May 8, 2013

Dr. Jay F. Kunze, Reactor Administrator
Idaho State University
833 South Eighth Street
Pocatello, ID 83209

SUBJECT: EXAMINATION REPORT NO. 50-284/OL-13-01, IDAHO STATE UNIVERSITY

Dear Dr. Kunze:

During the week of April 15, 2013, 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 those members of your staff 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 Mike Morlang at 301-415-4092 or via email at gary.morlang@nrc.gov.

Sincerely,

/RA/

Gregory T. Bowman, 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-13-01
2. Written Examination

cc: Adam Mallicoat, Reactor Supervisor, Idaho State University

cc: w/o enclosures: See next page

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NAME	GMorlang	CRevelle	GBowman
DATE	05/02/13	05/02/13	05/08/13

OFFICIAL RECORD COPY

Idaho State University Docket No. 50-284

cc:

Idaho State University
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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

EXAMINATION REPORT NO: 50-284/OL-13-01

FACILITY: Idaho State University

FACILITY DOCKET NO.: 50-284

FACILITY LICENSE NO.: R-110

SUBMITTED BY: ________**/RA/**_______________ ___05/02/13_
Mike Morlang, Chief Examiner Date

SUMMARY:

During the week of April 15, 2013, the NRC administered operator licensing examinations to one Senior Reactor Operator Upgrade (SROU), and two Reactor Operator candidates. All candidates passed the examinations and will be issued a license to operate the Idaho State University reactor.

REPORT DETAILS

1. Examiner: Mike Morlang, Chief Examiner

2. Results:

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

3. Exit Meeting:

Dr. Kunze, Nuclear Engineering Department Head
Adam Mallicoat, Idaho State University
Mike Morlang, 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: 4/15/2013

CANDIDATE: ______________________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	% of Candidates Score	Category Value	Category
20.00	33.3			A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
15.00	33.3			B. Normal and Emergency Operating Procedures and Radiological Controls
10.00	33.3			C. Facility and Radiation Monitoring Systems
45.00	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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 kg = 2.21 lbm

1 Horsepower = 2.54 x 10^3 BTU/hr

1 Mw = 3.41 x 10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_P = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C

Question A.001 [1.0 point] (1.0)

Which of the following is the largest effect on the reactivity worth of a control rod?

a. Overall reactor power.

b. Drop time of the control rod.

c. Axial and radial flux shape.

d. Delayed neutron fraction value.

Question A.002 [1.0 point] (2.0)

Which ONE of the following describes the difference between a moderator and reflector?

a. A reflector increases the neutron production factor and a moderator increases the fast fission factor.

b. A reflector decreases the thermal utilization factor and a moderator increases the fast fission factor.

c. A reflector decreases the neutron production factor and a moderator decreases the fast non-leakage factor.

d. A reflector increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

Question A.003 [1.0 point] (3.0)

The delayed neutron fraction changes over core life primarily due to the:

a. buildup of Pu^{241} which increases the delayed neutron fraction.

b. buildup of Pu^{239} which decreases the delayed neutron fraction.

c. depletion of U^{235} which decreases the delayed neutron fraction.

d. depletion of U^{238} which increases the delayed neutron fraction.

Question A.004 [1.0 point] (4.0)
Select the answer that describes the inherent **safety feature** provided by the temperature coefficient of reactivity.

a. Its negative value causes reactivity to increase as moderator temperature increases.
b. Its negative value causes reactivity to decrease as moderator temperature increases.
c. Its positive value causes reactivity to increase as moderator temperature increases.
d. Its positive value causes reactivity to decrease as moderator temperature increases.

Question A.005 [1.0 point] (5.0)
The reactor is initially shut down with count rate at 8 counts per second (cps) and K_{eff} = 0.975. Control rods are inserted, changing K_{eff} to 0.995. Select the stable count rate you would expect.

a. 15 cps
b. 25 cps
c. 40 cps
d. 90 cps

Question A.006 [1.0 point] (6.0)
Which one of the following is the correct reason that delayed neutrons allow human control of the reactor?

a. Fewer prompt neutrons are produced than delayed neutrons.
b. Delayed neutrons increase the mean neutron lifetime.
c. Delayed neutrons take longer to thermalize than prompt neutrons.
d. Delayed neutrons are born at higher energies than prompt neutrons.

Question A.007 [1.0 point] (7.0)
What is the kinetic energy range of a thermal neutron?

a. > 1 MeV

b. 100 KeV – 1 MeV

c. 10 eV – 100 KeV

d. < 1 eV

Question A.008 [1.0 point] (8.0)
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

Question A.009 [1.0 point] (9.0)
Which ONE of the following elements will produce the greatest energy loss per collison?

a. Plutonium

b. Graphite

c. Hydrogen

d. Uranium 238

Question A.010 [1.0 point] (10.0)
Excess reactivity is the amount of reactivity:

a. associated with experiments.

b. needed to achieve prompt criticality.

c. available above that which is required to keep the reactor critical.

d. available above that which is required to make the reactor subcritical.

Question A.011 [1.0 point] (11.0)
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.

Question A.012 [1.0 point] (12.0)
Which ONE of the following causes reactor period to stabilize several 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.

Question A.013 [1.0 point] (13.0)
Which ONE of the following samples when placed individually into the reactor experimental facilities will have a POSITIVE reactivity affect?

a. Gold wire

b. Indium foils

c. Cadmium foils

d. Polyethylene disk

Question A.014 [1.0 point] (14.0)

What is the definition of a cross section?

a. The probability that a neutron will be captured by the nucleus.

b. The most likely energy at which a charged particle will be captured.

c. The length a neutron travels past the nucleus before being captured.

d. The area of the nucleus including the electron cloud.

Question A.015 [1.0 point] (15.0)

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.

Question A.016 [1.0 point] (16.0)
A step insertion of positive reactivity to a critical reactor causes a rapid increase in the neutron population known as a prompt jump. Which ONE of the following explains the cause of this occurrence?

a. immediate increase in the prompt neutron population.

b. shift in the prompt neutron lifetime on up-power maneuvers.

c. rapid negative reactivity insertion due to the fuel temperature coefficient (Doppler) feedback.

d. magnitude of the reactivity insertion exceeding the value of the average effective delayed neutron fraction.

Question A.017 [1.0 point] (17.0)
Which of the following power manipulations would take the longest to complete assuming the same period is maintained?

a. 100 mW to 400 mW

b. 400 mW to 500 mW

c. 2 W to 3.5 W

d. 3.5 W to 4.5 W

Question A.018 [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.

Question A.019 [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

Question A.020 [1.0 point] (20.0)
Of the approximately 200 Mev of energy released per fission event, the largest amount appears in the form of:

a. Alpha radiation

b. Gamma radiation

c. Prompt and delayed neutrons

d. Kinetic energy of the fission fragments

END OF SECTION A

Question B.001 [1 point] (1.0)
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.

Question B.002 [1 point] (2.0)
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.

Question B.003 [1 point] (3.0)
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.

Question B.004 [1 point] (4.0)
According to Technical Specifications the reactor is considered Shutdown when:

a. the reactor is subcritical.

b. the reactor console key switch is in the "OFF" position.

c. no experiments worth more than 0.25¢ are being moved or serviced

d. all safety and control rods are withdrawn and the key is removed from the console with the key switch in "OFF

Question B.005 [1 point] (5.0)
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 % $\Delta k/k$

b. 0.65 % $\Delta k/k$

c. 1.00 % $\Delta k/k$

d. 1.25 % $\Delta k/k$

Question B.006 [1 point] (6.0)
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 RO in the reactor control room 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 in the control room, a certified observer in the reactor control room and a licensed SRO on call one half hour away.

Question B.007 [1 point] (7.0)
For abnormal radiation levels within the Operations Boundary, which ONE of the following describes how the reactor operator initiates an emergency building evacuation?

a. Call the Radiation Safety Office.

b. Notify the Pocatello Police and Fire Departments.

c. Trip the fire alarm on the east wall near the entrance to the Reactor Lab.

d. Using a Bull Horn making a public address announcement throughout the building.

Question B.008 [1 point] (8.0)
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.

Question B.009 [1 point] (9.0)
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

Question B.010 [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.

Question B.011 [1 point] (11.0)

The primary reason for using Nitrogen gas in the rabbit tube assembly is because it is:

a. not toxic.

b. the least expense gas.

c. more resistant to corrosion than other gases.

d. more resistant to neutron activation than other gases.

Question B.012 [1 point] (12.0)

A reactor sample has a disintegration rate of 2×10^{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

Question B.013 [1 point] (13.0)

A channel test of the seismic displacement interlock is required by Technical Specifications to be performed:

a. daily

b. quarterly

c. semiannually

d. annually

Question B.014 [1 point] (14.0)

All of the following prerequisites in MP-2, "Procedure to Open the AGN-201 Core Tank", must be met in order to open the Core Tank for maintenance EXCEPT:

a. the Reactor Supervisor must be present.

b. work must stop if radiation levels exceed 80 mRem/hr.

c. the reactor must have be shutdown for at least 24 hours.

d. no eating drinking or smoking permitted in the laboratory.

Question B.015 [1 point] (15.0)

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.

END OF SECTION B

Section C – Facility and Radiation Monitoring Systems

Question C.001 [1 point] (1.0)
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.

Question C.002 [1 point] (2.0)
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.

Question C.003 [1 point] (3.0)
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.

Question C.004 [1 point] (4.0)
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.

Question C.005 [1 point] (5.0)
Each ONE of the following would be considered an advantage of using fueled control rods over poison rods, EXCEPT:

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.

Question C.006 [1 point] (6.0)
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.

Question C.007 [1 point] (7.0)

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.

Question C.008 [1 point] (8.0)

The shield tank water level trip will occur if water level drops below:

a. 8 inches

b. 10 inches

c. 12 inches

d. 20 inches

Question C.009 [1 point] (9.0)

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.

Question C.010 [1 point] (10.0)

Which ONE of the following does NOT automatically cause a reactor scram?

a. Reactor period.

b. Radiation level.

c. Water level.

d. Power failure.

END OF SECTION C

END OF WRITTEN EXAMINATION

Answer: A.001 c.
Reference: Nuclear Reactor Theory, LaMarsh

Answer: A.002 d.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 1, Section 1.51 & 1.52

Answer: A.003 b.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 5, Section 5.170, Chapter 2, Table 2.10.

Answer: A.004 b.
Reference: Basic Reactor Theory

Answer: A.005 c.
Reference: Basic Reactor Theory

Answer: A.006 b.
Reference: Standard NRC Question

Answer: A.007 d.
Reference: Standard NRC Question

Answer: A.008 a.
Reference: ISU General Information, "The AGN-201 Reactor", p 5.

Answer: A.009 c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, Chapter 3, Section 3.66, Table 3.3, p 134.

Answer: A.010 c.
Reference: Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.172

Answer: A.011 a.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 5, Section 5.62;

Answer: A.012 b.
Reference: Nuclear Reactor Theory, LaMarsh

Answer: A.013 d.
Reference: ISU Experiments 3a and 4b

Answer: A.014 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 55

Answer: A.015 b.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 64.

Answer: A.016 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 340.

Answer: A.017 a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 346

Answer: A.018 c.
Reference: Safety Analysis Report, dated January 2003, pg. 104.

Answer: A.019 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

Answer: A.020 d.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 88.

Answer: B.001 b.
Reference: ISU Technical Specifications, 6.6, page 26

Answer: B.002 c.
Reference ISU Technical Specifications, 2.1 Basis, page 6

Answer: B.003 a.
Reference: ISU Technical Specifications, 3.3.a, page 11

Answer: B.004 d.
Reference: ISU Technical Specification, 1.22, page 4.

Answer: B.005 c.
Reference: ISU Technical Specifications, 3.1.b, page 8.

Answer: B.006 d.
Reference: ISU Technical Specifications, 6.1.11, page 23

Answer: B.007 c.
Reference: ISU Emergency Plan, 7.3 Protective Actions, 7.3.2, page 11.

Answer: B.008 c.
Reference: ISU Operating Procedure #1, Rev. 3, Step IV.E, page 6

Answer B.009 c.
Reference ISU TS 3.2 Basis, p 10.

Answer: B.010 b.
Reference: TS 3.2 Basis, page 10

Answer: B.011 d.
Reference: EP-19, Sample Transfer by Pneumatic Tube.

Answer: B.012 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

Answer: B.013 d.
Reference: ISU TS 4.2.d, page15

Answer: B.014 b.
Reference: ISU MP-2

Answer: B.015 c.
Reference: ISU MP-1, step 4.b, p 3.

Answer: C.001 c.
Reference ISU SAR Section 4.3.2 Instrumentation System

Answer: C.002 b.
Reference: ISU SAR Section 4.3.2 Instrumentation System, Figure 4.3-8

Answer: C.003 b.
Reference: ISU SAR Section 4.3.2 Instrumentation System, Figure 4.3-8

Answer: C.004 b.
Reference: ISU General Information, AGN - 201 Reactor, Control Rods

Answer: C.005 a.
Reference: ISU Exam 5/3/88; AGN - 201 Characteristics.

Answer: C.006 d.
Reference: ISU Tech. Spec's, 5.1.d., page 18.

Answer: C.007 d.
Reference: ISU Tech. Spec's., 3.2 Basis, page 10.

Answer: C.008 b.
Reference: ISU Tech. Spec's 3.2.e.

Answer: C.009 c.
Reference: ISU General Information, AGN - 201 Reactor, Access Ports & Glory Hole.

Answer: C.010 b.
Reference: ISU Safety Analysis Report, dated January 2003, Instrument Sys. 4.3.2