IDAHO STATE UNIVERSITY

College of Engineering
Campus Box 8060
Pocatello, Idaho
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November 6, 1992

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
ATTN: Frank Collins, Mailstop 10/D/22

Dear Mr. Collins:

On behalf of Idaho State University, I would like to thank you and Mr. Hughes for your time while administering the licensing exam to our SRO/RO candidates and Dr. Wilson's requalification exam.

I have attached comments concerning the written test for the initial licensing exam. If there are any questions regarding these comments, please feel free to contact me by phone at (208) 236-3637 or by FAX at (208) 236-4538.

Sincerely,

R. David Clovis

R. David Clovis
Senior Reactor Engineer

cc: Pete Isaksen, EG&G of Idaho, Inc.

Phone:
(208) 236-2902
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(208) 236-4538

Idaho State University
Comments of SRO/RO Exam
Administered November 2, 1992

Section A

Question 2: The reference used for this question was Glasstone and Sesonske. Section 5.286 states: "... a flux may arise from spontaneous fission of uranium-238 or from the inclusion of a special (independent) neutron source." and "... an additional source, such as one of polonium and beryllium yielding 10^6 to 10^7 neutrons/s, for initial startup at least."
Therefore, answer "A" is fine, but our AGN-201 needs a startup source for all subsequent reactor startups. Our reactor operates only four decades of power above our shutdown level. Also, our facility does not employ any type of "pull and wait" procedure to attempt startup on spontaneous fission neutrons of the AGN-201 fuel. If our reactor did not use a startup source for a subsequent reactor run, even if the elapsed time between runs is 10 minutes, we would not be able to startup due to a low sensitrol trip on one or more of the nuclear instrument channels. Therefore, an external source of neutrons will be necessary to re-start the reactor for subsequent runs and "B" is also an answer.

Section C

Question 12: In accordance with technical specifications of our reactor facility, this question has been properly worded for "C" to be a correct answer. However, "D" is also a correct answer. No matter what type of inspection, maintenance, surveillance, or operation is being performed in the reactor room, the high radiation alarm (Ludlum 300) must always be energized and fully operational in accordance with the 10 CFR 70.24 - "Criticality Alarm Requirements." As long as their is reactor fuel in our core, safety and control rods, or the fuel storage container, the facility must always have the high radiation alarm available. To reiterate, "D" is also an answer.

NRC RESOLUTION OF FACILITY COMMENTS FOR IDAHO STATE UNIVERSITY RO/SRO EXAM GIVEN 11/2/1992

Section A, Question 2:

Comment accepted, answer key modified to allow B or C as correct.

Section C, Question 12:

Comment noted, the reference to 10 CFR 70.24 for general criticality alarm requirements is not reflected in the specific Maintenance Procedure in question (MP #1) for choice "D", or in the General Operating Rules contained in the Operating Procedures. The answer key remains unchanged as choice "C", in accordance with the facility recognized proper wording from Technical Specification requirements.

United States Nuclear Regulatory Commission
Operator Licensing Examination
w/ Answer Key

IDAHO STATE UNIVERSITY
11/02/92

Nuclear Regulatory Commission
Operator Licensing
Examination

MASTER COPY

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

FACILITY: Idaho State Univ.

REACTOR TYPE: AGN-201

DATE ADMINISTERED: 92/11/02

REGION: 4

CANDIDATE: ______

LICENSE APPLIED FOR: ______

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers one side ONLY. Attach any answer sheets to the examination. Points for each question are indicated in parentheses 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	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	33.33			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	33.33			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.33			C. PLANT AND RADIATION MONITORING SYSTEMS
60.00		FINAL GRADE	%	TOTALS

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

______
Candidate's Signature

MASTER COPY

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 not received or 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.

6. Fill in the date on the cover sheet of the examination (if necessary).

7. The point value for each question is indicated in parentheses after the question. The amount of blank space on an examination question page is NOT an indication of the depth of answer required.

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. To pass the examination, you must achieve at least 70% in each category.

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

12. When you are done and have turned in your examination, leave the examination area as defined by the examiner. If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001 (1.00)

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

a. Plutonium - Beryllium

b. Radium - Beryllium

c. Americium - Plutonium

d. Neptunium - Antimony

QUESTION: 002 (1.00)

The primary reason a neutron source is required at the ISU AGN-201 is to:

a. allow for testing and irradiation experiments when the reactor is shutdown.

b. supply the neutrons required to start the chain reaction for subsequent reactor startups.

c. provide a neutron level high enough to be monitored for a controlled reactor startup.

d. increase the excess reactivity of the reactor which reduces the frequency for refueling.

QUESTION: 003 (1.00)

Given a source strength of 100 neutrons per second (N/sec) and a multiplication factor of 0.8, the expected neutron count rate would be?

a. 125 N/sec

b. 250 N/sec

c. 400 N/sec

d. 500 N/sec

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

Given the following:

Reactor operating at 5 Watts
Scram setpoint 10 W
Scram delay time 1 second
Reactor period of 10 seconds

What will be the approximate reactor power at the time of the scram due to this reactivity excursion?

a. 10.1 Watts

b. 11 Watts

c. 17.2 Watts

d. 23 Watts

QUESTION: 005 (1.00)

Which ONE of the following describes how delayed neutrons affect control of the reactor?

a. More delayed neutrons are produced than prompt neutrons resulting in a longer time to reach a stable subcritical countrate.

b. Delayed neutrons are born at higher energies than prompt neutrons resulting in a shorter reactor period from increased leakage.

c. Delayed neutrons take longer to thermalize than prompt neutrons resulting in a longer reactor period.

d. Delayed neutrons increase the average neutron lifetime resulting in a longer reactor period.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 006 (1.00)

Which ONE of the following decribes a source of delayed neutrons?

a. Gamma interactions with structural materials.

b. Decay of fission products.

c. Alpha interactions with the reflector.

d. Burnup of Xenon and Samarium.

QUESTION: 007 (1.00)

Which ONE of the following is the dominant factor in determining the differential reactivity worth of a control rod?

a. Radial and axial flux.

b. Total reactor power.

c. Control rod speed.

d. Delayed neutron fraction value.

QUESTION: 008 (1.00)

Which ONE of the following describes the reason for the constant rate of power change (negative 80 second period), several minutes following a reactor scram from full power?

a. The decay of the longer-lived delayed neutron precursors.

b. The fine control rod driving down after reactor scram.

c. The subcritical multiplication of source neutrons.

d. The decay of fission product gammas producing photoneutrons.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 009 (1.00)

With a 30 second period, power would double in approximately:

a. 15 seconds

b. 20 seconds

c. 30 seconds

d. 60 seconds

QUESTION: 010 (1.00)

Which ONE of the following elements will produce the greatest energy loss per collison?

a. Oxygen

b. Uranium 238

c. Hydrogen

d. Graphite

QUESTION: 011 (1.00)

Which ONE of the following statements describes Xenon behavior?

a. Xenon reaches equilibrium after 11 hours of steady state operation following startup.

b. Xenon production and removal varies linearly with reactor power so the value of Xenon at 100% is twice that at 50% power.

c. At equilibrium conditions the decay of Xenon is the major removal method.

d. Xenon is produced directly from fission and the decay of Iodine-135.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 012 (1.00)

Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

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

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

QUESTION: 013 (1.00)

The term "prompt critical" refers to:

a. the instantaneous jump in power due to raising a control rod.

b. a reactor which is supercritical using only prompt neutrons.

c. a reactor which is critical using both prompt and delayed neutrons.

d. a positive reactivity insertion which is less than Beta-effective.

QUESTION: 014 (1.00)

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

a. Xenon-135 capture.

b. Graphite C-12 absorption.

c. Uranium-235 fission.

d. Uranium-238 fission.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 015 (1.00)

A subcritical reactor is being started up. If the coarse control rod is raised in four equal steps (centimeters), reactor behavior is MOST accurately characterized by:

a. power increasing by the same amount for each rod insertion.

b. each rod insertion adding the same amount of reactivity.

c. an increase in the time for power to stabilize for each successive rod insertion.

d. a lower critical rod height when decreasing the time intervals between rod insertions.

QUESTION: 016 (1.00)

Which ONE of the following causes indicated power (count rate) to stabilize several hours after a reactor scram from full power? Assume normal system/component operation and no maintenance activity.

a. Subcritical multiplication of source neutrons.

b. Decay of compensating voltage at low power levels.

c. Power level dropping below the minimum detectable level.

d. Xenon removal by decay at a constant rate.

QUESTION: 017 (1.00)

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

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 018 (1.00)

The inherent safety feature provided by the temperature coefficient of reactivity is described by:

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: 019 (1.00)

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

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

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

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

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

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 020 (1.00)

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

a. buildup of Pu-240 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.

(***** END OF CATEGORY A *****)

QUESTION: 001 (1.00)

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

a. boiling of the shield water.

b. breakdown of the graphite reflector.

c. instrument inaccuracies due to drift.

d. release of fission products.

QUESTION: 002 (1.00)

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 Administer.

b. Reactor Supervisor.

c. Reactor Safety Committee.

d. Dean of the College of Engineering.

QUESTION: 003 (1.00)

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

b. be doubly encapsulated.

c. be limited to less than 5 grams.

d. be sprayed with Krylon prior to insertion.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

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

a. 0.55 % delta k/k

b. 0.65 % delta k/k

c. 0.80 % delta k/k

d. 1.00 % delta k/k

QUESTION: 005 (1.00)

According to Technical Specifications the reactor is considered Shutdown when:

a. the reactor is subcritical.

b. the safety rods are fully inserted and the control rods are fully withdrawn.

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

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

QUESTION: 006 (1.00)

The only persons who are authorized to have keys to the console key switch and turn power "ON" are the:

a. licensed Reactor Operators.

b. licensed Senior Reactor Operators.

c. Reactor Supervisor and Reactor Administrator.

d. Radiation Safety Officer and the Reactor Supervisor.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

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

a. One licensed SRO in the reactor control room and an authorized operator in the reactor room.

b. One authorized operator at the reactor console, a licensed RO 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 one hour away.

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

QUESTION: 008 (1.00)

Which ONE of the following describes how the reactor operator initiates an emergency building evacuation?

a. Tripping one of the building fire alarms.

b. Making a public address announcement.

c. Call the Radiation Safety Office.

d. Sound the evacuation siren.

QUESTION: 009 (1.00)

Which ONE of the following actions should be performed first for fire, in accordance with the ISU Emergency Plan?

a. Attempt to extinguish the fire.

b. Initiate a building evacuation.

c. Notify the ISU Campus Security.

d. Scram the reactor.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

The Emergency Classification associated with a fire would be:

a. not required, if fire can be extinguished within 15 minutes.

b. Class 1, Unusual incident.

c. Class 2, Personnel injury.

d. Class 3, Personnel injury with contamination.

QUESTION: 011 (1.00)

During the performance of a reactor startup checkoff for which the Automatic Reactivity Control System is intented to be used, the override switch fails to stop the drive motor. Which ONE of the following actions is required to be taken prior to continuing with the startup?

a. Place the override switch in the "STOP" position and log the results of the test.

b. Place the auto-rod in the most reactive position and disconnect the drive motor power supply and control wires.

c. Place the auto-rod in the least reactive position and put the override switch in the "STOP" position.

d. Place the auto-rod to the "OUT" limit switch position and put the override switch to the "OPERATE" position then disconnect the drive motor power supply and control wires.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 012 (1.00)

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 is met EXCEPT:

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

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

c. The position indicators for the fine and course control rods are within 0.05 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: 013 (1.00)

During a reactor startup, after the safety rods have been fully inserted from the all rods withdrawn position, the expected increase in readings in Channels #1, #2, and #3 is:

a. 10% to 20%

b. 20% to 30%

c. 30% to 50%

d. 50% to 100%

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 014 (1.00)

At the end of planned operation the reactor may be shutdown by simulating an earthquake only if:

a. power is less than 0.1 watt.

b. the low level scram by decreasing the sensitivity for Channel #3 was not successful.

c. the safety rods are fully inserted and the fine and course control rods are fully withdrawn.

d. console power is shut off (power off button depressed).

QUESTION: 015 (1.00)

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

a. monthly

b. quarterly

c. semiannually

d. annually

QUESTION: 016 (1.00)

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

c. work must stop if radiation levels exceed 50 mRem/hr.

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

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 017 (1.00)

An area would be classified as a radiation area if:

a. continuous exposure will result in a dose less than 2 mRem in an hour or less than 100 mRem in 5 consecutive days.

b. a major portion of the body could receive more than 5 mRem in an hour.

c. a major portion of the body could receive 100 mRem in 7 consecutive days.

d. a major portion of the body could receive more than 100 mRem in an hour.

QUESTION: 018 (1.00)

Personnel dosimetry is required to be worn by all persons in the Reactor Laboratory:

a. at all times.

b. for a tour when the reactor has been unattended.

c. if a person needs to verify the thermal column shield doors are closed.

d. during reactor operation or maintenance.

QUESTION: 019 (1.00)

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

a. 200 mR/hr

b. 325 mR/hr

c. 2 R/hr

d. 7.5 R/hr

QUESTION: 020 (1.00)

Which ONE of the following represents the 10 CFR 20 exposure limits for the skin?

a. 1.25 Rem/qtr

b. 3 Rem/qtr

c. 7.5 Rem/qtr

d. 18.75 Rem/qtr

(***** END OF CATEGORY B *****)

QUESTION: 001 (1.00)

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

a. not explosive.

b. the least expense gas.

c. more resistant to corrosion than other gases.

d. more resistant to neutron activation than other gases.

QUESTION: 002 (1.00)

In the event the reactor fails to scram, the TWO design features that serve to prevent exceeding core temperature limits are the:

a. thermal fuse and large temperature coefficient.

b. Glory Hole Cadmium plug and thermal fuse.

c. large temperature coefficient and volume of water shield.

d. Glory Hole Cadmium plug and volume of water shield.

QUESTION: 003 (1.00)

Which ONE of the following describe the effect of having Neutron Monitoring System Channel #1 test switch in a position other than "OPERATE"?

a. The scram interlock bus is opened.

b. The rod positon will indicate zero.

c. A period trip signal will remain locked-in.

d. Trips are bypassed and the meter will read the selected calibrated signal.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

The type of detector used for Channel #1 of the Neutron Monitoring System is a:

a. BF-3 Ion Chamber.

b. BF-3 Proportional Counter.

c. GM Meter.

d. Compensated Scintillation detector.

QUESTION: 005 (1.00)

During a reactor startup the low level scram on Channel #1 ensures:

a. an operating neutron monitor channel.

b. protection for a rod drop event.

c. protection for a temperature excursion.

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

QUESTION: 006 (1.00)

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

a. water level.

b. period trip.

c. manual scram.

d. low sensitrol level.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

In the event of a safety chassis 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: 008 (1.00)

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

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

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

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

d. The safety rods cannot be inserted unless all rods are "ENGAGED".

QUESTION: 009 (1.00)

Control rod position indication is obtained from:

a. drive motor synchros.

b. lead screw position limit switches.

c. chain drive counters.

d. reed switches actuated by magnet position.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

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

a. They use dashpots which consist of a spring to reduce the impact of the rods on 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: 011 (1.00)

Each ONE of the following would be considered an advantage of using fueled control rods over poison rods, EXCEPT:

a. more symmetrical flux distribution at power.

b. larger reactor size.

c. simplification of calculations for a homogeneous reactor.

d. no critical mass assembled when shutdown.

QUESTION: 012 (1.00)

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 and maintenance.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

A nuclear emergency requires actuation of the emergency ventilation cutout switch, which is located at the:

a. reactor console.

b. entrance to the reactor laboratory (Room 20).

c. south wall across from the ~~health physics~~ NUCLEAR OPERATIONS office.

d. entrance to the isotope laboratory.

QUESTION: 014 (1.00)

The shield tank is designed to provide shielding from:

a. high energy beta radiation.

b. high energy gamma radiation.

c. fast neutron radiation.

d. the thermal column area.

QUESTION: 015 (1.00)

The shield tank water temperature interlock prevents reactor operation:

a. in the event of a high temperature condition.

b. during a condition that will produce high radiation levels.

c. during periods of high thermal stress.

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

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

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

a. prevent the inadvertent interchange of parts.

b. prevent inadvertent criticality.

c. limit the radiation exposure to personnel.

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

QUESTION: 017 (1.00)

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

a. 10 inches

b. 16 inches

c. 20 inches

d. 24 inches

QUESTION: 018 (1.00)

The detector used for the shield tank water level signal is a:

a. manometer.

b. float switch.

c. pressure switch.

d. differential pressure switch.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

The AGN-201 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 reflector and then back out again.

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

QUESTION: 020 (1.00)

In the event of a fire in the reactor console, the console can be deenergized locally by pulling the plug or remotely by opening the:

a breaker in the panel across from the radiation safety office.

b. reactor laboratory room supply breaker in the machine shop.

c. breaker in the panel in the material testing laboratory.

d. reactor laboratory room supply breaker in the Physical Science Building.

(***** END OF CATEGORY C *****)
(********** END OF EXAMINATION **********)

EQUATION SHEET

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

Cycle Efficiency $= \dfrac{\text{Net Work (out)}}{\text{Energy (in)}}$

$\dot{Q} = \dot{m} \Delta h$

$SCR = S/(1-Keff)$

$\dot{Q} = UA \Delta T$

$CR_1 (1-Keff)_1 = CR_2 (1-Keff)_2$

$SUR = \dfrac{26.06 (\lambda_{eff} \rho)}{(\beta - \rho)}$

$M = \dfrac{(1-Keff)_0}{(1-Keff)_1}$

$SUR = 26.06/\tau$

$M = 1/(1-Keff) = CR_1/CR_0$

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

$SDM = (1-Keff)/Keff$

$P = P_0 e^{(t/\tau)}$

$Pwr = W_f \dot{m}$

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

$\ell^* = 1 \times 10^{-5}$ seconds

$\tau = (\ell^*/\rho) + [(\bar{\beta}-\rho)/\lambda_{eff}\rho]$

$\tau = \ell^*/(\rho-\bar{\beta})$

$\rho = (Keff-1)/Keff$

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

$\rho = \Delta Keff/Keff$

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

$\bar{\beta} = 0.0077$

$DR_1 D_1^2 = DR_2 D_2^2$

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

---

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5°C + 32

°C = 5/9 (°F - 32)

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a b c d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a b c d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

020 a b c d ____

(***** END OF CATEGORY A *****)

A N S W E R   S H E E T

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d ____
002 a b c d ____
003 a b c d ____
004 a b c d ____
005 a b c d ____
006 a b c d ____
007 a b c d ____
008 a b c d ____
009 a b c d ____
010 a b c d ____
011 a b c d ____
012 a b c d ____
013 a b c d ____
014 a b c d ____
015 a b c d ____
016 a b c d ____
017 a b c d ____
018 a b c d ____
019 a b c d ____
020 a b c d ____

(***** END OF CATEGORY B *****)

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d ____

002 a b c d ____

003 a b c d ____

004 a b c d ____

005 a b c d ____

006 a b c d ____

007 a b c d ____

008 a b c d ____

009 a b c d ____

010 a b c d ____

011 a b c d ____

012 a b c d ____

013 a b c d ____

014 a b c d ____

015 a b c d ____

016 a b c d ____

017 a b c d ____

018 a b c d ____

019 a b c d ____

020 a b c d ____

(***** END OF CATEGORY C *****)
(********** END OF EXAMINATION **********)

ANSWER: 001 (1.00)

B

REFERENCE:

ISU General Information, "The AGN-201 Reactor", p 5.

ANSWER: 002 (1.00)

C

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.286

ANSWER: 003 (1.00)

D

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 3, Section 3.162;
Equation Sheet:
CR=S/1-Keff CR=100/1-0.8 CR=100/0.2 CR=500

ANSWER: 004 (1.00)

B

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.18;
Equation Sheet:
P=PoE*t/T P=10E*1.0/10 P=10x1.105 P=11.05

ANSWER: 005 (1.00)

D

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.28

ANSWER: 006 (1.00)

B

REFERENCE:

Glasstone & Sesonske, Nuclear Reactor Engineering, Chapter 2, Section 2.169

ANSWER: 007 (1.00)

A

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.225

ANSWER: 008 (1.00)

A

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.46

ANSWER: 009 (1.00)

B

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.18;
Equation Sheet:
P=PoE*t/T P=2Po 2=E*t/30 Ln2=t/30 0.693=t/30 t=20.8

ANSWER: 010 (1.00)

C

REFERENCE:

Glasstone & Sesonske, Nuclear Reactor Engineering, Chapter 3, Section 3.66, Table 3.3, p 134.

ANSWER: 011 (1.00)

D

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Sections 5.57, & 5.62-5.72

ANSWER: 012 (1.00)

D

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.172

ANSWER: 013 (1.00)

B

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.52

ANSWER: 014 (1.00)

A

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.62;
Glasstone & Sesonke, Table A.3

ANSWER: 015 (1.00)

C

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 3, Sections 3.161-3.163;
Chapter 5, Section 5.288

ANSWER: 016 (1.00)

A

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.45-5.47

ANSWER: 017 (1.00)

D

REFERENCE:

ISU Experiments 3a and 4b

ANSWER: 018 (1.00)

B

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.91

ANSWER: 019 (1.00)

A

REFERENCE:

Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 1, Section 1.51 & 1.52

ANSWER: 020 (1.00)

B

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.170,
Chapter 2, Table 2.10.

(***** END OF CATEGORY A *****)

ANSWER: 001 (1.00)

D

REFERENCE:

ISU Technical Specifications, 2.1b Basis, p 5.

ANSWER: 002 (1.00)

B

REFERENCE:

ISU Technical Specifications, 6.6, p 26.

ANSWER: 003 (1.00)

B

REFERENCE:

ISU Technical Specifications, 3.3.a, p 11.

ANSWER: 004 (1.00)

D

REFERENCE:

ISU Technical Specifications, 3.1b, p 7.

ANSWER: 005 (1.00)

D

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

REFERENCE:

ISU Technical Specification, 1.14, p 4.

ANSWER: 006 (1.00)

B

REFERENCE:

ISU General Operating Rules, No. 2, p 1.

ANSWER: 007 (1.00)

A

REFERENCE:

ISU Technical Specifications, 6.1.9a, p 23; General Operating Rules 5-7.

ANSWER: 008 (1.00)

A

REFERENCE:

ISU Emergency Plan, Appendix 3, Step 6, p 28.

ANSWER: 009 (1.00)

D

REFERENCE:

ISU Emergency Plan, Section 4, Fire or Explosion, Step 1, p 16.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

ANSWER: 010 (1.00)

C

REFERENCE:

ISU Emergency Plan, Section 4, Table 2, p 9.

ANSWER: 011 (1.00)

B

REFERENCE:

ISU OP-3, Step 7.

ANSWER: 012 (1.00)

C

REFERENCE:

ISU O.P. #1, Rev 2, Step IV.E, p 8 & 9.

ANSWER: 013 (1.00)

D

REFERENCE:

ISU O.P. #1, Rev 2, Step IV.C, p 8.

ANSWER: 014 (1.00)

A

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

REFERENCE:

ISU O.P. #2, Rev 2, Section VII, Step 8, p 10.

ANSWER: 015 (1.00)

C

REFERENCE:

ISU TS 4.2.d, p 14.

ANSWER: 016 (1.00)

C

REFERENCE:

ISU MP-2

ANSWER: 017 (1.00)

B

REFERENCE:

ISU General Information, Radiation Protection Definitions, p 2.

ANSWER: 018 (1.00)

D

REFERENCE:

ISU Operating Procedures, General Operating Rules, Rev 1, No. 12, p 2.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

ANSWER: 019 (1.00)

C

REFERENCE:

ISU Test Bank; 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: 020 (1.00)

C

REFERENCE:

ISU General Information, Radiation Protection, Exposure Limits;10 CFR 20

(***** END OF CATEGORY B *****)

ANSWER: 001 (1.00)

D

REFERENCE:

ISU Exam Bank Essay, Radiation Protection #2.

ANSWER: 002 (1.00)

A

REFERENCE:

ISU TS 2.2 Basis, p 6.

ANSWER: 003 (1.00)

A

REFERENCE:

ISU General Information, NMS Ch #1.

ANSWER: 004 (1.00)

B

REFERENCE:

ISU General Information, NMS Ch #1.

ANSWER: 005 (1.00)

A

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

REFERENCE:

ISU Exam Bank; TS 3.2 Basis, p 10; Gen. Info., NMS.

ANSWER: 006 (1.00)

A

REFERENCE:

ISU General Information, safety chassis diagram.

ANSWER: 007 (1.00)

C

REFERENCE:

ISU General Information, Safety Chassis and diagram.

ANSWER: 008 (1.00)

D

REFERENCE:

ISU General Information, Control Rods.

ANSWER: 009 (1.00)

A

REFERENCE:

ISU General Information, Control Rods.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

ANSWER: 010 (1.00)

B

REFERENCE:

ISU General Information, Control Rods.

ANSWER: 011 (1.00)

B

REFERENCE:

ISU Exam 5/3/88; AGN-201 Characteristics.

ANSWER: 012 (1.00)

C

REFERENCE:

ISU TS 3.2 Basis, p 10.

ANSWER: 013 (1.00)

C

REFERENCE:

ISU Emergency Plan, p 12,13.

ANSWER: 014 (1.00)

C

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

REFERENCE:

ISU TS, 5.1.d., p 17.

ANSWER: 015 (1.00)

D

REFERENCE:

ISU TS, 3.2 Basis, p 10.

ANSWER: 016 (1.00)

A

REFERENCE:

ISU MP-1, step 4.b, p 2.

ANSWER: 017 (1.00)

A

REFERENCE:

ISU Surveillance Procedure #4, p 1.

ANSWER: 018 (1.00)

B

REFERENCE:

ISU Surveillance Procedure #4,Step II.F, p 2.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

ANSWER: 019 (1.00)

C

REFERENCE:

ISU General Information, AGN-201 Reactor, Access Ports & Glory Hole.

ANSWER: 020 (1.00)

A

REFERENCE:

ISU Exam 5/.. 8

(***** END OF CATEGORY C *****)
(********** END OF EXAMINATION **********)

ANSWER KEY

MULTIPLE CHOICE

001 B

002 C or B

003 D

004 B

005 D

006 B

007 A

008 A

009 B

010 C

011 D

012 D

013 B

014 A

015 C

016 A

017 D

018 B

019 A

020 B

(***** END OF CATEGORY A *****)

A N S W E R   K E Y

MULTIPLE CHOICE

001 D

002 B

003 B

004 D

005 D

006 B

007 A

008 A

009 D

010 C

011 B

012 C

013 D

014 A

015 C

016 C

017 B

018 D

019 C

020 C

(***** END OF CATEGORY B *****)

ANSWER KEY

MULTIPLE CHOICE

001 D

002 A

003 A

004 B

005 A

006 A

007 C

008 D

009 A

010 B

011 B

012 C

013 C

014 C

015 D

016 A

017 A

018 B

019 C

020 A

(***** END OF CATEGORY C *****)
(********** END OF EXAMINATION **********)