July 28, 2008

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-08-01, NORTH CAROLINA STATE UNIVERSITY

Dear Dr. Hawari:

During the week of June 23, 2008, the NRC administered an operator licensing examination at the North Carolina State University 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 Mr. Phillip T. Young at 301-415-4094 or via internet e-mail pty@nrc.gov.

Sincerely,

**/RA/**

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-297

Enclosures: 1. Initial Examination Report No. 50-297/OL-08-01
2. Written examination with facility comments incorporated

cc without enclosures: See next page

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| DATE | 7/16/08 | | 7/23/08 | | 7/28/08 | |

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Test, Research, and Training
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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-297/OL-08-01

FACILITY DOCKET NO.: 50-297

FACILITY LICENSE NO.: R-120

FACILITY: North Carolina State University

EXAMINATION DATES: June 23 – 24, 2008

SUBMITTED BY: _____**/RA/**_____ 07/03/2008
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of June 23, 2008, the NRC administered operator licensing examinations to four Reactor Operator candidates. All candidates passed the written examination and all candidates passed the operating test.

ENCLOSURE 1

**REPORT DETAILS**

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

2. Results:

| | RO PASS/FAIL | SRO PASS/FAIL | TOTAL PASS/FAIL |
|---|---|---|---|
| Written | 4/0 | 0/0 | 4/0 |
| Operating Tests | 4/0 | 0/0 | 4/0 |
| Overall | 4/0 | 0/0 | 4/0 |

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

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:

The examiner reported that all candidates demonstrated a good knowledge of Technical Specification requirements. However, they could not name the individual sections and did not demonstrate an understanding of the reasons behind the sequencing of the Technical Specification sections.

Although the applicants all took the appropriate actions given a loss of Secondary Cooling, they did not demonstrate an appreciation of an approximate rate of change in pool temperature to a loss of Secondary Cooling.

The applicants demonstrate a through knowledge of the Confinement System flow path, components and initiation signals, they did not have a working knowledge of the purpose of using a charcoal filter in the confinement ventilation train.

# North Carolina State University

# NRC License Examination

# Written Examination
# with Answer Key

# 06/23/2008

Enclosure 2

Question: A.001 [1.0 point] {1.0}
A reactor is subcritical with a $K_{eff}$ of 0.955. A positive reactivity of 650 pcm is inserted into the core. At this point, the reactor is:

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

Answer: A.001 a.
Reference: Pulstar Reactor Trainee Notebook, Section 1.4.1.
When $k_{eff}$ = 0.955, ρ = -0.0471 delta k/k; 650 pcm = +0.00650 delta k/k.
-0.0471 + 0.0065 delta k/k = -0.0406 delta k/k, therefore reactor is subcritical.

Question: A.002 [1.0 point] {2.0}
Which ONE of the following describes the term “prompt jump?”

a. A reactor which is critical on prompt neutrons only.
b. A negative reactivity insertion which is less than $\beta_{eff}$.
c. A reactor which is critical using both prompt and delayed neutrons.
d. The instantaneous change in the neutron population due to withdrawing a control rod.

Answer: A.002 d.
Reference: Pulstar Reactor Trainee Notebook, Section 2.2.

Question: A.003 [1.0 point] {3.0}
As a reactor continues to operate over time, for a constant power level, the thermal neutron flux:

a. decreases, due to the increase in fission product poisons.
b. increases, in order to compensate for fuel depletion.
c. decreases, because fuel is being depleted.
d. remains the same.

Answer: A.003 b.
Reference: Pulstar Reactor Trainee Notebook, Section 3.4.
Power = $\Sigma_f \Phi_{th}$ As $\Sigma_f$ decreases due to fuel burnup, $\Phi_{th}$ must increase.

Question: A.004 [1.0 point] {4.0}
Inelastic scattering can be described as a process whereby a neutron collides with a nucleus and:

a. recoils with the same kinetic energy it had prior to the collision.
b. is absorbed by the nucleus, with the nucleus emitting a gamma ray.
c. recoils with a lower kinetic energy, with the nucleus emitting a gamma ray.
d. recoils with a higher kinetic energy, with the nucleus absorbing a gamma ray.

Answer: A.004 c.
Reference: Pulstar Reactor Trainee Notebook, Section 1.1.

Question: A.005 [1.0 point] {5.0}
Two critical reactors at low power are identical except that Reactor #1 has a beta fraction of 720 pcm and Reactor #2 has a beta fraction of 600 pcm. 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 startup rate will be faster.
d. The resulting startup rate will be slower.

Answer: A.005 c.
Reference: Pulstar Reactor Trainee Notebook, Section 2.3.

Question: A.006 [1.0 point] {6.0}
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.006 b.
Reference: Pulstar Reactor Trainee Notebook, Section 1.5.3.

Question: A.007 [1.0 point] {7.0}
The resonance escape probability is the probability that a fission neutron will escape capture in resonances as it slows down to thermal energies. As the moderator temperature increases, the resonance escape probability:

a. increases, since the moderator becomes less dense.
b. increases, since the moderator-to-fuel ratio increases.
c. decreases, since the time required for a neutron to reach thermal energy increases.
d. remains constant, since the effect of moderator temperature change is relatively small.

Answer: A.007 c.
Reference: Pulstar Reactor Trainee Notebook, Section 2.7.1.

Question: A.008 [1.0 point] {8.0}
During the minutes following a reactor scram, reactor power decreases on a negative 80-second period (-1/3 DPM), corresponding to the half-life of the longest-lived delayed neutron precursors, which is approximately:

a. 20 seconds.
b. 40 seconds.
c. 55 seconds
d. 80 seconds.

Answer: A.008 c.
Reference: Pulstar Reactor Trainee Notebook, Section 2.4.

Question: A.009 [1.0 point] {9.0}
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 be completely unpredictable.
b. predicted criticality will occur later (i.e., with more elements loaded).
c. predicted criticality will occur earlier (i.e., with fewer elements loaded).
d. predicted criticality will occur with the same number of elements loaded as if the initial count rate had not been changed..

Answer: A.009 c.
Reference: Pulstar Reactor Trainee Notebook, Section 1.5.4.

Question: A.010 [1.0 point] {10.0}
A reactor pool contains 106, 000 gallons of water at 90 degrees F, and it heats up to 93 degrees F in two hours. Assuming no ambient losses, the calculated power level is:

a. 93 kW.
b. 259 kW.
c. 389 kW.
d. 777 kW.

Answer: A.010 c.
Reference: Pulstar Reactor Trainee Notebook, Section 3.7.
Power = $mc\Delta T/\Delta t$ , where: m=106,000 gallons x 8.34 lbs/gal = 884,040 lb; c=1 Btu/°F-lb; $\Delta T/\Delta t$ = 1.5 degrees/hour. Power = 1,326,060 Btu/hour; 3413 Btu/hour = 1 kW. Power = 1,326,060/3413 = 389 kW

Question: A.011 [1.0 point] {11.0}
Which ONE of the following parameter changes will require control rod INSERTION to maintain constant power level following the change?

a. Insertion of a void into the core.
b. Buildup of samarium in the core.
c. Pool water temperature increase at 90% power.
d. Removal of an experiment containing cadmium.

Answer: A.011 d.
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

Question: A.012 [1.0 point] {12.0}
Which ONE of the following is the approximate time period during which the MAXIMUM amount of Xenon-135 will be present in the core?

a. 40 to 50 hours after a startup to 100% power.
b. 10 to 12 hours after shutdown from 100% power.
c. 40 to 50 hours after a power increase from 50% to 100%.
d. 10 to 12 hours after a power decrease from 100% to 50%.

Answer: A.012 b.
Reference: Pulstar Reactor Trainee Notebook, Figure 2.11.

Question: A.013 [1.0 point] {13.0}
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 10 degrees F. Given that the moderator temperature coefficient is -4.0 pcm/deg. F and the differential rod worth of the regulating rod is 160 pcm/inch, the change in the position of the regulating rod will be:

a. two (2) inches in.
b. two (2) inches out.
c. one-quarter (0.25) inch in.
d. one-quarter (0.25) inch out.

Answer: A.013 d.
Reference: Pulstar Reactor Trainee Notebook, Section 2.7.1.
Since the coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn. (10 deg. F)x(-4.0 pcm/deg. F) / (160 pcm/inch) = -0.25 inches.

Question: A.014 [1.0 point] {14.0}
Which ONE of the following conditions describes a critical reactor?

a. $K_{eff} = 1$; $\Delta k/k$ ($\rho$) = 1
b. $K_{eff} = 1$; $\Delta k/k$ ($\rho$) = 0
c. $K_{eff} = 0$; $\Delta k/k$ ($\rho$) = 1
d. $K_{eff} = 0$; $\Delta k/k$ ($\rho$) = 0

Answer: A.014 b.
Reference:

Question: A.015 [1.0 point] {15.0}
Which ONE of the following is an example of beta decay?

a. $_{35}Br^{87}$ □ $_{33}As^{83}$
b. $_{35}Br^{87}$ □ $_{35}Br^{86}$
c. $_{35}Br^{87}$ □ $_{34}Se^{86}$
d. $_{35}Br^{87}$ □ $_{36}Kr^{87}$

Answer: A.015 d.
Reference:

Question: A.016 [1.0 point] {16.0}
You are increasing reactor power on a steady +26 second period. How long will it take to increase power by a factor of 1000?

a. 60 seconds (1 minute)
b. 180 seconds (3 minutes)
c. 300 seconds (5 minutes)
d. 480 seconds (8 minutes)

Answer: A.016 b.
Reference: $\ln (P/P_0) \times \text{period} = \text{time}$,
$\ln(1000) \times 26 = 6.908 \times 26 = 179.6 \approx 180$ seconds

Question: A.017 [1.0 point] {17.0}
Initially Nuclear Instrumentation is reading 30 CPS and the reactor has a $K_{eff}$ of 0.90. You add an experiment which causes the Nuclear Instrumentation reading to increase to 60 CPS. Which ONE of the following is the new $K_{eff}$?

a. 0.91
b 0.925
c. 0.95
d. 0.975

Answer: A.017 c.
Reference: $CR_2/CR_1) = (1 - K_{eff1})/(1 - K_{eff2})$ $60/30 = (1 - 0.900)/(1 - K_{eff2})$
$1- K_{eff2} = ½ \times 0.1 = 0.05$ $K_{eff2} = 1 - 0.05 = 0.95$

Question: A.018 [1.0 point] {18.0}
Several processes occur that may increase or decrease the available number of neutrons. SELECT from the following the six-factor formula term that describes an INCREASE in the number of neutrons during the cycle.

a. Thermal utilization factor (f).
b. Resonance escape probability (p).
c. Fast non-leakage probability ($□_f$).
d. Fast Fission factor (ε).

Answer: A.018 d.
Reference:

Question: A.019 [2.0 points, ½ each] {20.0}
Match each term 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.019 a. = 2; b. = 4; c = 1; d = 3
Reference: Pulstar Reactor Trainee Notebook, Chapter 2, § 2.2 and
Chapter 1, § 1.4.4 ¶¶ 5 and 7.

Question B.001 (1.0 point) {1.0}
Technical Specifications state "The rate of reactivity insertion of the control rods, averaged over the length of the rods, is not greater than 0.1% delta k/k per second." Which of the following is the bases for this limit?
The maximum rate of reactivity insertion by the control rods which is allowed by Specification 3.2c assures the Safety Limit will not be exceeded during:

a. a rod ejection accident in the steady state mode.
b. a startup accident due to a continuous linear reactivity insertion.
c. the flow reversal which occurs upon loss of forced convection coolant flow.
d. an accidental withdrawal of a 0.3% delta k/k experiment in the pneumatic rabbit.

Answer: B.001 b. ~~d.~~ Typo, facility comment.
Reference: NCSU Tech Spec 3.2.D Bases

Question B.002 (1.0 point) {2.0}
Which one of the following is the Limiting Safety System Setting for the height of water above the core?

a. 20 feet, 0 inches (min)
b. 17 feet, 0 inches (min)
c. 14 feet, 2 inches (min)
d. 14 feet, 0 inches (min)

Answer: B.002 c.
Reference: NCS Tech Spec Section 2.2.1 and 2.2.2

Question B.003 (1.0 point) {3.0}
Two centimeters of lead placed at a certain location in a beam of gamma rays reduced the gamma radiation level from 400 mR/hr to 200 mR/hr. Which one of the following is the amount of additional lead if placed in this beam would reduce the gamma radiation level to 25 mR/hr?

a. 2 cm
b. 4 cm
c. 6 cm
d. 8 cm

Answer: B.003 c.
Reference: NET Module 5 Section 3.3 Protection Technique: Shielding

Question B.004 (1.0 point) {4.0}
Given the following information:

3.5 curie point source of Cesium 137

Gamma Energy at 0..662 Mev

Which one of the following is the radiation level 2 meters from this source?

a. 1154 mr/hr
b. 901 mr/hr
c. 661 mr/hr
d. 330 mr/hr

Answer: B.004 d.
Reference: NET Module 5 Section 3.2 Protection Technique: Distance

Question B.005 (1.0 point) {5.0}
Because of an operational situation a Temporary Deviation of NRP-OP-101, Reactor Startup and Shutdown is required. Who, by title, represents minimal level of authority required to make this change?

a. Associate Director
b. Chief Reactor Operator
c. Reactor Operations Manager
d. Senior Reactor Operator on duty

Answer: B.005 d.
Reference: Special Procedure 2.1, Review and Approval of Documentation

Question B.006 (1.0 point) {6.0}
Which one of the following Emergency Classes is being described?
"Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the reactor."

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

Answer: B.006 b.
Reference: E-Plan, 4.2 Emergency Classification

Question B.007 (1.0 point) {7.0}
Which one of the following are the actions required by the fuel handling crew in the event of an evacuation signal during fuel movement, before the fuel handling crew evacuates the Reactor Bay? The fuel assembly in transit shall be:

a. secured in its present location and the bridge crane de-energized.
b. stored in a recorded location and the fuel handling tool disconnected from the fuel.
c. placed in its designated move location and bridge crane movement controls locked.
d. lowered to the bottom of the pool at it present location and the and the fuel handling tool tied in place.

*Answer: B.007 b.
*Reference: NRP-OP-301, Reactor Fuel Handling – Section 2. Precautions and Limitations

Question B.008 (2.0 points) {9.0} Question deleted from examination – answer not clear
~~For the procedure change types listed in Column A, match the list of Reviewers in Column B and the list of Approvers in Column C. For all procedures requiring a 10 CFR 50.95 Screening, this was completed successfully and an Evaluation was not required. Items in Column B and C may be used more than once or not at all.~~

| ~~Column A~~ | ~~Column B~~ | ~~Column C~~ |
|---|---|---|
| ~~Type of Document~~ | ~~Reviewers~~ | ~~Review & Approval~~ |
| ~~a. Procedure Change~~ | ~~v. Independent Reviewer~~ | ~~1. AD~~ |
| ~~b. Minor Change~~ | ~~w. SRO~~ | ~~2. RSAC~~ |
| ~~c. E-Plan~~ | ~~x. ROM~~ | ~~3. RSC~~ |
| ~~d. Experiments~~ | ~~y. RHP~~ | ~~4. NRC~~ |
| | ~~z. AD~~ | |

~~Answer: B.008 a. = w./x./y & 1./2./3; b. = w./x./y & 1; c. = w./x./y & 1./2./3; d. = w./x./y./z. & 3.~~
~~Reference: Special Procedure 2.1, Review and Approval of Documentation - TABLE 1 REVIEW and APPROVAL of DOCUMENTS~~

Question B.009 (1.0 point) {10.0}
An individual receives 100 mRem of Beta (ß), 25 mRem of gamma (γ), and 5 mRem of neutron radiation. What is his/her total dose?

a. 275 mRem
b. 205 mRem
c. 175 mRem
d. 130 mRem

Answer: B.009 d
Reference: 10 CFR 20.4 A rem is a rem is a rem

Question B.010 (1.0 point) {11.0}
Which ONE of the following statements is an expression of the ALARA program?

a. Reduces the chances of a nuclear accident occurring.
b. Reduces unauthorized visitor entry into radiation areas.
c. Reduces the amount of toxic chemical exposure during reaction operations.
d. Reduces radiation doses to occupational workers and members of the public.

Answer: B.010 d.
Reference: HP-1, Attachment 1 – ALARA Policy Statement

Question B.011 (1.0 point) {12.0}
Which ONE of the following is the amount of time a licensed operator must perform his/her licensed duties to maintain proficiency?

a. Four hours per month
b. Four hours per quarter
c. Six hours per month
d. Six hours per quarter

Answer: B.011 b.
Reference: NCSU Special Procedure 2.6

Question B.012 (1.0 point) {13.0}
Which one of the following positions represents the minimal level of authority required to approve the release of irradiated materials to off-campus users?

a. Any NRC licensed operator
b. Designated Senior Reactor Operator
c. Associate Director
d. Reactor Health Physicist

Answer: B.012 d.
Reference: NRP-OP-103, Reactor Operation - 2. Shift Staffing and Responsibilities

Question B.013 (1.0 point) {14.0}
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. 25.0 mr/hr
b. 17.5 mr/hr
c. 12.5 mr/hr
d. 6.25 mr/hr

Answer: B.013 c.
Reference: $DR_1D_1^2 = DR_2D_2^2$

Question B.014 (1.0 point) {15.0}
Which one of the following are the required signatures for a Radiation Work Permit once it is initiated and signed by the Reactor Health Physicist?

a. Designated Senior Reactor Operator and the Reactor Operations Manager.
b. Reactor Operator on watch and the Designated Senior Reactor Operator.
c. Person in charge of the job and the Designated Senior Reactor Operator.
d. Person in charge of the job and the Reactor Operations Manager.

Answer: B.014 d.
Reference: HP-8 Radiation Work Permit and Protective Clothing (4.2.7)

Question B.015 (1.0 point) {16.0}
When determining shutdown margin for an operating reactor, how many control rod assemblies are assumed to remain FULLY withdrawn? Select the answer that will be true for all conditions.

a. All control rod assemblies are fully withdrawn.
b. A single control rod of the highest reactivity worth.
c. The control assembly with the longest drop time is fully withdrawn.
d. None of the control rod assemblies are assumed to be fully withdrawn.

Answer: B.015 b.
Reference: T.S. 3.2a

Question B.016 (1.0 point) {17.0}
During which ONE of the following evolutions is the presence of the DSRO NOT required?

a. First startup of the day.
b. Use of interlock bypasses.
c. Recovery from a known SCRAM.
d. At the start of the Key-Off Checklist.

Answer: B.016 c.
Reference: NRP-OP-103, Reactor Operation - 2. Shift Staffing and Responsibilities

Question B.017 (1.0 point) {18.0}
In accordance with the Technical Specifications, which ONE condition below is NOT permissible when the reactor is operating?

a. Pool water temperature = 112 degrees F.
b. The Over-the-Pool monitor bypassed for 10 minutes.
c. Reactivity worth of a single non-secured experiment = 0.4% Δk/k (400 pcm).
d. Operation with a fueled experiment with the ventilation system in the confinement mode.

Answer: A.017 b.
Reference: Pulstar Technical Specifications, section 3.3.

Question B.018 (1.0 point) {19.0}
One of the immediate action steps following a reactor scram is the “ensure Reverse action of control rod position indicators.” Which ONE of the following is the action to be taken if the reverse action fails to occur?

a. Move the Ganged Insert switch to the “In’ position.
b. Inform the Designated Senior Reactor Operator.
c. Turn the Reactor Keyswitch off.
d. Initiate a Manual SCRAM.

Answer: B.018 a.
Reference: Pulstar Operations Manual, Reactor Operating Procedures, section 3.4.1.2.

Question B.019 (1.0 point) {20.0}

Which ONE of the following events is considered an unanticipated abnormal reactivity change?

a. Actual critical position is 50 pcm lower than the estimated critical position.
b. Reactivity value of an experiment is slightly higher than that which was anticipated.
c. Continuous withdrawal of a safety rod.
d. A change in reactivity greater the βeff

Answer: B.019 d. ~~a.~~ Typo, facility comment.
Reference: NRP-OP-105, Response to SCRAMS, Alarms and Abnormal Conditions
4. RESPONSE TO ABNORMAL CONDITIONS
4.1. Abnormal Reactivity Changes

Question C.001 (1.0 point) {1.0}
Which one of the following conditions is indicated by the confinement fan damper-verification lights on the Radiation-Monitoring Panel when they are illuminated?

a. power is available to the controlled dampers
b. negative air pressure in the Reactor Building is achieve
c. the main H & V supply and exhaust dampers are fully open
d. the main H & V supply and exhaust dampers are fully closed

Answer: C.001 d.
Reference: SAR, 5.2. Confinement Initiation

Question C.002 (1.0 point) {2.0}
Which one of the following combination of Air Monitoring systems constitutes an off-line isokinetic sampling system?

a. Stack Gas Monitor & Particulate monitor
b. Auxiliary GM monitor & Reactor Bay Cam
c. Recirculation GM monitor & Reactor Bay Cam
d. Over the Pool monitor & Stack Particulate monitor

Answer: C.002 a.
Reference: SAR - 5.2. Confinement Initiation

Question C.003 (1.0 point) {3.0}
Which one of the following monitors utilizes a gamma sensitive scintillation detector?

a. Waste Tank Monitor
b. Stack Particulate Monitor
c. Control Room Area Monitor
d. Personnel Hand and Feet Monitor

Answer: C.003 a.
Reference: SAR - 4.2.4. Liquid Radioactive Drain System

Question C.004 (1.0 point) {4.0}
Which one of the following monitors, when in an ALARM condition, DOES NOT cause an Evacuation?

a. West Reactor Bay Wall Monitor

b. Primary Demineralizer Monitor

c. Control Room Area Monitor

d. Auxiliary GM

Answer: C.004 b.
Reference: SAR - 10.2. Radiation Protection, 10.2.2.Installed Radiation Monitoring Instrumentation

Question C.005 (1.0 point) {5.0}
Which one of the following correctly describes how a Resistance Temperature Detector (RTD) failure would be indicated? If an RTD should fail,

a. because of a short, the temperature indication will go offscale in the low value direction.

b. because of a short, the temperature indication will go to the midpoint of the temperature scale.

c. in the open position, the temperature indication will go offscale in the low value direction.

d. in the open position, the temperature indication will go to the midpoint of the temperature scale.

Answer: C.005 a.
Reference: Generic Instrumentation Question

Question C.006 (1.0 point) {6.0}
Which ONE set of equations below describes the operation of the installed neutron source?

a. Pu -> U + alpha Be + alpha -> C + neutron

b. Pu -> Am + beta Be + beta -> Li + neutron

c. Pu -> U + alpha B + alpha -> N + neutron

d. Pu -> Am + beta B + beta -> Be + neutron

Answer: C.006 a.
Reference: SAR, TABLE 1-1 - Comparison of Pulstar Reactors
NCSU SNM Inventory Record

Question C.007 (1.0 point) {7.0}
Select the control rod magnet current required to be used prior to fuel movements.

a. 40 mA
b. 60 mA
c. 80 mA
d. 100 mA

Answer: C.008 b.
Reference: NRP-OP-301 - Reactor Fuel Handling; APPENDIX A – CONFIRMATION OF CONDITIONS FOR FUEL MOVEMENT

Question C.008 (1.0 point) {8.0}
An SRO is required to be present for insertion or relocation of any in-core experiment with a reactivity worth greater than _____.?

a. 300 pcm or 100 pcm/sec whichever is more limiting
b. 730 pcm
c. 1000 pcm
d. 2900 pcm

Answer: C.008 b.
Reference: NRP-OP-104 - Reactor Experiments; 2. PRECAUTIONS AND LIMITATIONS

Question C.009 (1.0 point) {9.0}
Which ONE of the following is the purpose of the Nitrogen Purge System?

a. It provides a nitrogen purge gas to the Pneumatic Transfer System to reduce the formation of Ar-41.

b. It acts as a backup motive force in the Pneumatic Transfer system should the air/vacuum supply blower fail.

c. It acts with the BT&TC exhaust system to supply a continuous nitrogen gas blanket to the Beam Tubes to minimize Ar-41 formation.

d. It is used as a source of nitrogen gas for moisture removal and humidity control within the Beam Tubes while in use as a specimen chamber.

Answer: C.009 a.
Reference: SAR - 10.1. Radioactive Wastes

Question C.010 (1.0 point) {10.0}
Which ONE of the following actions does not occur upon the receipt of a Confinement signal?

a. Control Room HVAC off
b. BT&TC exhaust fan off (and damper)
c. Confinement Fan #2 starts (and damper opens)
d. Main H&V system off (supply & exhaust fans and dampers)

Answer: C.010 c.
Reference: NRP-OP-101, Reactor Startup and Shutdown;
APPENDIX B – STARTUP CHECKLIST INSTRUCTIONS (Page 4 of 17) – Restoration of Normal H&V System

Question C.011 (1.0 point) {11.0}
Which ONE of the following statements is TRUE?

a. The Emergency Reactor Air is supplied by the BEL air compressor.
b. An orifice reduces city water pressure to 20 psig for use in the Service Water System.
c. The purification system uses non-regenerable nuclear grade resin to control primary system pH.
d. The Reactor Bay Raw Water system is used to directly supply water for beam tube annulus recirculation.

Answer: C.011 c.
Reference: SAR, 4.2.3. Purification System

Question C.012 (1.0 point) {12.0}
Which of the following reactions is used for neutron detection in the startup channel detector?

a. Neutron + Nitrogen-16 ---> Nitrogen-17 + Gamma
b. Neutron + Uranium-235 ---> 2 Fission Fragment Ions
c. Neutron + Boron-10 ---> Lithium-7 Ion + Helium-4 Ion
d. Neutron + Fluorine-19 ---> Nitrogen-15 Ion + Helium-4 Ion

Answer: C.012 b.
Reference: SAR, 7.2.1. Source Range Channel

Question C.013 (1.0 point) {13.0}
If a complete loss of pool water were to occur with the reactor having been operating at 1 MWt power, which of the following would be the primary hazard or concern.

a. Keeping the reactor shutdown.
b. Core meltdown due to loss of cooling.
c. Clean up of the highly radioactive coolant water.
d. Vertical beam of radiation from the uncovered core.

Answer: C.013 d.
Reference: SAR, 13.2.1.3. Loss of Pool Water

Question C.014 (1.0 point) {14.0}
Which ONE of the following statements describes how the three-way mixing valve is affected by a loss of control air?

a. The valve fails as is.
b. The valve fails to provide maximum flow to the cooling tower.
c. The valve is repositioned to provide maximum flow to the pump suction, thus bypassing the cooling tower.
d. The valve fails in mid-position. Half the flow is directed to the cooling tower and half to the pump suction.

Answer: C.014 b.
Reference: SAR, 4.2.2. Secondary System

Question C.015 (1.0 point) {15.0}
Which of the following describes how secondary system inventory is maintained?

a. Makeup is automatically initiated by cooling tower basin level.
b. Makeup is manually initiated on a low cooling tower basin level.
c. Makeup is automatically initiated by secondary pump suction pressure.
d. Chief of Reactor Maintenance (CRM) manually adds makeup on a predetermined schedule.

Answer: C.015 a.
Reference: SAR, Figure 4-1B, Secondary Coolant System

Question C.016 (1.0 point) {16.0}
Which ONE of the following events will occur due to a loss of the Reactor Air Supply while the reactor is operating at 100% power?

a. The shim rod will drift down into the core.
b. An Abnormal Pool Level alarm will annunciate due to a high pool level indication.
c. A Low Primary Flow alarm will annunciate and a Low Primary Flow scram will result.
d. A Low Primary Flow condition will be sensed and the flapper valve will open, causing a Flapper Open scram.

Answer: C.016 c.
Reference: NRP-OP-101, Reactor Startup and Shutdown, APPENDIX B – STARTUP CHECKLIST INSTRUCTIONS (Page 13 of 17)

Question C.017 (1.0 point) {17.0}
Which ONE of the following describes a fuel pin?

| | Cladding | Weight% U-235 | Fuel Length |
|---|---|---|---|
| a. | Stainless Steel | 6.0 | 15 inches |
| b. | Zircaloy | 4.0 | 24 inches |
| c. | Zircaloy | 6.0 | 15 inches |
| d. | Stainless Steel | 4.0 | 24 inches |

Answer: C.017 b.
Reference: SAR, TABLE 1-1 COMPARISON OF PULSTAR REACTORS

Question C.018 (1.0 point) {18.0}
Power is being supplied by the Auxiliary Generator and the Load Transfer Control switches have been operated so that the generator can supply the Control Room Distribution Panel, Confinement Fan No. 1 and Confinement Fan No. 2. When commercial power is restored:

a. Confinement Fan No. 1 instantly switches back to commercial power, while Confinement Fan No. 2 switches back after a one to two-minute delay, regardless of the positions of the Load Control Transfer switches.

b. the Control Room Distribution Panel instantly switches back to commercial power, while both Confinement Fans switch back after a one to two-minute delay, regardless of the positions of the Load Control Transfer switches.

c. all loads are instantly switched back to commercial power, regardless of the positions of the Load Control Transfer switches.

d. the Load Transfer Control switches must be manually reset so that commercial power can be restored to the loads.

Answer: C.018 b.
Reference: SAR, 8.3. Electrical Distribution System

Question C.019 (1.0 point) {19.0}
Primary coolant system flow rate is measured at an orifice installed:

a. prior to the suction of the primary coolant pump.

b. after the discharge of the primary coolant pump.

c. prior to the inlet of the heat exchanger.

d. after the outlet of the heat exchanger.

Answer: C.019 d.
Reference: SAR, 4.2.5. Instrumentation and Figure 4-1A Primary Coolant System

Question C.020 (1.0 point) {20.0}
The flow rate through the Purification system is controlled by:

a. adjusting the speed of the centrifugal pump.

b. adjusting the position of a valve at the inlet to the pump.

c. adjusting the position of a valve at the inlet to the demineralizer.

d. adjusting the position of a valve prior to return to the primary system.

Answer: C.020 d.
Reference: SAR, Figure 4-1F Primary Purification System