946. Which one of the following is the amount of reactivity that was added to the core?

a. 0.086 delta K/K
b. 0.104 delta K/K
c. 0.125 delta K/K
d. 0.220 delta K/K

Answer: A.001 b.
Reference: DPC Fundamentals of Nuclear Reactor Engineering p. 121
NUS, Vol. 3, p. 6.1-3

Question: A.002 (1.0 points) {2.0}
If the Reactor is shutdown by 4 percent delta k/k with a count rate (CR) of 8 cpm.
Which one of the following is the amount of positive reactivity that would have to be added to the reactor to have the count rate increase by a factor of three (3)?

a. 0.026 delta K/K
b. 0.058 delta K/K
c. 0.098 delta K/K
d. 0.113 delta K/K

Answer: A.002 a.
Reference: Nuclear Energy Training Module 3 section 6

Question: A.003 (1.0 points) {3.0}
Which one of the following is the amount of reactivity that has been added to a subcritical reactor if the count rate has increased from 100 cps to 150 cps and the initial value of Keff was 0.95 ?

a. 2840 pcm
b. 1850 pcm
c. 1700 pcm
d. 600 pcm

Answer: A.003 b.
Reference: Procedure Manual (PM) 2.3 pg. 1,2

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.004 (1.0 points) {4.0}

Which one of the following is the reason for operating with thermal neutrons instead of fast neutrons?

a. Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

b. Neutron absorption in non fuel material increases exponentially as neutron energy increases.

c. The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

d. Doppler and moderator temperature coefficients become positive as neutron energy increases.

Answer: A.004 c.
Reference: Nuclear Energy Training, Module 3, 1.5-2 and 2.6-1.

Question: A.005 (1.0 points) {5.0}

Given the following conditions:

Reactor is shutdown

Shutdown margin: 4%

Source range power level: 100 cps

An installed experiment is worth: -0.0114 delta K/K

Xenon is decaying

Following removal of the experiment, source range power level is 196 cps. Which one of the following is the CHANGE in reactivity DUE to Xenon.

a. 0.0078 delta K/K

b. 0.0094 delta K/K

c. 0.0201 delta K/K

d. 0.0251 delta K/K

Answer: A.005 b.
Reference: Nuclear Energy Training, Module 3, Section 10.2

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.006 (1.0 points) {6.0}
Which one of the following is the definition for INTEGRAL ROD WORTH?
Integral Rod Worth is defined as the reactivity…..

a. due to control rod position.
b. change per unit of rod motion.
c. due to the difference in a control rods position.
d. still available for shutdown after control rod withdrawal.

Answer: A.006 a.
Reference: Nuclear Energy Training Module 3 Section 7 page 7.5-1

Question: A.007 (1.0 points) {7.0}
The following facility parameters are given:

Primary coolant flow rate	500 GPM
Secondary system flow rate	700 GPM
Primary side delta-T across the heat exchanger	13 degrees F
Secondary side heat exchanger inlet temperature	73 degrees F

Which one of the following is the power level of the reactor with the above parameters?

a. 1.3 mW
b. 1.0 mW
c. 0.95 mW
d. 0.92 mW

Answer: A.007 ~~c.~~ d. correct answer changed to d. per facility comment.
Reference: General Electric, Heat Transfer and Fluid Flow - Chapter 7

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.008 (1.0 points) {8.0}

Given the following Primary System Parameters.

Reactor Pool Volume	14,250 gals
Reactor Pool Temperature	104º F
Reactor Power Level	1 MW

Which one of the following is the amount of time that is available before the reactor has to be scrammed, at 118 F pool temperature, when primary coolant flow is lost?

a. 15 minutes

b. 22 minutes

c. 29 minutes

d. 36 minutes

Answer: A.008 c.
Reference: Nuclear Energy Training, Module 4, Plant Performance Section 2

Question: A.009 (1.0 points) {9.0}

Which statement illustrates a characteristic of Subcritical Multiplication?

a. As Keff approaches unity (1), for the same increase in Keff, a greater increase in neutron population occurs.

b. The number of neutrons gained per generation gets larger for each succeeding generation.

c. The number of fission neutrons remains constant for each generation.

d. The number of source neutrons decreases for each generation.

Answer: A.009 a.
Reference: Nuclear Training Manual

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.010 (1.0 points) {10.0}
During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required intermediate range (IR) level. The critical data was taken again at the proper IR level with the same reactor coolant temperatures.

The critical rod (CEA) position taken at the proper IR level _____ the critical rod position taken two decades below the proper IR level.

a. is less than
b. is the same as
c. is greater than
d. cannot be compared to

Answer: A.010 b.
Reference: Fundamentals of Nuclear Reactor Engineering pg. 87, 117, 150

Question: A.011 (1.0 points) {11.0}
Why does the fuel temperature (Doppler) coefficient becomes less negative at higher fuel temperatures?

a. As reactor power increases, the rate of increase in the fuel temperature diminishes.
b. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.
c. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.
d. The broadening of the resonance peaks diminishes per degree change in fuel temperature.

Answer: A.011 d.
Reference: FNRE pg. 146, 149 / Nuc. Trng. Man. pg. RX 6-8

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.012 (1.0 points) {12.0}
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.012 d.
Reference: Pulstar Reactor Trainee Notebook, Section 1.5.2.

Question: A.013 (1.0 points) {13.0}
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. predicted criticality will occur with the same number of elements loaded as if the initial count rate had not been changed.

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

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

d. criticality will be completely unpredictable.

Answer: A. 013 a.
Reference: Pulstar Reactor Trainee Notebook, Section 1.5.4.

Question: A.014 (1.0 points) {14.0}
Which ONE of the following correctly describes the generation of neutrons from the Am-Be source?

a. $_{95}Am^{241} \rightarrow {}_{93}Np^{237} + {}_{2}\alpha^{4}$; $\quad {}_{2}\alpha^{4} + {}_{4}Be^{9} \rightarrow [{}_{6}C^{13}]^* \rightarrow {}_{6}C^{12} + {}_{0}n^{1}$

b. $_{95}Am^{241} \rightarrow {}_{96}Np^{241} + {}_{-1}\beta^{0} + \gamma$; $\quad {}_{0}\gamma^{0} + {}_{4}Be^{9} \rightarrow [{}_{4}Be^{9}]^* \rightarrow {}_{4}Be^{8} + {}_{0}n^{1}$

c. $_{95}Am^{241} \rightarrow {}_{96}Np^{241} + {}_{-1}\beta^{0} + \gamma$; $\quad {}_{-1}\beta^{0} + {}_{4}Be^{9} \rightarrow [{}_{3}Li^{9}]^* \rightarrow {}_{3}Li^{8} + {}_{0}n^{1}$

d. $_{95}Am^{241} \rightarrow$; [S.F.] $\rightarrow$ 2 fission products + $_{0}n^{1}$

Answer: A.014 a.
Reference:

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.015 (1.0 points) {15.0}
Which ONE of the following is an example of beta 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.015 d.
Reference:

Question: A.016 (1.0 points) {16.0}
Which of the following statements best characterizes Natural Circulation?

a. The driving force is a difference in density.

b. Heat transfer is more efficient as the heat source decays.

c. Heat transfer is more efficient if steam is mixed with water.

d. The elevation of the heat source must be above that of the heat sink.

Answer: A.016 a.
Reference: General Physics, HT&FF, pp. 355 - 358

Question: A.017 (1.0 points) {17.0}
During a reactor startup, criticality occurred at a lower rod height than the last startup. Which ONE of the following reasons could be the cause?

a. Xe^{135} peaked.

b. Moderator temperature increased.

c. Adding an experiment with positive reactivity.

d. Maintenance on the control rods resulted in a slightly faster rod speed.

Answer: A.017 c.
Reference:

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.018 (1.0 points) {18.0}
Given the following data, which ONE of the following is the closest to the half life of the material?

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

a. 11 minutes
b. 22 minutes
c. 44 minutes
d. 51 minutes

Answer: A.018 b.
Reference: $I = I_0 e^{-t/\tau}$ $Ln(369/2400) = 60min/\tau$ $\tau = 60min/[ln(369/2400)] = 32.044\ min^{-1}$.
$t_{1/2} = ln(2) \times \tau = -22.211$

Question: A.019 (1.0 points) {19.0}
Which ONE of the following ***IS CORRECT*** with regard to criticality?

a. Critical rod height does NOT depend on how fast control rods are withdrawn.
b. Critical rod height dictates the reactor power level when criticality is first achieved.
c. The reactivity of the reactor increases towards infinity during the approach to criticality.
d. The slower the approach to criticality, the lower the reactor power level will be when reaching criticality.

Answer: A.019 a.
Reference: Pulstar Reactor Trainee Notebook, Chapter 1, § 1.5.3, p. 19.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question: A.020 (1.0 points) {20.0}
Which ONE of the following describes a property of a ***GOOD MODERATOR***?

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

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

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

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

Answer: A.020 a.
Reference: Standard NRC QUESTION.

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.001 (1 point) {1.0}

During which of the following Start-up/Shutdown evolutions, described in NRP-OP-101, could you expect the stated reactor response to occur.

"However, if the power continues to rise at a steady exponential rate (stable positive period), the reactor is supercritical."

a. KEY-ON
b. FAST RECOVERY
c. SHUTDOWN – KEY-OFF
d. FORCED CONVECTION
e. NATURAL CIRCULATION

Answer: B.001 b.
Reference: NRP-OP-101, Reactor Startup and Shutdown Rev 3, Page 10,
SECTION - 5. REACTOR STARTUP – FAST RECOVERY

Question: B.002 (1 point) {2.0}

NRP-OP-101, Reactor Startup and Shutdown states the following "…a "benchmark" rod gang position is computed for a specified core configuration and set of control rod values. This value will be such that if the ACP results in the control rod gang being withdrawn beyond the "benchmark", then the cold, clean SDM will be > _____ and may be logged as such without computation."

What is the predetermined value for SDM that may be logged?

a. >500 pcm
b. >650 pcm
c. >800 pcm
d. >950 pcm

Answer: B.002 c.
Reference: NRP-OP-101, Reactor Startup and Shutdown Rev 3, Page 13,
SECTION - 8. SHUTDOWN MARGIN (SDM) VERFICATION

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.003 (1 point) {3.0}
Which of the following **does not** describe a Minor Change (to procedure)?

a. inclusion of additional reviews

b. changes in method of performance

c. changes or rearrangement of attachments

d. wording changes which are necessary for clarification or enhancement

Answer: B.003 b.
Reference: Special Procedure 2.1, Review and Approval of Documentation, Rev 8

Question: B.004 (1 point) {4.0}
All Minor changes shall be approved by the Associate Director or his designated alternate within _____ following implementation of the MC.

a. 24 hours
b. 48 hours
c. 7 days
d. 14 days

Answer: B.004 d.
Reference: Special Procedure 2.1, Review and Approval of Documentation, Rev 8

Question: B.005 (1 point) {5.0}
If a complete loss of water was to occur with the reactor having been operating at 1 Mwt power, which of the following would be the primary hazard of concern?

a. Keeping the reactor shutdown.

b. Core meltdown due to loss of cooling.

c. Clean up of the highly radioactive coolant water.

d. The vertical beam of radiation from the uncovered core.

Answer: B.005 d.
Reference: Generic question

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.006 (1 point) {6.0}
A point source of gamma radiation measures 50 mr/hr at a distance of 5 ft. What is the exposure rate (mr/hr) from the source at a distance of 10 ft.

a. 25 mr/hr

b. 17.5 mr/hr

c. 12.5 mr/hr

d. 6.25 mr/hr

Answer: B.006 c.
Reference: $DR_1D_1^2 = DR_2D_2^2$

Question: B.007 (1 point) {7.0} QUESTION DELETED – NO CORRECT ANSWER
~~A reactor startup is in progress. A stable N-16 indication of 900 kW has been obtained.~~
~~Verification of the Log N Channel, Linear Channel and Safety Channel is performed.~~
~~Which one of the following indications would require adjustment of the nuclear instruments to obtain agreement?~~
~~a. 990 kW~~

~~b. 900 kW~~

~~c. 880 kW~~

~~d. 860 kW~~
~~Answer: B.007 a.~~
~~Reference: NRP-OP-103, Reactor Operation, Rev 1 - Page 9 SECTION – 4. REACTOR POWER LEVELS~~

Question: B.008 (1 point) {8.0}
The Operations Boundary consists of:

a. the area within the Burlington Engineering Laboratory.

b. the area within the Pulstar Reactor Building and the South Wing.

c. the area within the Pulstar Reactor Building, Control Room and Primary Piping Vault.

d. the area within the Administration and Laboratory Building, and the Reactor Building.

Answer: B.008 c.
Reference: PULSTAR Emergency Plan Rev 8, FIGURE 4, REACTOR SITE MAP

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.009 (1 point) {9.0}
Which ONE of the following events does NOT require the direct presence (i.e., supervision) of a Senior Reactor Operator?

a. Recovery from an unplanned significant power reduction.

b. Movement of fuel within the reactor pool.

c. Reactor power calibration.

d. Control rod removal.

Answer: B.009 c.
Reference: Pulstar Technical Specifications, section 6.1.3.

Question: B.010 (1 point) {10.0}
Which ONE of the following events is considered an unanticipated abnormal reactivity change?

a. Continuous withdrawal of a safety rod.

b. Actual critical position is 150 pcm lower than the estimated critical position.

c. Reactivity value of an experiment is 150 pcm higher than that which was anticipated.

d. Unanticipated step change in power during operation resulting in short reactor period.

Answer: B.010 d.
Reference: NRP-OP-105 Response to SCRAMS, Alarms and Abnormal Conditions, Rev 0

Question: B.011 (1 point) {11.0}
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. The reading from Source B is half that of Source A.

d. Both readings are the same.

Answer: B.011 d.
Reference: GM tubes cannot distinguish between gammas of different energy.

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.012 (1 point) {12.0}
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 basis for emergency classification.

Answer: B.012 d.
Reference: Pulstar Emergency Plan Rev. 8

Question: B.013 (1 point) {13.0}
The minimum number of personnel required during movement of fuel into and from the core is:

a. a DSRO and a fuel handler.

b. a DSRO and a licensed operator at the reactor console.

c. a DSRO, a licensed operator at the reactor console and a fuel handler.

d. a DSRO at the reactor console and at least two Reactor Operator Assistants.

Answer: B.013 c.
Reference: NRP-OP-301 Reactor Fuel Handling

Question: B.014 (1 point) {14.0}
Which ONE of the following operations allows the Stack Gas and Particulate monitors to be bypassed?

a. Initiation of confinement system.

b. Movement of fuel out of the core.

c. Startup of the pneumatic blower system.

d. Removal of experiments from the reactor pool.

Answer: B.014 c.
Reference: Pulstar Technical Specifications, section 3.5.

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.015 (1 point) {15.0}
Which ONE of the following correctly defines a Safety Limit?

a. Limits on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

b. The Lowest functional capability of performance levels of equipment required for safe operation of the facility.

c. Settings for automatic protective devices related to those variables having significant safety functions.

d. a measuring or protective channel in the reactor safety system.

Answer: B.015 a
Reference: Technical Specifications § 1.0 which references 10CFR50.36

Question: B.016 (1 point) {16.0}
A radiation survey instrument was used to measure an irradiated experiment. The results were 100 mrem/hr with the window open and 60 mrem/hr with the window closed. What was the beta dose rate?

a. 40 mrem/hr

b. 60 mrem/hr

c. 100 mrem/hr

d. 140 mrem/hr

Answer: B.016 a.
Reference: Instrument reads only γ dose with window closed. Instrument reads both β and γ dose with window open. Therefore, β dose is window open dose less window closed dose.

Question: B.017 (1 point) {17.0}
Per the North Carolina State University Radiation Protection Program (HP 1), as an Adult Radiation Worker your TEDE yearly limit is 5 Rem. Your Admin and ALARA Goal limits for TEDE are …

a. 20% (1000 mrem) and 10% (500 mrem) of this limit.

b. 10% (500 mrem) and 5% (250 mrem) of this limit.

c. 10% (500 mrem) and 2% (100 mrem) of this limit.

d. 2% (100 mrem) and 1% (50 mrem) of this limit.

Answer: B.017 c.
Reference: HP-1 Radiation Protection Program, Rev. 6

Section B Normal/Emergency Procedures & Radiological Controls

Question: B.018 (1 point, 0.25 points each) {18.0}
10 CFR 55 contains requirements associated with your operator or senior operator license. Match each of the requirements listed in column A with it's appropriate time period in column B. (Note: Periods from column B may be used more than once or not at all.)

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

Answer: B.018 a. = 6; b. = 2; c. = 1; d. = 2
Reference: 10CFR55

Question: B.019 (1 point) {19.0}
Following a reactor scram reverse action of the control rod position indicates does NOT occur. As Reactor Operator your immediate action is to …

a. place the ganged insert switch to the IN position.
b. turn the reactor keyswitch OFF.
c. initiate a manual SCRAM.
d. inform the DRSO.

Answer: B.019 a.
Reference: NRP-OP-105 Response to SCRAMS, Alarms and Abnormal Conditions, Rev. 0 - Page 4

Question: B.020 (1 point) {20.0}
Personnel should be considered contaminated if (using an open window frisker), the reading exceeds

a. 50 net cpm
b. 100 net cpm
c. 200 net cpm
d. 500 net cpm

Answer: B.020 b.
Reference: HP-1 Radiation Protection Program, Rev. 6

Section C Facility and Radiation Monitoring Systems

Question C.001 (1.0 point) {1.0}
The reactor has been secured for a week. You startup the reactor and raise power to 1 Megawatt thermal. You depress the AUTO button but the rod control system fails to go into AUTO. Which ONE of the following is the most likely reasons the rod control system would not go into Automatic control?

a. Regulating rod is at 11.5 inches
b. Servo deviation is -0.35% of scale
c. Mode selector switch is in "steady State"
d. The ganged drive switch is not being operated

Answer: C.001 a.
Reference: NRP-OP-103 - Reactor Operation, Rev 1 - July 13, 2005; Page 10

Question C.002 (1.0 point) {1.0}
Match the purification system functions in column A with the purification component listed in column B

Column A	Column B
a. remove dissolved impurities	1. Demineralizer (Ion Exchanger)
b. remove suspended solids	2. Filters
c. maintain pH	3. Wye Strainer
d. Protect Purification Pump Impeller	

Answer: C.002 a. = 1; b. = 2; c. = 1; d. = 3
Reference: SAR

Question C.003 (1.0 point) {3.0}
Which ONE of the following primary parameters, if alarming, requires the operator to manually insert a scram?

a. Low Pool Level
b. Low Primary Flow
c. High Temperature
d. Safety Flapper Not Closed

Answer: C.003 c.
Reference: NRP-OP-105 - Response to SCRAMS, Alarms and Abnormal Conditions, Rev 0 - April 1, 2005; Page 7

Section C Facility and Radiation Monitoring Systems

Question C.004 (1.0 point) {4.0}
Which of the following methods is used to remove the gamma signal from the neutron signal in the Startup Channel?

a. The outer chamber prevents gammas from ionizing the inner chamber.
b. Inner chamber current cancels out gamma current in the outer chamber.
c. A pulse height discriminator does not allow the gamma signals to be counted.
d. Squaring the combined signal makes the gamma contribution insignificant.

Answer: C.004 c.
Reference: SAR, 7.2.1. Source Range Channel

Question C.005 (1.0 point) {5.0}
You may bypass the rod drive inhibits by depressing the Log N operative pushbutton if …

a. the startup channel is reading < 2 cps
b. the Log N startup channel is reading > 2 watts
c. the startup channel is reading > 9×10^4 cps
d. The Log N channel is reading > 4 watts

Answer C.005 d.
Reference: NRP-OP-101 - Reactor Startup and Shutdown, Rev 3 - July 25, 2006; Page 5 and NRP-OP-105 - Response to SCRAMS, Alarms and Abnormal Conditions, Rev 0 - April 1, 2005; Page 6

Question C.006 (1.0 point) {6.0}
Which ONE of the following conditions will prevent you from energizing the rod magnets prior to startup?

a. Linear Power Scram relay is energized
b. Over-the-Pool Radiation Monitor in alarm
c. Air line to Pool level bubbler is isolated
d. 48 VDC is present at SCRAM Logic circuit input

Answer: C.006 c.
Reference: SAR - 7.3.3. Pool Level Measuring Channel and NRP-OP-101 - Reactor Startup and Shutdown, Rev 3 - July 25, 2006 APPENDIX B – STARTUP CHECKLIST INSTRUCTIONS

Section C Facility and Radiation Monitoring Systems

Question C.007 (1.0 point) {7.0}
The NCSU reactor cladding is made of …

a. aluminum
b. silver-indium-cadmium alloy
c. stainless steel
d. zirconium alloy

Answer: C.007 d.
Reference: SAR § 3.2. Reactor Design

Question C.008 (1.0 point) {8.0}
TWO channels provide protection against exceeding the Safety Limit due to insufficient pool height, Pool Water Level and the …

a. Over-the-Pool Radiation Monitor
b. Flow Monitoring (Flapper)
c. Pool Water Temperature
d. Primary Coolant Flow

Answer: C.008 a.
Reference: NCSU Tech. Specs. pg 17

Question C.009 (1.0 point) {9.0}
When a fuel assembly is inserted into the core, misalignment is prevented by:

a. proper orientation of the upper end fitting.
b. proper orientation of openings on the sides of the assembly.
c. proper orientation of the bail between the side plates at the top of the assembly.
d. proper orientation of two holes on the lower end fitting which mate with a pin on the grid plate.

Answer: C.009 ~~c.~~ Correct answer changed to d., typo error.
Reference: Pulstar Safety Analysis Report, section 3.2.2.4.

Section C Facility and Radiation Monitoring Systems

Question C.010 (1.0 point) {10.0}
The purpose of the aluminum-to-stainless steel transition couplings are to prevent:

a. buildup of fission gases in the beamports.

b. Fatigue (Vibrational) Failure of the piping.

c. galvanic corrosion in the primary system.

d. stress corrosion of the stainless steel due to chlorine leaching from the barytes concrete.

Answer: C.010 c.
Reference: SAR 4.2.6

Question C.011 (1.0 point) {11.0}
The auxiliary generator emergency latch relay will open if either oil pressure is …

a. low or water temperature is low

b. low or water temperature is high

c. high or water temperature is low

d. high or water temperature is high

Answer: C.011 b.
Reference: SAR, 8.3.3. Auxiliary Generator Control Panel

Question C.012 (1.0 point) {12.0}
Typically for a fuel leak within the pool, some isotopes are not detected by the air radiation monitors. Which ONE of the following would **NOT** be detected by the air monitors and why.

a. I^{131}, because it is soluble, and will never make it out of the pool (except in the demineralizer).

b. Cs^{131}, because it is a daughter product of a noble gas and will dissipate.

c. Kr^{88}, because it is a noble gas which cannot be detected.

d. Xe^{131}, because it has too short a half-life.

Answer: C.012 a.
Reference:

Section C Facility and Radiation Monitoring Systems

Question C.013 (1.0 point) {13.0}
Which ONE of the following statements is true?

a. The primary pump must be operating for the secondary pump to operate.
b. The secondary pump must be operating for the primary pump to operate.
c. The secondary pump must be operating for the cooling tower fans to operate.
d. The cooling tower fans must be operating for the secondary pump to operate.

Answer: C.013 c.
Reference: POM, § 5.2

Question C.014 (1.0 point) {14.0}
A facility Evacuation signal will also cause an automatic confinement initiation. In Confinement, the Heating & Ventilation fans…

a. must be manually secured, but the confinement fans start automatically.
b. automatically secure, but the confinement fans must be started manually.
c. automatically secure, and Confinement Fan #1 automatically starts immediately.
d. automatically secure, and BOTH of the confinement fans automatically start immediately.

Answer: C.014 c.
Reference: POM § 8.2.5.

Question C.015 (1.0 point) {15.0}
Which ONE of the following statements describes the reactor instrumentation and protection channels response to a High failure of the regulator supplying the flow measuring channel?

a. Low flow indication and low flow scram at 475 gpm if greater than 150 kw.
b. High flow indication and low flow scram signal.
c. High reactor coolant flow indication
d. No effect.

Answer: C.015 b.
Reference: POM Sect. 4 pg. 4-12

Section C Facility and Radiation Monitoring Systems

Question C.016 (1.0 point) {16.0}
To satisfy the Control Rod Drives Interlocks, which ONE of the following inputs requires that the reactor key switch be "ON" ?

a. Individual Magnet power
b. Ganged up-drive power bus
c. Ganged down-drive power bus
d. Individual Drive Motor power line

Answer: C.015 a.
Reference: POM Sect. 4 pg. 4-20/Fig. 4.4

Question C.017 (1.0 point) {17.0} QUESTION DELETED FROM EXAM _ NO CORRECT ANSWER, ALL ON UPS POWER.
~~Which one of the following Area Monitors will automatically shift to battery power upon the loss of AC voltage?~~
~~a. Control Room~~
~~b. Reactor Bridge~~
~~c. Over Reactor Pool~~
~~d. Reactor Bay West Wall~~
~~Answer: C.017 b.~~
~~Reference: 1991 NRC Exam & {NCS Section 7 Radiation Monitoring and Radioactive Drain System, Subsection 7.2.1 page 7-2}~~

Question C.018 (1.0 point) {18.0} QUESTION DELETED FROM EXAM _ NO CORRECT ANSWER, ALL ARE SELF RESETTING.
~~Which one of the following Alert Annunciators is self-resetting in addition to being acknowledgeable in the normal manner?~~
~~a. Rabbit in Reactor~~
~~b. Pulse Pressure~~
~~c. Radiation Alert~~
~~d. Door Open~~
~~Answer: C.018 d.~~
~~Reference: 1991 NRC Exam & NCS Section 3 Reactor Operating Procedures Subsection 3.4.3.5 page 3~~

Section C Facility and Radiation Monitoring Systems

Question C.019 (1.0 point) {19.0}

Temperatures in the primary coolant system are measured at five locations using a:

a. thermometer.

b. thermocouple.

c. bimetallic temperature detector.

d. resistance temperature detector.

Answer: C.019 d.
Reference: Safety Analysis Report

Question C.020 (1.0 point) {20.0}

Following an automatic reactor scram, the control rod motor will drive the magnet down because:

a. the seating light is activated.

b. the down-limit light is activated.

c. magnet current has been interrupted.

d. the contact switch between the magnet and armature rod opens, signaling that they are no longer magnetically coupled.

Answer: C.020 c.
Reference: Pulstar Operations Manual, section 4.4.3.