August 29, 2014

Dr. Jeffrey Geuther, Director
Nuclear Reactor Facility Manager
Kansas State University
112 Ward Hall
Manhattan, KS 66506-2500

SUBJECT: EXAMINATION REPORT NO. 50-188/OL-14-02, KANSAS STATE UNIVERSITY

Dear Dr. Geuther:

During the week of July 14, 2014, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Kansas State University reactor. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10 of the *Code of Federal Regulations*, Section 2.390 a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the 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 this examination, please contact Phillip T. Young at 301-415-4094 or via internet e-mail Phillip.Young@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-188

Enclosure:
Examination Report No. 50-188/OL-14-02

cc w/o enclosure: see next page

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<u>DISTRIBUTION</u>:
PUBLIC PROB r/f KHsueh CRevelle

ADAMS ACCESSION #: ML14204A088 **NRR-079**

OFFICE	NRR/DPR/PROB	NRR/DPR/PROB	NRR/DPR/PROB
NAME	PYoung	CRevelle	KHsueh
DATE	7/24/2014	8/28/2014	8/29/2014

OFFICIAL RECORD COPY

cc:

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

U.S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-188/OL-14-02

FACILITY DOCKET NO.: 50-188

FACILITY LICENSE NO.: R-88

FACILITY: Kansas State University

SUBMITTED BY: **/RA/** 07/24/2014
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of July 12, 2014, the U.S. Nuclear Regulatory Commission (NRC) administered license examinations to one Reactor Operator license candidate. The applicant passed all portions of the examination.

REPORT DETAILS

1. Examiner: Phillip T. Young, Chief Examiner

2. Results:

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

3. Exit Meeting:

An exit meeting was not conducted. The Director was out of state and the applicant was administered the written examination at a later date.

ENCLOSURE

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 7/15/2014

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
20.00	33.3	______	____	B. Normal and Emergency Operating Procedures and Radiological Controls
20.00	33.3	______	____	C. Facility 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

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

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

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

4. Use black ink or dark pencil only to facilitate legible reproductions.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$T_{‰} = \frac{0.693}{\lambda}$$

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

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

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

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

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

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

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

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

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}
A reactor with an initial population of $1x10^8$ neutrons is operating with K_{eff} = 1.001. Considering only the increase in neutron population, how many neutrons (of the increase) will be prompt when the neutron population changes from the current generation to the next? Assume β = 0.007.

a. 700.
b. 7,000.
c. 99,300.
d. 100,000.

Answer: A.02 c.
Reference: DOE Fundamentals Handbook, Mod 2, Prompt and Delayed Neutrons, pg 29.Increase = $1.001x10^8 - 1x10^8 = 1x10^5$.
Prompt neutron population = $0.993x1x10^5$ = 99,300.

Question A.003 [1.00 point] {3.0}
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.03 d.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-9.

Question A.004 (1.00 point) {4.0}
For the same constant reactor period, which ONE of the following transients requires the LONGEST time to occur? A power increase of:

a. 5% of rated power - increasing from 1% to 6% of rated power.
b. 10% of rated power - increasing from 10% to 20% of rated power.
c. 15% of rated power - increasing from 20% to 35% of rated power.
d. 20% of rated power - increasing from 40% to 60% of rated power.

Answer: A.04 a.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-4.
P/P_o is largest for answer A, therefore requires the longest time.

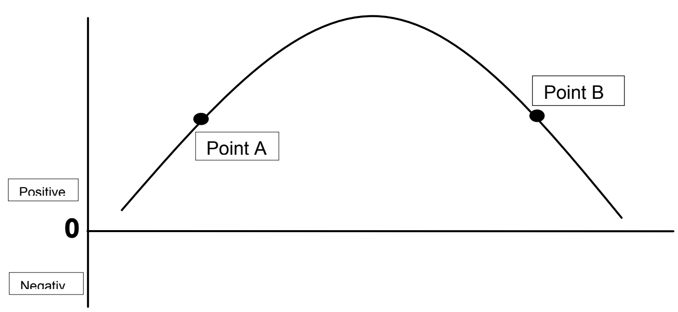
Question A.005 [1 points, ¼ each] {5.0}
Match the description of plant conditions in column A with resulting xenon conditions in column B.

Column A	Column B
a. 4 hours after a power increase	1. Xenon concentration is increasing to a peak
b. 2 hours after a power decrease	2. Xe concentration is decreasing to a trough
c. 16 hours after a “clean” startup	3. Xenon concentration is approximately zero (reactor is “clean”)
d. 72 hours after a shutdown	4. Xenon concentration is “relatively” steady at a “non-zero” value

Answer: A.05 a. = 2; b. = 1; c. = 4; d. = 3
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question: A.006 [1.0 point] {6.0}
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.06 a.
Reference: Standard NRC Question[1]

Question A.007 [1.0 point] {7.0}
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.07 a.
$0.1 \times 3.79 = 0.379$ $0.9 \times 0.23 = 0.207$ $0.1 \times 7.9 = 0.79$ $0.9 \times 1.49 = 1.34$
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.008 [1.0 point] {8.0}
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.08 b.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.3.

Question A.009 [1.0 point] {9.0}
Which ONE of the reactions below is an example of a <u>photoneutron</u> source?

a. ${}_{51}Sb^{123} + n \rightarrow {}_{51}Sb^{124} + \gamma$
b. ${}_{92}U^{238} \rightarrow {}_{35}Br^{87} + {}_{57}La^{148} + 3n + \gamma$
c. ${}_{1}H^{2} + \gamma \rightarrow {}_{1}H^{1} + n$
d. ${}_{4}Be^{9} + \alpha \rightarrow {}_{6}C^{12} + n$

Answer: A.09 c.
Reference DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 1.3.

Question A.010 [1.0 point] {10.0}
You are performing a fuel load and predicting criticality using a 1/M curve. You stop for lunch. After lunch you recommence using the count rate at that time as a new initial count rate C_o. You load additional elements into the core and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur with the same number of elements loaded as if there were no change in the initial count rate.
b. criticality will occur earlier (i.e., with fewer elements loaded.)
c. criticality will occur later (i.e., with more elements loaded.)
d. criticality will be completely unpredictable.

Answer: A.10 a.
Reference: DOE Fundamentals Handbook, Volume 2, Module 4, pg. 6, "Use of 1/M plots. Exam 1

Question A.011 [1.0 point] {11.0}
A reactor is critical at 18.1 inches on a controlling rod. You withdraw the controlling rod to 18.4 inches, adding 14.4 cents worth of reactivity. What is the differential rod worth?

a. 14.4 cents/inch at 18.25 inches.
b. 14.4 cents/inch only between 18.1 and 18.4 inches.
c. 48 cents/inch at 18.4 inches.
d. 48 cents/inch at 18.25 inches.

Answer: A.11 d.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3, Enabling Objective 5.3. Exam 1

Question A.012 [1.0 point] {12.0}
ELASTIC SCATTERING 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.12 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.013 [1.0 point] {13.0}
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.13 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory,

Question A.014 [1.0 point] {14.0}
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.14 c.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.12. Exam 2

Question A.015 [1.0 point] {15.0}
The major contribution to the production of Xenon-135 in a reactor operating at full power is:

a. directly from the fission of U-235.
b. from the radioactive decay of iodine.
c. from the radioactive decay of promethium.
d. directly from the fission of U-238.

Answer: A.15 b.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3, Enabling Objective 4.1. Exam 2

Question A.016 [1.0 point] {16.0}
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.16 c.
Reference: DOE Fundamentals Handbook, Volume 2, Module 4, Enabling Objective 1.3.

Question A.017 [1.0 point] {17.0}
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.17 c.
Reference: DOE Fundamentals Handbook, Volume 2, Module 4, Enabling Objective 2.8. Exam 7

Question A.018 [1.0 point] {18.0}
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.18 c.
Reference: DOE Fundamentals Handbook, Volume 1, Module 2, Enabling Objective 2.13. Exam

Question A.019 [1.0 point] {19.0}
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.19 c.
Reference: Standard NRC Question

Question A.20 [1.0 point] {20.0}
Given the following data, which ONE of the following is the closest to the half-life of the material?

TIME	ACTIVITY
0	2400 cps
10 min.	1757 cps
20 min.	1286 cps
30 min.	941 cps
60 min.	369 cps

a. 11 minutes
b. 22 minutes
c. 44 minutes
d. 51 minutes

Answer: A.20 b.
Reference: DOE Fundamentals Handbook, Volume 1, Module 1, Enabling Objective 2.5. $A = A_0 e^{-\lambda T}$ (22 minutes).

Question B.001 [1 point] {1.0}
Two senior reactor operators are operating the reactor at night. One receives a phone call for an emergency at home. What addition actions must be taken to continue to operate the reactor?

a. none, the single SRO may operate the reactor alone.
b. an operator-in-training, must be called in to accompany the SRO.
c. a licensed reactor operator must be called in to operate the reactor.
d. another licensed senior operator must be called in to either operate or supervise the operation of the reactor.

Answer: B.01 a
Reference: KSU Technical specification § 6.1(c)

Question B.002 [1 point] {2.0}
Technical Specification defines a reportable occurrence as … "2. VIOLATION OF SL, LSSS OR LCO; **NOTES**: Violation of an LSSS or LCO occurs through failure to comply with an "Action" statement when "Specification" is not met; failure to comply with the "Specification" is not by itself a violation. Surveillance Requirements must be met for all equipment/ components/conditions to be considered operable. Failure to perform surveillance within the required time interval or failure of a surveillance test shall result in the /component /condition being inoperable…. Using this guidance, which one of the following is a reportable occurrence, if discovered during normal operations?

a. The maximum available core reactivity (excess reactivity) with all control rods fully withdrawn is $3.50.
b. The Continuous Air Monitor has been inoperable for 20 days, the Exhaust Plenum Radiation monitor is operating normally.
c. The ventilation system has been inoperable for 15 days, there are no experiments in the core, but you are moving irradiated within the fuel storage racks.
d. The last semiannual shutdown margin determination was performed seven (7) months and three (3) weeks ago.

Answer: B.02 c.
Reference: KSU Technical specification §§ 6.9, 3.1.3(1), 3.3.4(e), 4.1.2 & 1

Question B.003 [1.0 point] {3.0}
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. What percentage of the source consists of beta radiation?

a. 20%
b. 40%
c. 60%
d. 80%

Answer: B.03 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.004 [1.0 point] {4.0}
"Protective Action Guides" are:

a. specific instrument readings, observations, dose rates, etc., which provide thresholds for establishing emergency classes.
b. projected dose equivalents to individuals in the general population which warrants protective actions following a nuclear incident.
c. dose equivalents that are projected to be received by individuals in a population group from a contaminating event if no protective actions were taken.
d. instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

Answer: B.04 b.
Reference: Emergency Plan, section 7.1.

Question B.005 [1.0 point] {5.0}
During fuel handling the Reactor Operator (RO) is required to record fuel movement in the control room operations log book. Which of the following is **completely** correct for the RO is required log entries?

a. When the fuel to be removed is out of the reactor core and after the tool is release from the fuel with the fuel in the desired location.
b. When the fuel handling tool is latched to fuel to be moved and after the tool is released from the fuel with the fuel in the desired location.
c. When the SRO in charge of the fuel movement directs the RO to make the log entry.
d. Only after the fuel is seated in the desired final location.

Answer: B.05 b.
Reference: KSU Procedure 26 Fuel Handling Procedure

Question B.006 [1.0 point] {6.0}
When checking the Pulse Power Interlock, Per Procedure No. 5 – Semi-Annual Check Minimum Interlock & SCRAM Checks, Sequentially WITHDRAW the shim, safety, AND the regulating rod UNTIL the DOWN light is de-energized. Then DEPRESS the Pulse Interlock pushbutton and VERIFY that the ____________. Which of the following expected indications is NOT correct for this situation?

a. all SCRAMs are reset
b. pulse interlock light is energized
c. the NLW-1000 is reading downscale
d. the SOURCE interlock light is de-energized

Answer: B.06 d.
Reference: KSU Procedure No. 5 – Semi-Annual Check Minimum Interlock & SCRAM Checks

Question B.007 [1.0 point] {7.0}
The Emergency Plan defines a Medical Incident as:

a. a laboratory accident involving radiation exposure.
b. bodily injury requiring medical treatment.
c. a laboratory accident involving radiation exposure accompanied by bodily injury.
d. a laboratory accident involving radioactive contamination.

Answer: B.07 c.
Reference: Emergency Plan, 4.1.

Question B.008 [1.0 point] {8.0}
According to 10 CFR 20, the "Annual Limit on Intake (ALI)" refers to …

a. the amount of radioactive material taken into the body by inhalation or ingestion in one (1) year which would result in a committed effective dose equivalent of five (5) rems.
b. the concentration of a given radionuclide in air which, if breathed for a working year of 2000 hours, would result in a committed effective dose equivalent of 5 rems.
c. the dose equivalent to organs that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
d. limits on the release of effluents to an unrestricted environment.

Answer: B.08 a
Reference: Radiation Protection Program, page A-2.

Question B.009 [1.0 point] {9.0}
There has been a confirmed breach of cladding for multiple fuel elements. In accordance with the Emergency Plan, this event would be classified as a(n):

a. Unusual Event.
b. Alert.
c. Site Emergency.
d. General Emergency.

Answer: B.09 b.
Reference: Emergency Plan, section 6.2.

Question B.010 [1.0 point] {10.0}
Which ONE of the following would be an initiating condition for an ALERT?

a. On-site life-threatening release of toxic or flammable gases.
b. Tornado damage to facility.
c. Threatened compromise of security.
d. Attempted sabotage.

Answer: B.10 b.
Reference: Emergency Plan

Question B.011 [1.0 point] {11.0}
You are removing a sample from the pool. You expect the sample to emit both a beta and a gamma radiation. You stop removal at 1 meter below the surface to check for radiation levels from the sample. Given the HVL for 1 Mev gamma radiation in water is about 8 inches, is this a realistic level to stop to detect a radiation problem and why?

a. Yes, three feet of water is not a very good at shielding either beta or gamma radiation.
b. No, three feet of water is an excellent shield for betas, you will however get an accurate reading for gammas.
c. No, three feet of water is an excellent shield for gammas, you will however get an accurate reading for betas.
d. No, three feet of water is an excellent shield for betas and the reading for gammas will be off by a factor of about 30.

Answer: B.11 d.
Reference: New NRC Question under development.

Question B.012 [1.0 point] {12.0}
Per 10CFR20.1201, the annual dose limit for the skin of your extremities per year is …

a. 1.0 rem.
b. 5.0 rem.
c. 15.0 rem.
d. 50.0 rem.

Answer: B.12 d.
Reference: 10CFR20.1201

Question B.013 [1.0 point] {13.0}
Calculate the amount of reactivity by which the reactor is shutdown if the Pulse rod is stuck all the way out. Assume the following worths:

Shim= $2.10; Regulating = $1.05; Pulse = $1.10; Excess reactivity = $2.05.

a. $0.95
b. $1.10
c. $2.20
d. $4.25

Answer: B.13 b.
Reference: Shim rod + Reg rod = $3.15. Excess reactivity - $3.15 = -$1.10.

Question B.014 [1.0 point] {14.0}
Which ONE of the following would be an initiating condition for an Unusual Event?

a. Fire potentially affecting safety systems.
b. Indication of damage to a fuel element
c. Earthquake with damage to facility.
d. Tornado damage to facility.

Answer: B.14 b.
Reference: Emergency Plan Section 7.0

Question B.015 [1 point, 0.25 each] {15.0}
Match type of radiation (a thru d) with the proper penetrating power (1 thru 4)

a. Gamma	1. Stopped by thin sheet of paper
b. Beta	2. Stopped by thin sheet of metal
c. Alpha	3. Best shielded by light material
d. Neutron	4. Best shielded by dense material

Answer: B.15 a. = 4; b. = 2; c. = 1; d. = 3
Reference: Standard NRC Health Physics Question

Question B.016 [1.0 point] {16.0}
Which ONE of the following (i.e., presence) of an SRO?

a. Control rod calibrations.
b. Control rod drop time measurement.
c. Pulsing the reactor.
d. Discharging radioactive material to sanitary sewer

Answer: B.16 c.
Reference: Facility supplied question.

Question B.017 [1.0 point] {17.0}
An alpha particle assay of the primary coolant is to be performed. In accordance with Procedure No. 21, "Alpha-Particle Assay of Reactor Liquids," the purpose of this assay is to:

a. assure compliance with limits for alpha-particle activity in effluents to the sanitary sewer system.
b. detect the presence of uranium in the coolant due to clad leakage.
c. detect leakage from an in-core experiment.
d. detect the presence of N-16.

Answer B.17 a.
Reference: KSU Procedure No. 21.

Question B.018 [1.0 point] {18.0}
Which ONE of the following statements describes a reactivity limitation imposed on experiments?

a. The absolute reactivity worth of all experiments in the reactor shall not exceed $2.00.
b. An experiment which will not cause a 20-second period can be inserted in the core when the reactor is at power.
c. When determining the absolute reactivity worth of an experiment, the reactivity effects associated with the moderator temperature is to be considered.
d. No experiment shall be inserted or removed unless all control blades are fully inserted.

Answer: B.18 a.
Reference: Technical Specifications, I.3(a).

Question B.019 [1.0 point] {19.0}
Which ONE of the following interlocks, according to Technical Specifications, may be bypassed during fuel loading operations?

a. Movement of any rod except the transient rod.
b. Shim and regulating rod withdrawal with less than two counts per second on the start-up channel.
c. Simultaneous manual withdrawal of two rods.
d. Application of air to the transient rods unless regulating and shim rods are fully inserted.

Answer: B.19 b.
Reference: Technical Specifications, Table II

Question B.020 [1.0 point] {20.0}
Which ONE of the following statements correctly describes the relationship between the Safety Limit (SL) and the Limiting Safety System Setting (LSSS)?

a. The SL is a maximum operationally limiting value that prevents exceeding the LSSS during normal operations.
b. The SL is a parameter that assures the integrity of the fuel cladding. The LSSS initiates protective actions to preclude reaching the SL.
c. The SL is a maximum setpoint for instrumentation response. The LSSS is the minimum number of channels required to be operable.
d. The LSSS is a parameter that assures the integrity of the fuel cladding. The SL initiates protective action to preclude reaching the LSSS.

Answer: B.20 b.
Reference: Standard NRC question on Safety Limits

Question C.001 [1.0 point] {1.0}
When the reactor is operating at full power, the highest thermal neutron flux occurs at:

a. the E-ring.
b. the central thimble.
c. the rotary specimen rack.
d. the F-ring rabbit terminus.

Answer: C.01 b.
Reference: Training Manual, page A1-11.

Question C.002 [1.0 point] {2.0}
When the reactor is in the steady state mode, two or more control rods may not be withdrawn simultaneously. The purpose of this interlock is to:

a. prevent the possibility of a sourceless startup.
b. minimize the possibility of pulsing a supercritical reactor.
c. prevent violation of the maximum reactivity insertion rate.
d. prevent the inadvertent pulsing of a reactor in the steady state mode.

Answer: C.02 c.
Reference: Training Manual, page A1-18.

Question C.003 [1.0 point] {3.0}
Which ONE of the following is the main function performed by the **DISCRIMINATOR** circuit in the Startup Channel?

a. To convert the linear output of the Startup Channel Detector to a logarithmic signal for metering purposes.
b. To convert the logarithmic output of the metering circuit to a δt (delta time) output for period metering purposes.
c. To filter out small pulses due to gamma interactions, passing only pulses due to neutron events within the Startup Channel Detector.
d. To generate a current signal equal and of opposite polarity as the signal due to gammas generated within the Startup Channel Detector.

Answer: C.03 c.
Reference: Standard NRC Question for proportional counters.
SAR chapter 7 shows a Fission Chamber.

Question C.004 [1.0 point] {4.0}
The water monitor vessel contains:

a. a temperature probe, a pressure probe, and a GM tube.
b. a temperature probe, a conductivity probe, and a pressure probe.
c. a conductivity probe, a pressure probe, and a GM tube.
d. a conductivity probe, a temperature probe, and a GM tube.

Answer: C.04 d.
Reference: Training Manual, page A1-10

Question C.005 [1.0 point] {5.0}
The shim rod and the regulating rod are constructed of:

a. graphite with aluminum cladding.
b. boron and carbon with aluminum cladding.
c. cadmium with aluminum cladding.
d. graphite and boron with aluminum cladding.

Answer: C.05 b.
Reference: Training Manual, page A1-6.

Question C.006 [1.0 point] {6.0}
Which ONE of the following is the flow through the primary loop and the cleanup loop?

a. 120 gpm total flow with 10 gpm through the cleanup loop
b. 110 gpm total flow with 10 gpm through the cleanup loop
c. 120 gpm total flow with 20 gpm through the cleanup loop
d. 110 gpm total flow with 20 gpm through the cleanup loop

Answer: C.06 b.
Reference: SAR Section 5.2 and 5.4

Question C.007 [1.0 point] {7.0}
WHICH ONE of the following detectors is used primarily to measure N16 released to the environment?

a. NONE, N16 has too short a half-life to require environmental monitoring.
b. Stack Gas Monitor
c. Air Particulate Monitor
d. Area Radiation Monitor above pool

Answer: C.07 a.
Reference: Standard NRC Question

Question C.008 [1.0 points, 0.25 each] {8.0}
Match the purification system conditions listed in column A with their respective causes listed in column B. Each choice is used only once.

Column A	Column B
a. High Radiation Level at demineralizer.	1. Channeling in demineralizer.
b. High Radiation Level downstream of demineralizer.	2. Fuel element failure.
c. High flow rate through demineralizer.	3. High temperature in demineralizer system
d. High pressure upstream of demineralizer.	4. Clogged demineralizer

Answer: C.08 a. = 2; b. = 3; c. = 1; d. = 4;
Reference: Standard NRC cleanup loop question

Question C.009 [1.0 point] {9.0}
Which ONE of the following describes the purpose of the Pull Rod in the control rod drive assembly?

a. Actuates the rod down microswitch.
b. Provides rod full out position indication.
c. Automatically engages the control rod on a withdraw signal.
d. Provides a means for manually adjusting the rod position by pulling rod out.

Answer: C.09 a.
Reference: KSU Training Manual, Section 8.2, Circuit Operations.

Question C.010 [1.0 point] {10.0}
Which ONE of the following describes the action of the rod control system to drive the magnet draw tube down after a dropped rod? Downward motion of the draw tube is initiated by …

a. deenergizing the rod magnet.
b. closing the contact on the MAGNET DOWN limit switch.
c. closing the contact on the ROD DOWN limit switch.
d. de-energizing both contact light (DS317) and the MAGNET UP limit switch.

Answer: C.10 c.
Reference: KSU Training Manual, Section 8.2, Circuit Operations.

Question C.011 [1.0 point] {11.0}
When the percent power channel is used for neutron detection, how is the gamma flux accounted for?

a. Pulse height discrimination is used to eliminate the gamma flux.
b. The gamma flux is proportional to neutron flux and is counted with the neutrons.
c. The gamma flux is canceled by creating an equal and opposite gamma current in the detector.
d. The gamma flux passes through the detector with no interaction because of detector design.

Answer: C.11 b.
Reference: Training Manual, page A1-15.

Question C.012 [1.0 point, 0.25 each] {12.0}
Select from column B the actual rod movement that would result from attempting to move the rods in column A. (Items in column B may be used once, more than once or not at all.

Column A (Attempted Rod Move)	Column B (Result)
a. Attempt to withdraw reg rod (pulse mode).	1. Shim rod moves up.
b. Attempt to withdraw both shim and reg rods (steady state mode)	2. Reg rod moves up.
c. Attempt to withdraw both pulse and reg rod (steady state mode).	3. Shim & reg rods move up.
d. Shim and pulse rods are up and attempt to withdraw pulse rod (steady state mode).	4. Pulse rod moves up
	5. No rod motion.

Answer: C.12 a. = 5; b. = 5; c. = 4; d. = 4.
Reference: KSU Procedure No. 5, Part 1.

Question C.013 [1.0 point] {13.0}
The continuous air monitors are calibrated to detect the presence of:

a. noble gases from a leaking fuel element.
b. Ar^{41}
c. N^{16}
d. I^{131}

Answer: C.13 d.
Reference: KSU Procedure No. 8.

Question C.14 [1.0 point] {14.0}
The reactor is operating in the pulse mode when a reactor scram occurs. The transient rod solenoid valve:

a. is energized by the scram circuitry, which opens the valve and removes air from the cylinder.
b. is de-energized by the scram circuitry, which closes the valve and removes air from the cylinder.
c. is energized by a timer, which closes the valve and removes air from the cylinder.
d. is de-energized by a timer, which opens the valve and removes air from the cylinder.

Answer: C.14 d.
Reference: Training Manual, page A1-18.

Question C.15 [1.0 point] {15.0}
In the reactor cooling system, there is a pressure gauge on each side of the filter. The purpose of these gauges is to:

a. provide a computer input for measuring system pressure.
b. provide a differential pressure to measure flow through the deionizer.
c. measure the pressure drop across the filter to determine filter clogging.
d. measure primary pressure to ensure that it is always lower than secondary pressure.

Answer: C.15 c.
Reference: Training Manual, page A1-11.

Question C.16 [1.0 point] {16.0}
When the shim control rod is withdrawn, the withdrawing force is provided by the:

a. pull rod.
b. push rod
c. draw tube.
d. worm gear.

Answer: C.16 c.
Reference: Training Manual, page A1-16.

Question C.017 [1 point] {17.0}
A high reactor sump level light concurrent with a bulk water alarm might mean which of the following:

a. Fuel element failure
b. Loss of reactor pool water
c. Secondary coolant system leakage
d. Humidity in the reactor bay (HVCA condensate)

Answer: C.17 b.
Reference: KSU exam bank

Question C.018 [1 point] {18.0}
Which of the following controls the amount of reactivity that is inserted by the transient rod during pulse operations?

a. The position of the cylinder
b. The timer setting that vents the pneumatic piston
c. The pressure of the air applied to the pneumatic piston
d. The initial power level of the reactor prior to firing the pulse

Answer: C.18 a.
Reference: KSU exam bank

Question C.019 [1 point] {19.0}
The central thimble is an aluminum tube extending from the top of the reactor tank and terminating:

a. below the bottom grid plate.
b. at the bottom grid plate.
c. at the midpoint of the core.
d. at the top grid plate.

Answer: C.19 a.
Reference: Training Manual, page A1-7.

Question C.020 [1 point] {20.0}
The purpose of the diffuser above the core during operation is to:

a. reduce dose rate at the pool surface from N-16.
b. enhance heat transfer across all fuel elements in the core.
c. better distribute heat throughout the pool.
d. ensure consistent water chemistry in the pool.

Answer: C.20 a.
Reference: SAR, page 5-10.