June 21, 2016

Dr. Mary Lou Dunzik-Gougar, Reactor Administrator
Professor and Chair of Nuclear Engineering
College of Science and Engineering
Idaho State University
Pocatello, ID 83209-8060

SUBJECT: EXAMINATION REPORT NO. 50-284/OL-16-01, IDAHO STATE UNIVERSITY

Dear Dr. Dunzik-Gougar:

During the week of May 9, 2016, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Idaho State University AGN reactor. The examination was 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 examination with Adam Mallicoat, Reactor Supervisor.

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 Phillip T. Young at 301-415-4094 or via email at Phillip.young@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, 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-16-01
2. Written Examination

cc: Adam Mallicoat, Reactor Supervisor, Idaho State University

cc: w/o enclosures: See next page

cc:

Dr. Wendland Beezhold
Idaho State University
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Nuclear and Electrical Engineering
Physics Department
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Pocatello, ID 83209-8106

Dr. Cornelis J. Van der Schyf
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Dr. Peter Farina, Director
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Radiation Safety Officer
Technical Safety Office
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Director
Idaho Dept. of Environmental Quality
1410 North Hilton
Boise, ID 83606

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

Dr. Mary Lou Dunzik-Gougar, Reactor Administrator
Professor and Chair of Nuclear Engineering
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OFFICE	NRR/DPR/PROB/CE	NRR/DPR/PROB/OLA	NRR/DPR/PROB/ABC	NRR/DPR/PROB/BC
NAME	PYoung	CRevelle	EReed	AMendiola
DATE	06/08/2016	06/07/2016	06/10/2016	06/21/2016

EXAMINATION REPORT NO: 50-284/OL-16-01

FACILITY: Idaho State University

FACILITY DOCKET NO.: 50-284

FACILITY LICENSE NO.: R-110

SUBMITTED BY: /RA/ 5/23/16

Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of May 9, 2016, the NRC administered operator licensing examinations to one Senior Reactor Operator Upgrade (SROU), one Senior Operator Instant SROI and four Reactor Operator candidates. One of the Reactor Operator candidates failed one section of the written examination. All other candidates passed the examinations and will be issued a license to operate the Idaho State University reactor.

REPORT DETAILS

1. Examiner: Phillip T. Young, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/1	1/0	4/1
Operating Tests	4/0	2/0	6/0
Overall	3/1	2/0	5/1

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.

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

FACILITY: Idaho State University AGN-201M Reactor

REACTOR TYPE: AGN-201M

DATE ADMINISTERED: 5/10/2016

CANDIDATE: ______________________________

<u>INSTRUCTIONS TO CANDIDATE:</u>
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
18.00	38.3			A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
~~16.00~~ 15.00	~~33.3~~ 31.9			B. Normal and Emergency Operating Procedures and Radiological Controls
14.00	~~29.2~~ 29.8			C. Facility and Radiation Monitoring Systems
~~48.00~~ 47.00	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 <u>only</u> to facilitate legible reproductions.

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

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

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

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

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

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

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

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

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

EQUATION SHEET

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

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

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

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

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

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

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

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

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

$$P = P_0 \, e^{\frac{t}{\tau}}$$

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

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

$$\tau = \frac{\lambda^*}{\rho - \bar{\beta}}$$

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

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

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

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

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

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

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

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

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

1 Curie = 3.7×10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

ºF = 9/5 EC + 32

1 gal (H_2O) . 8 lbm

ºC = 5/9 (EF - 32)

c_P = 1.0 BTU/hr/lbm/EF

c_p = 1 cal/sec/gm/EC

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.001 [1.00 point] {1.0}
Which ONE of the following is the reason for operating with thermal neutrons rather than fast neutrons?

a. Probability of fission is increased since thermal neutrons are less likely to leak out of the core.

b. As neutron energy increases, neutron absorption in non-fuel materials increases exponentially.

c. The absorption cross-section of U-235 is much higher for thermal neutrons.

d. The fuel temperature coefficient becomes positive as neutron energy increases.

Answer: A.01 c.
Reference: DOE Fundamentals Handbook, Module 2, page 9.

Question A.002 [1.00 point] {2.0}
Two critical reactors at low power are identical except that Reactor 1 has a beta fraction of 0.0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors. Which ONE of the following will be the response of Reactor 2 compared to Reactor 1?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be longer.

d. The resulting period will be shorter.

Answer: A.02 d.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-9.

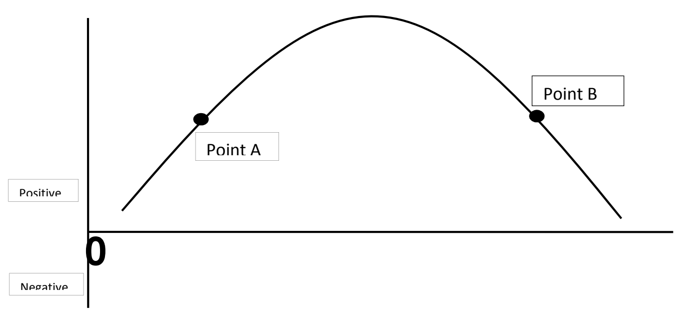
Question A.003 [1.00 point] {3.0}
Shown below is a trace of reactor period as a function of time. Between points A and B reactor power is:

a. continually increasing.

b. continually decreasing.

c. increasing, then decreasing.

d. constant.



Answer: A.03 a.
Reference: Standard NRC Question[1]

Question A.004 (1.00 point) {4.0}

A thin foil target of 10% copper and 90% aluminum is in a thermal neutron beam. Given $\sigma_{a\ Cu}$ = 3.79 barns, $\sigma_{a\ Al}$ = 0.23 barns, $\sigma_{s\ Cu}$ = 7.90 barns, and $\sigma_{s\ Al}$ =1.49 barns, which ONE of the following reactions has the highest probability of occurring? A neutron

a. scattering reaction with aluminum

b. scattering reaction with copper

c. absorption in aluminum

d. absorption in copper

Answer: A.04 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.005 [1 point] {5.0}

The neutron microscopic cross-section for absorption, σ_a, generally:

a. increases as neutron energy increases.

b. decreases as neutron energy increases.

c. increases as the mass of the target nucleus increases.

d. decreases as the mass of the target nucleus increases.

Answer: A.05 b.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.3.

Question: A.006 [1.0 point] {6.0}

<u>ELASTIC SCATTERING</u> is the process by which a neutron collides with a nucleus ….

a. and the nucleus recoil with the same total kinetic energy as the neutron and nucleus had prior to the collision.

b. and the nucleus recoil with less total kinetic energy than the neutron and nucleus had prior to the collision with the nucleus emitting a gamma ray.

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

d. and the nucleus recoil with a higher total kinetic energy than the neutron and nucleus had prior to the collision with the nucleus emitting a gamma ray.

Answer: A.06 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.007 [1.0 point] {7.0}

Which ONE of the following is the major source of energy released during fission?

a. Absorption of prompt gamma rays

b. Slowing down of fission fragments

c. Neutrino interactions

d. Fission neutron scattering

Answer: A.07 b.

Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.008 [1.0 point] {8.0}

Which ONE of the following elements will slow down fast neutrons most quickly, i.e. produces the greatest energy loss per collision.

a. Oxygen-16

b. Uranium-238

c. Hydrogen-1

d. Boron-10

Answer: A.08 c.

Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.12. Exam 2

Question A.009 [1.0 point] {9.0}

The initial conditions for a reactor startup are count rate = 45 cps and K_{eff} = 0.980. When the count rate reaches 90 cps, the new K_{eff} will be:

a. 0.986.

b. 0.988

c. 0.990.

d. 0.992

Answer: A.09 c.

Reference: DOE Fundamentals Handbook, Volume 2, Module 4, Enabling Objective 1.3.

Question A.010 [1.0 point] {10.0}

By definition, you may make an exactly critical reactor PROMPT CRITICAL by adding positive reactivity equal to …

a. the shutdown margin

b. the K_{excess} margin

c. the β_{eff} value

d. 1.0 %ΔK/K

Answer: A.10 c.
Reference: DOE Fundamentals Handbook, Volume 2, Module 4, Enabling Objective 2.8. Exam 7

Question A.011 [1.0 point] {11.0}

Which one of the following statements correctly describes the property of a GOOD MODERATOR?

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

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

Answer: A.11 c.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.13. Exam

Question A.012 [1.0 point] {12.0}

Which of the following factors has the LEAST effect on rod worth?

a. number and location of adjacent rods.

b. temperature of the moderator.

c. temperature of the fuel.

d. core age.

Answer: A.12 c.
Reference: Standard NRC Question

Question A.013 [1.0 point] {13.0}

Reactor power is increasing by a factor of 10 every minute. The reactor period is:

a. 65 seconds.

b. 52 seconds.

c. 26 seconds.

d. 13 seconds.

Answer: A.13 c.
Reference: Reference 1, Volume 2, Module 4, Reactor Kinetics, page 17. Reactor Period = 26/Startup Rate. Exam 3. $\mathbf{P = P_0\, e^{t/\vartheta}}$ $\mathbf{\vartheta = 60/\ln(10) = 26.06}$

Question A.014 [1.0 point] {14.0}

While the reactor is shutdown you place an experiment into the glory hole to determine its worth. The reactor is shutdown by 2% ΔK/K. Before insertion of the experiment, Channel #1 reads 70 cps. After insertion of the experiment, Channel #1 reads 35 cps. What is the worth of the experiment?

a. -2.1% ΔK/K

b. -1.05% ΔK/K

c. -0.21% ΔK/K

d. -0.105% ΔK/K

Answer: A.14 a.
Reference: $SDM = (1 - K_{eff})/K_{eff}$ $K_{eff} = 1/(1 + SDM)$ Given SDM = 0.2
$K_{eff} = 1/(1 + 0.2) = 1/1.02$
Initial $K_{eff} = .9804$ $CR_1/ CR_2 = (1 - K_{eff1})/(1 - K_{eff2})$
Rearranging: $K_{eff2} = 1 - (1 - K_{eff1}) \times CR_2/CR_1$
$K_{eff2} = 1 - [(1 - 0.9804) \times 35/70] = 1 - 0.0196 \times 2 = 1 - 0.0392 = 0.9608$
$\Delta\rho = (K_{eff2} - K_{eff1})/K_{eff2}\ K_{eff2} = (0.9804 - 0.9608)/(0.9804 \times 0.9608) = 0.0196/ 0.94197$
$\Delta\rho = 0.02081$

Question A.015 [1.0 point] {15.0}

A reactor has a shutdown margin of 0.0526 ΔK/K. Adding a reactor experiment increases the indicated count rate from 10 cps to 20 cps. Which one of the following is the new K_{eff} of the reactor?

a. 0.53

b. 0.90

c. 0.975

d. 1.001

Answer: A.15 c.

Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 4, Enabling Objective 3.6, p. 28.

$SDM = 1\text{-}K_{eff}/K_{eff} \rightarrow K_{eff} = 1/SDM + 1 \rightarrow K_{eff} = 1/0.0526 + 1 \rightarrow K_{eff} = .95$

$CR_1/CR_2 = (1 - K_{eff2}) / (1 - K_{eff1}) \rightarrow 10/20 = (1 - K_{eff2}) / (1 - 0.95)$

$(0.5) \times (0.05) = (1 - K_{eff2}) \rightarrow K_{eff2} = 1 - (0.5)(0.05) = 0.975$

Question A.016 [1.0 point] {16.0}

Which ONE of the following causes reactor period to stabilize shortly after a reactor scram from full power? Assume normal system/component operation and no maintenance activity.

a. Xenon removal by decay at a constant rate.

b. Longest lived delayed neutron precursor.

c. Decay of compensating voltage at low power levels.

d. Power level dropping below the minimum detectable level.

Answer: A.16 b.

Reference: Nuclear Reactor Theory, LaMarsh

Question A.017 [1.0 point] {17.0}

A reactor is operating at criticality. Instantaneously, all of the delayed neutrons are suddenly removed from the reactor. The K_{eff} of the reactor in this state would be approximately:

a. 1.007

b. 1.000

c. 0.993

d. 0.000

Answer: A.17 c.

Reference: DOE Fundamentals Handbook, Module 2, page 30.

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

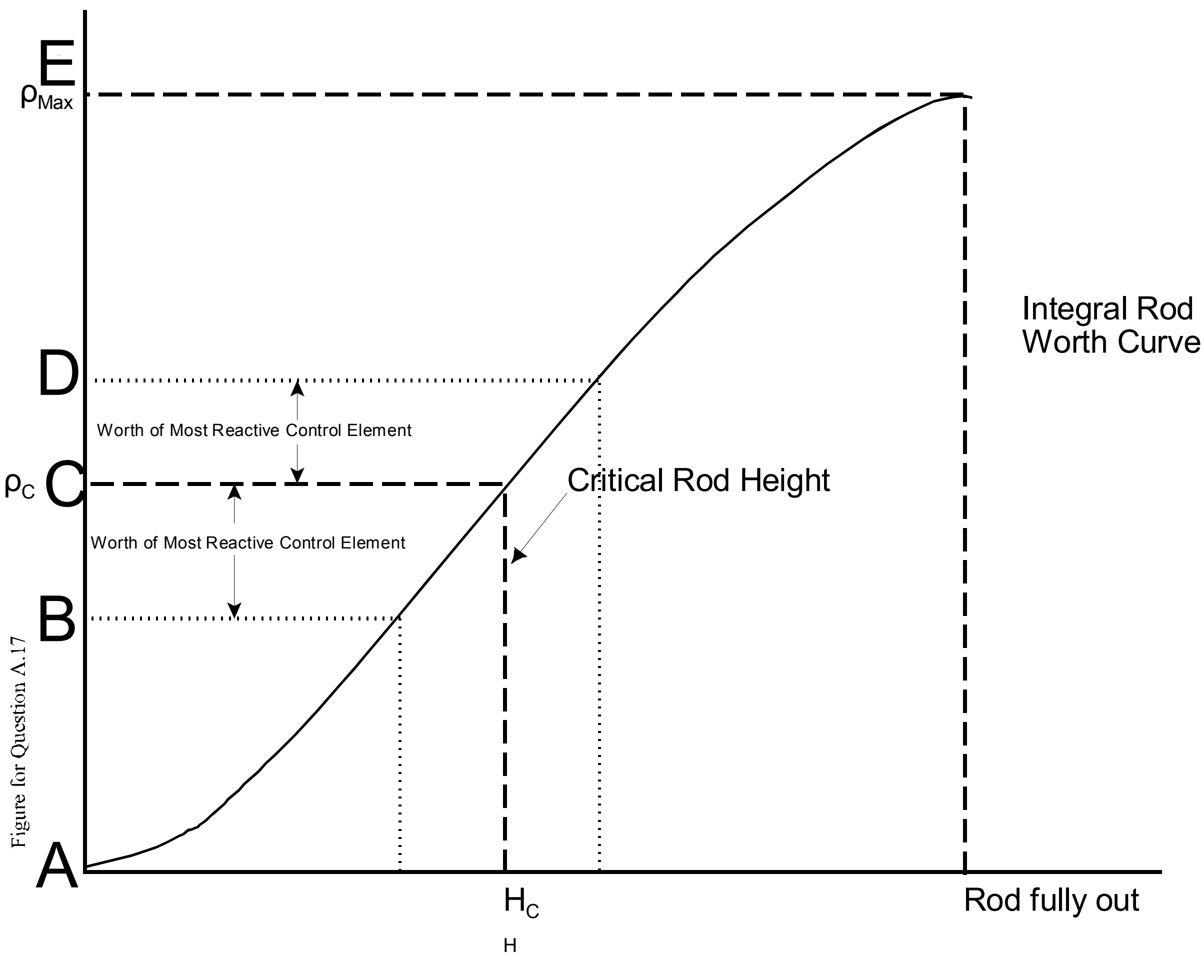
Question A.018 [1.0 points 0.25 each] {18.0}

Using the drawing of the Integral Rod Worth Curve provided, identify each of the following reactivity worth's.

a.	Total Rod Worth	1.	B - A
b.	Actual Shutdown Margin	2.	C - A
c.	Technical Specification Shutdown Margin Limit	3.	C - B
d.	Excess Reactivity	4.	D - C
		5.	E - C
		6.	E - D
		7.	E - A

Answer: A.18 a. = 7; b. = 2; c. = 1; d. = 5

Reference: Standard NRC Question



END OF SECTION A

Question B.001 [1.0 point, 0.25 each] {1.0}

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

a. Power ≥ 100 watts

b. Temperature ≥ 120 °C

c. Excess Reactivity 0.65% Δk/k (corrected to 20 °C)

d. Safety Rod with a reactivity addition rate of 0.065% Δk/k.

Answer: B.01 a. = SL; b. = LSSS; c. = LCO; d. = LCO
Reference: ISU TS §§ 2.1, 2.2 and 3.0

Question B.002 [1 point] {2.0}

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.02 c.
Reference: Emergency Plan, Section 4, “Fire or Explosion”

Question B.003 [1 point] {3.0}

Temporary procedures which do NOT change the intent of the original procedure or involve an unreviewed safety question may be approved as a MINIMUM by the:

a. Reactor Operator.

b. Reactor Supervisor.

c. Reactor Safety Committee.

d. Dean of the College of Engineering.

Answer: B.03 b.
Reference: ISU Technical Specifications, 6.6, page 26

Question B.004 [1 point] {4.0}

A reactor sample has a disintegration rate of 2 X 10^{12} disintegrations per second and emits a 0.6 Mev γ. The expected dose rate from this sample at a distance of 10 feet would be approximately: (Assume a point source)

a. 100 mR/hr

b. 325 mR/hr

c. 2 R/hr

d. 7.5 R/hr

Answer: B.04 c.
Reference: Glasstone & Sesonke, Sect 9.41, p 525.
DR = 6CE/f*2 R/hr, =6(2 X 10*12/3.7X10*10)(0.6)/10*2, =1.9459 R/hr

Question B.005 [1.0 point] {5.0}

You performed a startup this morning with the pneumatic tube terminus and no experiment in the reactor. After shutting down, one hour later, you removed the tube. No other changes were made to the reactor. During a new startup the new core excess will be …

a. larger than the previous startup.

b. smaller than the previous startup.

c. the same as the previous startup.

d. dependent on the time of shutdown.

Answer: B.05 c.
Reference: ISU Experimental Plan No. 19 *Sample Transfer by Pneumatic Tube,* <u>Safety Analysis</u> p. 3

Question B.006 [1 point] {6.0}

The shutdown margin, required by Technical Specifications, with the most reactive safety or control rod fully inserted and the fine control rod fully inserted shall be at least:

a. 0.29 % Δk/k

b. 0.65 % Δk/k

c. 1.00 % Δk/k

d. 1.25 % Δk/k

Answer: B.06 c.
Reference: ISU Technical Specifications, 3.1.b, page 8.

Question B.007 [1.0 point] {7.0}

You have evacuated the EPZ. Which ONE of the following ISU staff positions is responsible (by title) for authorizing reentry?

a. The Senior Reactor Operator

b. The Reactor Supervisor

c. The Director of Emergency Operations

d. The ISU Radiation Safety Officer

Answer: B.07 c.
Reference: Emergency Plan, *Nuclear Emergency* p. 13.

Question B.008 [1 point] {8.0}

The reason for allowing only one control rod at a time to be removed and disassembled during control rod maintenance is to:

a. prevent inadvertent reactor criticality.

b. limit the radiation exposure to personnel.

c. prevent the inadvertent interchange of parts.

d. limit the number of maintenance operations being performed concurrently.

Answer: B.08 c.
Reference: ISU MP-1, step 4.b, p 3. (AGN-201 ROD MAINTENANCE PROCEDURE)

Question B.009 [1 point] {9.0}

The Technical Specification basis for the MAXIMUM core temperature limit is to prevent:

a. breakdown of the graphite reflector.

b. instrument inaccuracies.

c. release of fission products.

d. boiling of the shield water.

Answer: B.09 c.
Reference: ISU Technical Specifications, 2.1 Basis, page 6

Question B.010 [1.0 point] {10.0}

Deleted during the examination

~~Per the emergency plan the *EMERGENCY PLANNING ZONE (EPZ)* is …~~
~~a. rooms 19 and 20.~~
~~b. rooms 20 and 23.~~
~~c. rooms 15, 16, 18, 19, 20, 22, 23 and 24~~
~~d. the entire Lillibridge Engineering Laboratory basement.~~
~~Answer: B.10 b~~
~~Reference: Emergency Plan, 2.0 DEFINITIONS, 2.8~~

Question B.011 [1.0 point] {11.0}
The dose rate from a mixed beta-gamma point source is 100 mrem/hour at a distance of one (1) foot, and is 0.1 mrem/hour at a distance of twenty (20) feet. At one (1) foot what percentage of the source consists of beta radiation?

a. 20%

b. 40%

c. 60%

d. 80%

Answer: B.11 c
Reference: 10CFR20. At 20 feet, there is no beta radiation. Gamma at 20 feet = 0.1 mrem/hour, gamma at 1 foot = 40 mrem/hour. Therefore beta at 1 foot = 60 mrem/hour = 60%.

Question B.012 [1 point] (12.0)
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.12 d.
Reference: ISU Technical Specification 3.2.a

Question B.013 [1 point] (13.0)
To prevent damage to the reactor or excessive release of radioactive materials in the event of an experiment failure, experiments containing corrosive materials shall:

a. be doubly encapsulated.

b. be limited to less than 10 grams.

c. not be inserted into the reactor or stored at the facility.

d. have a TEDE of less than 500 mrem over two hours from the beginning of the release.

Answer: B.13 a.
Reference: ISU Technical Specifications, 3.3.a, page 11

Question B.014 [1.0 point] {14.0}
A radiation survey of an area reveals a general radiation reading of 1 mRem/hr. However, a small section of pipe (point source) reads 10 mRem/hr at one (1) meter. Which ONE of the following is the posting requirement for the area, in accordance with 10 CFR Part 20?

a. "CAUTION - RADIATION AREA"

b. "CAUTION - HIGH RADIATION AREA"

c. "CAUTION - RADIOACTIVE MATERIAL"

d. "CAUTION - AIRBORNE RADIOACTIVITY AREA"

Answer: B.14 b.
Reference: 10 CFR 20.1003
For a point source, 10 mrem/hr at 100 cm (1 meter) = 111.1 mrem/hr at 30 cm.

Question B.015 [1.0 point] {15.0}
As a licensed reactor operator at the AGN-201 facility, who is allowed to operate the controls of the reactor under your direction?

a. A local college newspaper reporter who wants to write a story on the safety of nuclear reactors.

b. A new student participating in a nuclear engineering laboratory course.

c. A health physicist who is trying to gain a certified health physicist (CHP) license.

d. An NRC inspector trying to make sure that all set points of the reactor are the same as those in the technical specifications.

Answer: B.15 b.
Reference: General Operating Rules, Revision 4, dated September 19, 1994.
and 10 CFR 55.13

Question B.016 [1 point] {10.0}
During a reactor startup the low level scram on Channel #1 ensures:

a. protection for a rod drop event.

b. an operating neutron monitor channel.

c. protection for a temperature excursion.

d. the minimum number of period trips are available for startup.

Answer: B.16 b.
Reference: TS 3.2 Basis, page 10

END OF SECTION B

Section C – Facility and Radiation Monitoring Systems

Question C.001 [1 point] {1.0}

The shield tank level trip shall be set to scram the reactor if shield water level falls ____ below the highest point on the reactor shield tank manhole opening.

a. 8 inches

b. 10 inches

c. 12 inches

d. 20 inches

Answer: C.01 b.
Reference: ISU Tech. Spec's 3.2.e.

Question C.002 [1.0 point] {2.0}

The Idaho State University reactor Access Ports pass through the steel tank:

a. up to the reflector.

b. then the lead shield, up to the reflector.

c. then the lead shield, the graphite reflector and then back out again.

d. then the lead shield, graphite reflector, and the core and then back out again.

Answer: C.02 c.
Reference: ISU General Information, AGN - 201 Reactor, Access Ports & Glory Hole.

Question C.003 [1.0 point] {3.0}

When using the movable tank on the top of the reactor as a Thermal Neutron column, it is filled with …

a. Water

b. Beryllium

c. Graphite

d. Heavy Water

Answer: C.03 c.
Reference: ISU SAR, § 4.1

Question C.004 [1 point] {4.0}

The shield tank water temperature interlock prevents reactor operation:

a. during periods of high thermal stress.

b. in the event of a high temperature condition.

c. during a condition that will produce excess radiation levels.

d. from a reactivity addition due to a temperature decrease.

Answer: C.04 d.
Reference: ISU Tech. Spec's., 3.2 Basis, page 10.

Question C.005 [1 point] {5.0}

The U-235 fuel in the AGN is contained in fuel disks and control rods. Of the total fuel in the reactor, approximately how much is contained in the control and safety rods?

a. 9%.

b. 24%.

c. 55%

d. 78%.

Answer: C.05 a.
Reference: Safety Analysis Report, dated November 23, 1995, pg. 46-47

Question C.006 [1 point] {6.0}

Which ONE of the following trips/conditions is associated with the safety chassis interlock bus?

a. period trip.

b. water level.

c. manual scram.

d. low sensitrol temperature.

Answer: C.06 b.
Reference: ISU SAR Section 4.3.2 Instrumentation System, Figure 4.3-8

Section C – Facility and Radiation Monitoring Systems

Question C.007 [1 point] {7.0}

Which ONE of the following describes the design purpose of the space in the top section of the core tank above the reactor core and the reflector?

a. Ensures free fall of the bottom half of the core during the most severe transient.

b. Prevents core damage during the design basis earthquake and 6 cm. displacements.

c. Allows for accumulation of fission product gases created during reactor operation.

d. Increases the fast neutron population in the vicinity of experiments placed in the access ports.

Answer; C.07 c.
Reference: Safety Analysis Report, dated November 23, 1995, pg. 41

Question C.008 [1 point] {8.0}

Which ONE of the following is **NOT** true when considering the advantages of using fueled control rods over poison rods:

a. larger reactor size.

b. more symmetrical flux distribution at power.

c. no critical mass assembled when shutdown.

d. simplification of calculations for a homogeneous reactor.

Answer: C.08 a.
Reference: Previous ISU Exam

Question C.009 [1 point] {9.0}

The shield tank is designed to provide shielding from:

a. the glory hole area.

b. high energy β radiation.

c. high energy γ radiation.

d. fast neutron radiation.

Answer: C.09 d.
Reference: ISU Tech. Spec's, 5.1.d., page 18.

Question C.010 [1 point] {10.0}

Which one of the following materials will have a positive effect on reactivity when inserted into the Glory Hole?

a. Borated Polyethylene

b. Polyethylene

c. Natural Uranium

d. Gold

Answer: C.10 b.
Reference: NRC Examination Question Bank

Question C.011 [1 point] {11.0}

Which ONE of the following statements describes the control rod interlocks?

a. The safety rods cannot be inserted unless the course control rod is "DISENGAGED".

b. The fine control rod cannot be inserted until the safety rods are "FULLY INSERTED".

c. The fine control rod cannot be inserted unless the course control rod is "DISENGAGED".

d. The safety rods must be fully inserted before their drive motors will operate in the "LOWER" position.

Answer: C.11 b.
Reference: ISU SAR Section 4.3.2 Instrumentation System, Figure 4.3-8

Question C.012 [1 point] {12.0}

Which ONE of the following statements describes the design/operation of the control rod drive assemblies?

a. The dashpots consist of a foam cushion to reduce rod impact following a scram.

b. The fine control rod does not have a dashpot since it does not scram.

c. The course control rod dashpot uses magnetic force to slow the rod down before impact on a scram.

d. Dashpots are only associated with the safety rods since these rods have been raised against spring tension to assist in driving these rods down on a scram.

Answer: C.12 b.
Reference: ISU General Information, AGN - 201 Reactor, Control Rods

Question C.013 [1 point] {13.0}
Which ONE of the following does NOT automatically cause a reactor scram?

a. Reactor period.

b. Radiation level.

c. Water level.

d. Power failure.

Answer: C.13 b.
Reference: ISU Safety Analysis Report, dated January 2003, Instrument Sys. 4.3.2

Question C.014 [1 point] {14.0}
What type of detector is used for the Low temperature switch?

a. A simple bi-metallic thermal switch

b. A precision platinum wound resistance temperature detector (RTD)

c. A chromel-alumel (Type K) thermocouple.

d. A copper-constantan (Type T) thermocouple

Answer: C.14 a.
Reference: ISU Safety Analysis Report (SAR) § 4.3.4, Interlock System.

END OF SECTION C

END OF WRITTEN EXAMINATION