June 2, 2015

Dr. Jay F. Kunze, Reactor Administrator
Idaho State University
921 S. 8th Avenue
Pocatello, ID 83209

SUBJECT: EXAMINATION REPORT NO. 50-284/OL-15-02, IDAHO STATE UNIVERSITY

Dear Dr. Kunze:

During the week of April 20, 2015, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Idaho State University AGN reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examinations with Mr. Adam Mallicoat, Reactor Supervisor, as identified in the enclosed report.

In accordance with Section 2.390 of Title 10 of the *Code of Federal Regulations*, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records 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 Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning the examination, please contact Mr. Phillip T. Young at 301-415-4094 or via email at Phillip.Young@nrc.gov.

Sincerely,
**/RA/**

Kevin Hsueh, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-284

Enclosures:
1. Examination Report No. 50-284/OL-15-02
2. Facility Comments on Written Examination
3. Written Examination with Corrections

cc: Adam Mallicoat, Reactor Supervisor, Idaho State University

cc: w/o enclosures: See next page

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Idaho State University
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DISTRIBUTION w/ encls.:
PUBLIC PROB r/f KHsueh

ADAMS ACCESSION #: ML15118A387

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|---|---|---|---|
| OFFICE | DPR/PROB:CE | DIRS/IOLB:LA | DPR/PROB:BC |
| NAME | PYoung | CRevelle | KHsueh |
| DATE | 5/12/2015 | 5/26/2015 | 6/02/2015 |

OFFICIAL RECORD COPY

cc:

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

U. S. NUCLEAR REGULATORY COMMISSION

OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-284/OL-15-02

FACILITY DOCKET NO.: 50-284

FACILITY LICENSE NO.: R-110

FACILITY: AGN-201

EXAMINATION DATES: April 20 - 23, 2015

SUBMITTED BY: /RA/ 05/12/2015
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of April 20, 2015, the NRC administered operator licensing examinations to one Senior Reactor Operator Upgrade (SROU), and five Reactor Operator candidates. All candidates passed the examinations and will be issued licenses to operate the Idaho State University reactor.

**REPORT DETAILS**

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

2. Results:

| | RO PASS/FAIL | SRO PASS/FAIL | TOTAL PASS/FAIL |
|---|---|---|---|
| Written | 5/0 | 0/0 | 5/0 |
| Operating Tests | 5/0 | 1/0 | 6/0 |
| Overall | 5/0 | 1/0 | 6/0 |

3. Exit Meeting:

Adam Mallicoat, Idaho State University
Phillip T. Young, NRC, Examiner

The NRC Examiner thanked the facility for their support in the administration of the examinations and noted how well the candidates were prepared.

## FACILITY COMMENTS:

**COMMENT:** Question A.001:
This is not true for fueled control rods.

**JUSTIFICATION**: See comment.

**NRC Resolution:**
Since the question is not applicable to the operation of the AGN reactor, the question has been deleted from the examination and grading adjusted accordingly.

**COMMENT:** Question B.003:
The answer key was mismarked showing b. as the correct answer. The actual correct answer is d.

**JUSTIFICATION**: See comment

**NRC Resolution:**
NRC staff agrees with the comment and changed the answer to d.

**COMMENT:** Question C.005:
This is not part of the current revision of OP-1.

**JUSTIFICATION**: AGN-201 OPERATING PROCEDURE #1

**NRC Resolution:**
NRC staff agrees with the comment, the question is deleted from the examination.

**COMMENT:** Question C.014:
The Low Level Interlock is controlled by power level indication from:
a. Channel 1.
b. Channel 2.
c. Channel 3.
d. Auxiliary Channel.
Answer: C.14 a.
Reference: Safety Analysis Report, dated November 23, 1995, pg. 58

This question might be better reworded as channel 1 is only used at start up and is not so relevant at power. Perhaps it might be better to word this as "The source interlock is controlled by the output from: Channel 1" There was some confusion because they did not recognize Channel 1 as a power level.

**NRC Resolution:**
Agree with the comment, the question is changed as follows (No change was made in grading of the examination).
The Low Level Source Interlock is controlled by indication from:

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

FACILITY: Idaho State University AGN-201M Reactor

REACTOR TYPE: AGN-201M

DATE ADMINISTERED: 4/20/2015

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 |
|---|---|---|---|---|
| | | | | |
| 19.00 | 33.3 | | | A. Reactor Theory, Thermodynamics and Facility Operating Characteristics |
| | | | | |
| 16.00 | 33.3 | | | B. Normal and Emergency Operating Procedures and Radiological Controls |
| | | | | |
| 15.00 | 33.3 | | | C. Facility and Radiation Monitoring Systems |
| | | | | |
| 50.00 | 100.0 | | | TOTALS |
| | | | | |

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

______________________________
Candidate's Signature

# NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

4. Use black ink or dark pencil 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$T_{‰} = \frac{0.693}{\lambda}$$

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

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

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

$$DR_1 d_1^2 = DR_2 d_2^2$$

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

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

1 Curie = $3.7 \times 10^{10}$ dis/sec
1 Horsepower = $2.54 \times 10^3$ BTU/hr
1 BTU = 778 ft-lbf
1 gal ($H_2O$) ≈ 8 lbm
$c_P$ = 1.0 BTU/hr/lbm/ºF

1 kg = 2.21 lbm
1 Mw = $3.41 \times 10^6$ BTU/hr
ºF = 9/5 °C + 32
ºC = 5/9 (°F - 32)
$c_p$ = 1 cal/sec/gm/ºC

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

**Question** A.001 (1.00 point) {1.0} Question Deleted per facility comment

~~Starting with a critical reactor at low power, a control rod is withdrawn from position X and reactor power starts to increase. Neglecting any temperature effects, in order to terminate the increase with the reactor again critical but at a higher power, the control rod must be:~~

~~a. inserted deeper than position X.~~

~~b. inserted, but not as far as position X.~~

~~c. inserted back to position X.~~

~~d. inserted, but exact position depends on power level.~~

~~Answer: A.01 c.~~
~~Reference: R. R. Burn, Introduction to Nuclear Reactor Operations.~~

**Question** A.002 [1.0 point] {1.0}

Which one of the following is the PRIMARY reason that delayed neutrons are so effective at controlling reactor power?

a. Delayed neutrons make up a very large fraction of the fission neutrons in the core.

b. Delayed neutrons have a much longer mean lifetime than prompt neutrons.

c. Delayed neutrons are born at lower energies than prompt neutrons.

d. Delayed neutrons are born at thermal energies.

Answer: A.02 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, §§ 3.2.2 — 3.2.3

**Question** A.003 [1.0 point] {2.0}

Which ONE of the following factors in the six-factor formula can be varied by the reactor operator?

a. Fast fission factor.

b. Reproduction factor.

c. Fast non-leakage factor.

d. Thermal utilization factor.

Answer: A.03 d
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 312.

**Question** A.004 [1.0 point] {3.0}

The reactor supervisor tells you that the $K_{eff}$ for the reactor is 0.955. How much reactivity must you add to the reactor to reach criticality?

a. +0.0471

b. +0.0450

c. -0.0471

d. -0.0450

Answer: A.04 a.

Reference: $\Delta\rho = (K_{eff1} - K_{eff2}) \div (K_{eff1} * K_{eff2})$

$\Delta\rho = (0.9550 - 1.0000) \div (0.9550 * 1.0000)$

$\Delta\rho = -0.0450 \div 0.9550 = +0.0471$

**Question** A.005 [1.0 point] {4.0}

If reactor period (τ) is at 25 seconds, approximately how long will it take for reactor power to increase by a factor of 10?

a. 10 seconds

b. 25 seconds

c. 1 minute

d. 3 minutes

Answer: A.05 c.

Reference:

SUR (in decades per minute) = 26.06/τ OR $\ln(P_0/P) = t/\tau \Rightarrow \ln(10) = \text{time}/25$

$\Rightarrow 2.302585092994 = \text{time}/25$ seconds. time = 2.3026 × 25 = 57.6 seconds or ≈ 1 minute

**Question** A.006 [1.0 point] {5.0}

Which ONE of the following statements describes the difference between Differential (DRW) and Integral (IRW) rod worth curves?

a. DRW relates the worth of the rod per increment of movement to rod position. IRW relates the total reactivity added by the rod to the rod position.

b. DRW relates the time rate of reactivity change to rod position. IRW relates the total reactivity in the core to the time rate of reactivity change.

c. IRW relates the worth of the rod per increment of movement to rod position. DRW relates the total reactivity added by the rod to the rod position.

d. IRW is the slope of the DRW at a given rod position

Answer: A.06 a.

Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 361, 362.

**Question** A.007 [1.0 point] {6.0}

The reactor is at 5 watts, when someone inserts an experiment which causes a 10 second positive period. If the scram delay time is 1 second and the lowest scram setpoint is 9.7 watts, which ONE of the following is the MAXIMUM power the reactor will reach prior to scramming?

a. 9.1 watts

b. 10.7 watts

c. 15.5 watts

d. 25 watts

Answer: A.07 b.
Reference: Glasstone, S. & Sesonske, , § 5.18

$P = P_0\ e^{t/\tau} = 9.7 \times e^{1/10} = 9.7 \times 1.1052 = 10.72$

**Question** A.008 [1.0 point] {7.0}

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

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

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

Answer: A.08 c.
Reference: Standard NRC Question

**Question** A.009 [1.0 point] {8.0}

The probability of neutron interaction per cm of travel in a material is defined as:

a. a neutron flux.

b. a mean free path.

c. a microscopic cross section.

d. a macroscopic cross section.

Answer: A.09 d.
Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Section 2.5.2, page 2-44.

**Question** A.010 [1.0 point] {9.0}

The reactor is shutdown by 1.0% Δk/k and an experiment is placed into the glory hole. Count rate on the startup channel increased from 15 cps to 30 cps. What is the worth of the experiment?

a. positive 1.01% Δk/k

b. negative 1.01% Δk/k

c. positive 0.508% Δk/k

d. negative 0.508% Δk/k

Answer: A.10 c.

Reference: SDM = 1 - $K_{eff}/K_{eff}$ or

$K_{eff}$ = 1/(1 + SDM) = 1/(1 + .01) = 0.990

$CR_1/CR_2 = (1 - K_{eff2})/(1 - K_{eff1})$ or

$1 - K_{eff2} = (1 - K_{eff1})\ CR_1/CR_2$ = 0.0099 (15/30) = .00495

$1 - K_{eff2}$ = 0.00495 $K_{eff}$ = 1 - 0.00495 = 0.995

Reactivity Added = $(K_{eff1} - K_{eff2})/K_{eff1}K_{eff2}$ = (0.990 - 0.995)/(0.995 × 0.990) = 0.005076 (positive) or 0.508%

**Question** A.011 [1.0 point] {10.0}

Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. Lowering moderator temperature if the moderator temperature coefficient is negative.

b. Inserting an experiment adding positive reactivity.

c. Depletion of a burnable poison.

d. Depletion of uranium fuel.

Answer: A.11 d.

Reference: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 6.2.3, p. 6-4.

**Question** A.012 [1.0 point] {11.0}

You enter the control console area and note that all nuclear instrumentation channels show a steady neutron level, and no rods are in motion. Which ONE of the following conditions **CANNOT** be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source has been removed from the core.

Answer: A.12 c.

Reference: Standard NRC Question

**Question** A.013 [1.0 point] {12.0}

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation defines the:

a. fast fission factor.

b. neutron non-leakage factor.

c. neutron reproduction factor.

d. effective multiplication factor.

Answer: A.13 d.
Reference: Introduction to Nuclear Operation, Reed Burn, 1982, Sec 3.3

**Question** A.014 [1.0 point] {13.0}

With the reactor on a constant period, which of the following changes in reactor power would take the **LONGEST** time?

a. 5% — from 1% to 6%

b. 15% — from 20% to 35%

c. 20% — from 40% to 60%

d. 25% — from 75% to 100%

Answer: A.14 a
Reference: $P = P_0 e^{t/\tau}$ $\ln(P/P_0) = t/\tau$ Since you are looking for which would take the longest time it, the ratio $P/P_0$ must be the largest.

**Question** A.015 [1.0 point {14.0}

Which ONE of the following is the type of neutron source that is used at the Idaho State University AGN-201?

a. Radium - Beryllium

b. Plutonium - Beryllium

c. Americium - Plutonium

d. Neptunium – Beryllium

Answer: A.15 a.
Reference: ISU General Information, "The AGN-201 Reactor", p 5.

**Question** A.016 [1.0 point] {15.0}

Which ONE of the following samples when placed individually into the reactor experimental facilities will have a POSITIVE reactivity effect?

a. Gold wire

b. Indium foils

c. Cadmium foils

d. Polyethylene disk

Answer: A.16 d.
Reference: ISU Experiments 3a and 4b

**Question** A.017 [1.0 point] {16.0}

Inelastic scattering is the process whereby a neutron collides with a nucleus and:

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

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

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

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

Answer: A.17 b.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 64.

**Question** A.018 [1.0 point] {17.0}

In the ISU AGN - 201, the largest thermal neutron microscopic cross section is:

a. Xenon-135 capture.

b. Uranium-235 fission.

c. Uranium-238 fission.

d. Plutonium 240 absorption.

Answer: A.18 a.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 5, Section 5.62;

**Question** A.019 [1.0 point] {18.0}

The AGN-201 is designed to produce a fission rate within the thermal fuse that is approximately twice the average of the core. Which ONE of the following describes how this higher reaction rate is accomplished?

a. The non-uniform fuel loading in the upper fuel disc increases the thermal flux in fuse area.

b. The polystyrene media used in the thermal fuse is a better moderator, raising the thermal flux in the fuse area.

c. The fuel density used in the thermal fuse is twice that of the balance of the core resulting in a higher fission rate in the fuse area.

d. The fuel enrichment used in the thermal fuse is twice that of the balance of the core resulting in a higher fission rate in the fuse area.

Answer: A.19 c.
Reference: Safety Analysis Report, dated January 2003, pg. 104.

**Question** A.020 [1.0 point] {19.0}

At the beginning of a reactor startup, Keff is 0.90 with a count rate of 30 CPS. Power is increased to a new, steady value of 60 CPS. The new Keff is:

a. 0.92

b. 0.925

c. 0.95

d. 0.975

Answer: A.20 c.
Reference: Lamarsh, Introduction To Nuclear Engineering, 3rd Edition.
$(CR_2/CR_1) = (1-K_{eff0})/(1-K_{eff1})$ $(60/30) = (0.90)(1-K_{eff1})$ Keff1 = 0.95

END OF SECTION A

**Question** B.001 [1.0 point] {1.0}

The reactor is operating at steady-state power. Under this circumstance:

a. At least two persons must be present in the laboratory. One NRC-licensed operator must be present at the reactor console.

b. Two NRC-licensed operators must be present in the laboratory. One of the operators must be present at the reactor console.

c. One NRC-licensed operator and a Reactor Supervisor must be present at the reactor console.

d. Only one NRC-licensed operator must be present at the reactor console.

Answer: B.01 a.

Reference: General Operating Rules, Revision 4, dated September 19, 1994.

**Question** B.002 [1.0 point] {2.0}

Given a 1 cm (0.394 inch) thick lead shield reduces the dose rate from an experiment by a factor of 2. A 10 cm (3.94 inch) thick shield will reduce the dose by a factor of approximately …

a. 4

b. 20

c. 100

d. 1000

Answer: B.02 d.

Reference: $2^{10}$ = 1024 - 1000

**Question** B.003 [1 point] {3.0}

Which ONE of the following would satisfy the MINIMUM Technical Specification staffing requirements whenever the reactor is NOT Shutdown?

a. One authorized operator at the reactor console, a licensed RO in the reactor room.

b. One licensed SRO at the reactor console, and an authorized operator in the reactor room.

c. One authorized operator at the reactor console, a licensed RO in the reactor control room and a licensed SRO on call.

d. One licensed RO at the reactor console, an certified observer in the reactor control room and a licensed SRO on call one hour away.

Answer: B.03 d.

Reference: ISU Technical Specifications, 6.1.11, page 23;

Question B.004 [2.0 points, 0.5 each] {5.0}

Match the Area radiation levels in column A with the corresponding area type (as defined by 10 CFR 20) from column B. (Some of the items in Col. B may be used more than once or not at all)

| Column A | Column B |
|---|---|
| a. 2 mr/hr | 1. Unrestricted |
| b. 5 mr/hr | 2. Radiation Area |
| c. 10 mr/hr | 3. High Radiation Area |
| d. 100 mr/hr | 4. Very High Radiation Area |

Answer: B.04 a. = 1; b. = 2; c. = 2; d. = 3

Reference: 10 CFR 20 § 20.1003 *Definitions*

Question B.005 [2.0 points, 0.5 each] {7.0}

Match the operator license requirements in Column A with the proper time period from column B.

| Column A | Column B |
|---|---|
| a. License Renewal | 1 year |
| b. Medical Examination | 2 years |
| c. Requalification Written Exam | 4 years |
| d. Requalification Operating Test | 6 years |

Answer: B.05 a. = 6; b. = 2; c. = 2 or 1; d. = 1

Reference: 10 CFR 55.21, 10 CFR 55.55, 10 CFR 55.59, ISU Requalification Plan
ISU Requal plan has yearly written.

**Question** B.006 [2.0 point, 0.5 each] {9.0}

Identify each of the following statements as a Safety Limit (SL), a Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO).

a. The core thermal fuse shall melt when heated to a temperature of about 120°C resulting in core separation and reactivity loss greater than 5% dk/k.

b. The shutdown margin with the most reactive safety or control rod fully inserted and the fine control rod fully inserted shall be at least 1% dk/k.

c. The maximum core temperature shall not exceed 200°C during either steady-state or transient operation.

d. The reactor room shall be considered a restricted area whenever the reactor is not secured.

Answer: B.06 a. = LSSS; b. = LCO; c. = SL; d. = LCO

Reference: per Technical Specifications, Safety Limit (SL), Limiting Safety System Setting (LSSS), and Limiting Conditions for Operation (LCO) are as defined in 10 CFR 50.36

**Question** B.007 [1 point] {10.0}

In the event of any emergency, if the radiation level outside of the operations area exceeds ____mR/hr, the operator shall order an evacuation.

a. 10.

b. 50.

c. 75.

d. 100.

Answer: B.07 a.
Reference: ISU Emerg. Plan Sect C.6

**Question** B.008 [1 point] {11.0}

In accordance with Emergency procedures, in the event of a fire, which ONE of the following actions should the reactor operator perform immediately after securing the reactor?

a. Notify the Pocatello Police Department.

b. Notify the U.S. NRC Operations Center.

c. Initiate a building evacuation.

d. Notify the Reactor Supervisor.

Answer: B.08 c.
Reference: Emergency Plan, Section 4, "Fire or Explosion"

**Question** B.009 [1 point] {12.0}

During the preparations for a reactor startup a rod drop test is performed in accordance with O.P. #1. This test is considered satisfactory if ALL of the following criteria are met EXCEPT:

a. The readings of Channels 1, 2, and 3 return to the values they had prior to raising the rods.

b. The rods drop as indicated by the "ENGAGED" lights going out for the rods that were raised.

c. The position indicators for the fine and course control rods are within 0.10 centimeters of 0.00.

d. The drive motors automatically return the magnets to the down position and the "DOWN" and "ENGAGED" lights illuminate for the dropped rods.

Answer: B.09 c.
Reference: ISU Operating Procedure #1, Rev. 3, Step IV.E, page 6

**Question** B.010 [1 point] {12.0}

The reactor room high radiation alarm:

a. will automatically scram the reactor on an alarm condition.

b. serves as the evacuation alarm for inadvertent criticality.

c. would require the reactor to be shutdown on an alarm condition.

d. is required to be operable during control rod drive inspection

Answer: B.10 c.
Reference: ISU TS 3.2 Basis, p 10.

Question B.011 [1 point] {13.0}

During a survey you read 100 mrem/hr with the window open and 40 mRem/hr with the window closed. Which ONE of the following is the dose rate due to GAMMA radiation?

a. 140 mRem/Hr

b. 100 mRem/Hr

c. 60 mRem/Hr

d. 40 mRem/Hr

Answer: B.11 d.
Reference: Dose (γ) = Dose with window closed

**Question** B.012 [1 point] {14.0}

"A channel test of Nuclear Safety Channels #1, #2 and #3 shall be performed prior to the first reactor startup of the day or prior to each reactor operation extending more than one day." This is an example of a(n):

a. safety limit.

b. limiting condition for operation.

c. limiting safety system setting.

d. surveillance requirement.

Answer: B.12 d.
Reference: ISU Technical Specification 4.2.c

Question B.013 [1 point] {15.0}

Which ONE of the following is the basis for the maximum core temperature safety limit?

a. Prevent separation of the core.

b. Prevent melting of the polyethylene core material.

c. Prevent operating personnel from being exposed to high temperature.

d. Prevent spontaneous ignition of the graphite reflector.

Answer: B.13 b.
Reference: ISU Technical Specification 2.1.b

**Question** B.014 [1 point] {16.0}

The total scram withdrawal time of the coarse control rod and the safety rods must be less than:

a. 200 milliseconds.

b. 500 milliseconds.

c. 800 milliseconds.

d. 1000 milliseconds.

Answer: B.14 d.
Reference: ISU Technical Specification 3.2.a

END OF SECTION B

**Question** C.001 [1.0 point] {1.0}
The detector used for the shield tank water level signal is a:

a. manometer.

b. float switch.

c. pressure switch.

d. differential pressure switch.

Answer: C.01 b.
Reference: ISU Safety Analysis Report (SAR) § 4.3.4, Interlock System.

Question C.002 [2.0 points, 0.4 each] {3.0}
Identify each of the following systems as either **EN**ERGIZED or **DE**-ENERGIZED after depressing the **"OFF"** button on the console.

a. Nuclear Instrumentation Channel #3

b. Fixed Radiation Monitor

c. Rod Position Instrumentation

d. Reactor Laboratory Ventilation

e. Control Rod Drives

Answer: C.02 a. = E; b. = E; c. = D; d. = E e. = D
Reference: Rewrite of EQB question, also Operating Procedure # 1 § VII, Shutdown, paragraph D.1.

Question C.003 [2.0 points, 0.4 each] {5.0}
Match the purpose in column A with the correct material from column B.

| Column A | Column B |
|---|---|
| a. fast neutron shield | 1. Lead |
| b. reflector | 2. Graphite |
| c. gamma-ray shield | 3. Beryllium |
| d. moderator in core | 4. Aluminum |
| e. moderator in fuse | 5. Polyethylene |
| | 6. Polystyrene |
| | 7. Water |

Answer: C.03 a. = 7; b. = 2; c. = 1; d. = 5; e. = 6;
Reference: ISU, Safety Analysis Report (SAR), § 4.2, Table 4.2-1

**Question** C.004 [1.0 point] {6.0}
What is one of the purposes for the neutron count interlock?

a. To prevent the reactor from being manipulated to a critical position before channel 1 is verified to be operable.

b. To provide a reference point where all instruments undergo a check before the reactor is brought to a critical position.

c. To allow for all experiments to be installed before the reactor is critical.

d. To ensure that the reactor is not started up without a neutron source.

Answer: C.04 d.
Reference: Safety Analysis Report

Question C.005 [1.0 point] {7.0} Question Deleted per facility comment
~~Which one of the following is the reason you rotate the Nuclear Instrumentation Channel #1 range switch counterclockwise after depressing the "RAISE" button?~~

~~a. To prevent a reactor trip due to excessive period.~~

~~b. To prevent a low level trip of the Safety Channel #1 sensitrol.~~

~~c. To bring Safety Channel #1 readings into agreement with Safety Channels #2 and #3.~~

~~d. To compensate for control rod shadowing effects on Safety Channel #1, at higher power levels.~~

~~Answer: C.05 b.~~
~~Reference: ISU OP-1 Chap. V *Startup* Step A.3~~

**Question** C.006 [1.0 point] {7.0}
In the event of a safety chassis interlock bus grid to cathode short the:

a. fine control rod would scram.

b. magnet current reversal relay would energize.

c. overcurrent relay will disconnect the tube supply voltage.

d. reset relay will energize and remove power to the magnets.

Answer: C.06 c.
Reference: ISU SAR Section 4.3.2 Instrumentation System

Question C.007 [1.0 point] {8.0}

Where would you go to deenergize the ventilation system during an emergency?

a. On the reactor room wall opposite room 15 (Reactor Supervisor Office)

b. On the corridor wall just outside the door to room 23 (Subcritical Assembly Laboratory).

c. On the corridor wall just outside the door to room 19 (Reactor Observation Room).

d. Just inside the door to room 22 (Counting Laboratory).

Answer: C.07 a.
Reference: Emergency Plan, Section 7.3.2

Question C.008 [1.0 point] {9.0}

Which ONE of the following is NOT an interlock preventing rod insertion?

a. Both safety rods must be fully inserted prior to inserting the coarse control rod.

b. Both safety rods must be fully inserted prior to inserting the fine control rod.

c. The coarse control rod must be fully withdrawn prior to inserting the safety rods.

d. The fine control rod must be greater than or equal to half inserted prior to inserting the safety rods.

Answer: C.08 d. or 4
Reference: ISU SAR § 4.3.1 Control Rods

Question C.009 [1.0 point] {10.0}

Which ONE of the following is the gas used in the rabbit tube assembly?

a. Air

b. Carbon Dioxide

c. Helium

d. Nitrogen

Answer: C.09 d.
Reference: NRC examination bank

**Question** C.010 [1.0 point] {11.0}

Which ONE of the following **IS** the location of a fixed radiation area monitor?

a. Radiation Counting Laboratory.

b. Observation Classroom.

c. Above the Reactor.

d. near the control console.

Answer: C.10 d.
Reference: Technical Specifications – 3.4

**Question** C.011 [1.0 point] {12.0}
Which ONE of the following signals will result in opening the interlock bus?

a. Manual scram switch

b. Period trip

c. Earthquake sensor

d. Channel #1 high (95% full scale)

Answer: C.11 c.
Reference: NRC Examination Question Bank

**Question** C.012 [1.0 point] {13.0}
Which one of the following detectors is used for Nuclear Instrumentation Channel #2?

a. $BF_3$ filled Proportional Counter

b. $BF_3$ filled Ionization Chamber

c. $BF_3$ filled Geiger-Muller tuber

d. $U^{235}$ lined Fission Chamber

Answer: C.12 b.
Reference: ISU SAR § 4,3,2, p. 61

**Question** C.013 [1.0 point] {14.0}
The reactor is critical, with the Fine Control Rod (FCR) fully inserted. If you wish to reposition the FCR to the mid-plane of its travel, how far and in what direction must you move the Coarse Control Rod (CCR), maintaining critical conditions?

a. 6.7 cm, out of core

b. 3.3 cm, into core

c. 3.3 cm, out of core

d. 6.7 cm, into core

Answer: C.13 b.
Reference: NRC Examination Question Bank

**Question** C.014 [1.0 point] {15.0}
The Low Level Source Interlock is controlled by indication from:

a. Channel 1.

b. Channel 2.

c. Channel 3.

d. Auxiliary Channel.

Answer: C.14 a.
Reference: Safety Analysis Report, dated November 23, 1995, pg. 58

END OF SECTION C

END OF WRITTEN EXAMINATION