October 25, 2006

Mr. P. M. Whaley
Nuclear Reactor Facility Manager
Kansas State University
112 Ward Hall
Manhattan, KS 66506-2500

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-188/OL-07-01, KANSAS STATE UNIVERSITY

Dear Mr. Whaley:

During the week of October 2, 2006, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Kansas State University reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.390 of the Commission's 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 (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip T. Young at 301-415-4094 or internet e-mail pty@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-188

Enclosures:
1. Initial Examination Report No. 50-188/OL-07-01
2. Facility comments with NRC resolution
3. Examination and answer key with facility comments incorporated.

cc w/encls: Please see next page

cc:

Office of the Governor
State of Kansas
Topeka, KS 66612

Mayor of Manhattan
P.O. Box 748
Manhattan, KS 66502

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

October 25, 2006

Mr. P. M. Whaley
Nuclear Reactor Facility Manager
Kansas State University
112 Ward Hall
Manhattan, KS 66506-2500

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-188/OL-06-01, KANSAS STATE UNIVERSITY

Dear Mr. Whaley:

During the week of October 2, 2006, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Kansas State University reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.390 of the Commission's 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 (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip T. Young at 301-415-4094 or internet e-mail pty@nrc.gov.

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DISTRIBUTION w/ encls.:
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OFFICE	PRTB:CE	IOLB:LA	PRTB:SC
NAME	PYoung;tls*	EBarnhill	JEads:tls*
DATE	10/18/2006	10/23/2006	10/25/2006

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

REPORT NO.: 50-188/OL-07-01

FACILITY DOCKET NO.: 50-188

FACILITY LICENSE NO.: R-88

FACILITY: Kansas State University

EXAMINATION DATES: October 4, 2006

EXAMINERS: Phillip T Young, Chief Examiner

SUBMITTED BY: /RA/ 10/17/2006
Phillip T Young, Chief Examiner Date

SUMMARY:

During the week of August 7, 2006, the NRC administered operator licensing examinations to one Reactor Operator and one Senior Reactor Operator (Upgrade) candidates. All candidates passed the examination.

ENCLOSURE 1

REPORT DETAILS

1. Examiners: Phillip T Young, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**1/0**	**N/A**	**1/0**
Operating Tests	**1/0**	**1/0**	**2/0**
Overall	**1/0**	**1/0**	**2/0**

3. Exit Meeting:

Phillip T Young, NRC Chief Examiner
Paul M. Whaley, Facility Manager

The NRC thanked the facility staff for their cooperation during the examinations. No generic concerns were noted.

Facility Comments with NRC Resolution

Facility Comment:
Question: A.006,

1. Integral worth of the control rods are fairly constant over time (based on annual measurements)
2. The TRIGA is a low-leakage core, so coolant temp has little effect on net core reactivity, but a significant amount of moderation occurs from hydride in the fuel and fuel temperature is a big component of the moderator temperature.

   "Beta" symbol didn't print right, came out a backwards E -- I don't think it is a problem

   "Delta" symbol didn't print right -- I don't think it is a problem

NRC Resolution:
Comments noted. Problems with “Beta” and “Delta” symbol printing corrected on official copy.

Facility Comment:
Question: C.004,

No diagram; I used the key to generate a diagram, sent it with the package

NRC Resolution:
Comments noted, diagram verified correct.

ENCLOSURE 2

KANSAS STATE UNIVERSITY

WRITTEN EXAM w/ANSWER KEY

OPERATOR LICENSING EXAMINATION

OCTOBER 04, 2006

ENCLOSURE 3

Section A - Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION A.001 [2.0 points, 0.5 each] {2.0}
The listed isotopes are all potential daughter products due to the radioactive decay of $_{35}Br^{87}$. Identify the type of decay necessary (Alpha, Beta, Gamma or Neutron emission) to produce each of the isotopes.

a. $_{33}As^{83}$
b. $_{35}Br^{86}$
c. $_{35}Br^{87}$
d. $_{36}Kr^{87}$

Answer: A.001 a. = alpha; b. = neutron; c. = gamma; d. = Beta
Reference: Volume 1, Module 1, *Modes of Radioactive Decay*, pp. 22–29.

QUESTION A.002 [1.0 point] {3.0}
What is the kinetic energy range of a thermal neutron?
a. > 1 MeV
b. 100 KeV – 1 MeV
c. 1 eV – 100 KeV
d. < 1 eV

Answer: A.002 d.
Reference: Volume 1, Module 2, *Neutron Moderation*, p. 23.

QUESTION A.003 [1.0 point] {4.0}
Suppose the temperature coefficient of a core is -2.5×10^{-4} ΔK/K/°C and the average control rod worth of the regulating control rod is 5.895×10^{-3} ΔK/K/inch. If the temperature INCREASES by 50°C what will the automatic control command the regulating rod to do? Select the answer that is closest to the calculated value.

a. 5.6 inches in

b. 2.1 inches out

c. 0.5 inches in

d. 4.3 inches out

Answer: A.003 b.
Reference: The temperature increase will result in a change in reactivity of: -2.5×10^{-4} ΔK/K/°C × 50°C = -1.25×10^{-2} ΔK/K. Since the temperature rise results in a negative reactivity insertion, the control rod will need to drive out to add positive reactivity. D = (1.25×10^{-2} ΔK/K) ÷ (5.895 × 10^{-3} ΔK/K/inch) = 2.12 inches. Reference 1, Volume 2, Module 3, *Reactivity Coefficients,* p. 48.

QUESTION A.004 [1.0 point] {5.0}
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.004 b.
Reference: Standard NRC Question $A = A_0 e^{-\lambda T}$ (22 minutes)

QUESTION A.005 [1.0 point] {6.0}
Initially Nuclear Instrumentation is reading 30 CPS and the reactor has a K_{eff} of 0.90. You add an experiment which causes the Nuclear instrumentation reading to increase to 60 CPS. Which ONE of the following is the new K_{eff}?

a. 0.91

b. 0.925

c. 0.95

d. 0.975

Answer: A.005 c.
Reference: $CR_2/CR_1 = (1 - K_{eff1})/(1 - K_{eff2})$ $60/30 = (1 - 0.900)/(1 - K_{eff2})$ $1- K_{eff2} = ½ \times 0.1 = 0.05$
$K_{eff2} = 1 - 0.05 = 0.95$

QUESTION A.006 [1.0 point] {7.0}
During a fuel loading of the core, as the reactor approaches criticality, the value of 1/M:

a. Increases toward one

b. Decreases toward one

c. Increases toward infinity

d. Decreases toward zero

Answer: A.006 d.
Reference: Module 4, ℞ Theory (℞ Operations), E.O. 1.4, pg. 7 and DOE Fundamentals Handbook Nuclear Physics and Reactor Theory Volumes 1 and 2, January 1993.

QUESTION A.007 [1.0 point] {8.0}
Which ONE of the following is the reason for an installed neutron source within the core? A startup without an installed neutron source …

a. is impossible as there would be no neutrons available to start up the reactor.

b. would be very slow due to the long time to build up neutron population from so low a level.

c. could result in a very short period due to the reactor going critical before neutron population built up high enough to be read on nuclear instrumentation.

d. can be compensated for by adjusting the compensating voltage on the source range detector.

Answer: A.007 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.008 [1.0 point] {9.0}
By definition, an exactly critical reactor can be made 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.008 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.009 [1.0 point] {10.0}
Reactor power doubles in 42 seconds. Based on the period associated with this transient, how long will it take for reactor power to increase by a factor of 10?

a. 80 seconds

b. 110 seconds

c. 140 seconds

d. 170 seconds

Answer: A.009 c.
Reference: $P = P_0 e^{t/\tau}$ 1st find τ. τ = time/(ln(2)) = 42/0.693 = 60.6 sec.
Time = τ × ln(10) = 60.6 × 139.5 sec DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory.

QUESTION A.010 [1.0 point] {11.0}
Which one of the following statements correctly describes the property of a **GOOD MODERATOR**?

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

b. It reduces gamma radiation to thermal energy levels via a small number of collisions.

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

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

Answer: A.010 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.011 [1.0 point] {12.0}
Which of the following statements correctly describe the influence of ***DELAYED NEUTRONS*** on the neutron life cycle? Delayed neutrons …

a. increase the time required for PU^{239} to moderate the fission process.
b. decrease the time required for the neutron population to change between generations.
c. increase the time required for the neutron population to change between generations.
d. decrease the amount of reflection possible with a steel reflector.

Answer: A.011 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.012 [1.0 point] {13.0}
Why is the stable negative period following a scram always the same value, regardless of initial power level? The rate of power change is dependent on the …

a. mean lifetime of the longest lived delayed precursor.

b. constant decay rate of prompt neutrons.

c. mean lifetime of the shortest lived delayed neutron precursor.

d. constant decay rate of prompt gamma emitters.

Answer: A.012 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.013 [1.0 point] {14.0}
Which one of the following correctly describes the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

a. DRW is the slope of the IRW curve at a given location.

b. DRW is the area under the IRW curve at a given location.

c. DRW is the square root of the IRW curve at a given location.

d. There is no relationship between DRW and IRW.

Answer A.013 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.014 [1.0 point] {15.0}
Which one of the following accurately details a factor contributing to Xenon balance within the reactor?

a. Most Xe^{135} is formed by fission.

b. Te^{135} is a fission product which quickly decays to I^{135}.

c. Within approximately 8 hours after startup, Xe^{135} has reached its equilibrium value.

d. Several minutes following a reactor shutdown, Xe level is increasing because I^{135} is not being produced.

Answer: A.014 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.015 [1.0 point] {16.0}
Delayed neutrons comprise approximately what percent of all neutrons produced in the reactor?

a. 0.65%

b. 1.3%

c. 6.5%

d. 13%

Answer: A.015 a.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.016 [1.0 point] {17.0}
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.016 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.017 [1.0 point] {18.0}
β and β_{eff} both describe the total fraction of delayed neutrons. The difference between the two is that β_{eff} is …

a. smaller than β since delayed neutrons are born at lower energy levels than prompt neutrons.

b. larger than β since delayed neutrons are born at lower energy levels than prompt neutrons.

c. smaller than β since delayed neutrons are born at higher energy levels than prompt neutrons.

d. larger than β since delayed neutrons are born at higher energy levels than prompt neutrons.

Answer: A.017 b.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory, Volume X, Module Y, Enabling Objective Z.Z

QUESTION A.018 [1.0 point] {19.0}
Which one of the following is the definition of the ***<u>FAST FISSION FACTOR</u>***?

a. The ratio of the number of neutrons produced by fast fission to the number produced by thermal fission

b. The ratio of the number of neutrons produced by thermal fission to the number produced by fast fission

c. The ratio of the number of neutrons produced by fast and thermal fission to the number produced by thermal fission

d. The ratio of the number of neutrons produced by fast fission to the number produced by fast and thermal fission

Answer: A.018 c.
Reference: Reference 1, Volume 2, Module 3, *Neutron Life Cycle*, p. 3.

QUESTION A.019 [1.0 point] {20.0}
In a reactor at full power, the thermal neutron flux (φ) is 2.5×10^{12} neutrons/cm^2/sec. and the macroscopic fission cross-section Σ_f is 0.1 cm^{-1}. The fission reaction rate is:

a. 2.5×10^{11} fissions/sec.

b. 2.5×10^{13} fissions/sec.

c. 2.5×10^{11} fissions/cm^3/sec.

d. 2.5×10^{13} fissions/cm^3/sec.

Answer: A.019 c
Referenced: Reference 1, Volume 1, Module 2 *Reaction Rate*, p. 18.

NOTE: Where the question states Reference 1, it refers to the reference listed below.
Reference 1: DOE Fundamentals Handbook Nuclear Physics and Reactor Theory Volumes 1 and 2, January 1993.

QUESTION B.001 [1.0 point] (1.0)
Which of the following conditions is required to be met prior to the Annual Power Level Calibration?

a. The secondary cooling system will not be operated for 24 hours
b. The pool temperature will be 20 ± 5 °C.
c. The pool temperature will be 5 ± 1 °C below ambient temperature.
d. The secondary cooling system will be in use, maintaining pool temperature at 22 °C for 36 hours.

Answer: 001 b.
Reference: Procedure No. 2 Annual Power Level Calibration

QUESTION B.002 [1.0 point] (2.0)
Which method is used to determine the void coefficient of an air filled capsule?

a. 1/M plot
b. rod drop method
c. positive period method
d. difference in critical rod positions

Answer: 002 d.
Reference: EQB Question

QUESTION B.003 [1.0 point] (3.0)
Two point sources have the same curie strength. Source A's gammas have an energy of 1 Mev, whereas Source B's gammas have an energy of 2 Mev. You obtain a reading from the same GM tube 10 feet from each source. Concerning the two readings, which ONE of the following statements is correct?

a. The reading from Source B is four times that of Source A.
b. The reading from Source B is twice that of Source A.
c. The reading from Source B is half that of Source A.
d. Both readings are the same.

Answer: 003 d.
Reference: GM tube cannot distinguish between energies.

QUESTION B.004 [1.0 point] (4.0)
In accordance with Experiment No. 42, "Operation of Sample Rapid Transfer System (Rabbit)," stuck rabbit limitations refer to:

a. the radiation dose received by the public as a result of a rabbit stuck in the tube.
b. limitations on helium purge gas pressure used to dislodge a stuck rabbit.
c. limitations on sample reactivity if the rabbit becomes stuck in the core.
d. Argon-41 concentrations in the reactor bay due to a stuck rabbit.

Answer: 004 a.
Reference: Experiment No. 42.

QUESTION B.005 [1.0 point] (5.0)
A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. There is, however, a small pipe which reads 10 mrem/hr at one (1) meter. Which ONE of the following defines the posting requirements for the area in accordance with 10CFR20?

a. Restricted Area.
b. Caution Radiation Area.
c. Caution High Radiation Area.
d. Grave Danger, Very High Radiation Area.

Answer: 005 c.
Reference: $DR_1D_1^2 = DR_2D_2^2$; 10 mrem/hr at one meter (100 cm.) results in 111.1 mrem/hr at 30 cm.

QUESTION B.006 [1.0 point] (6.0)
The OPERATIONS BOUNDARY is defined as:

a. Room 110 of Ward Hall.
b. Ward Hall and adjacent fenced areas.
c. Facility Control Center.
d. Nuclear Engineering Departmental Office.

Answer: 006 a.
Reference: Emergency Plan, section 1.1.

QUESTION B.007 [1.0 point] (7.0)
In accordance with 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: 007 a.
Reference: Radiation Protection Program, page A-2.

QUESTION B.008 [1.0 point] (8.0)
Which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. The sum of the absolute reactivity worths of all experiments = $2.20.
b. A pulse reactivity insertion of $2.20.
c. A reactivity insertion rate of a standard control rod = $0.87 per second.
d. Operating in steady state mode with the linear power channel inoperable.

Answer: 008 b
Reference: Technical Specifications, section E.4.

QUESTION B.009 [1.0 point] (9.0)
In accordance with the Technical Specifications, which ONE of the following conditions is NOT permissible when the reactor is operating, or about to be operated?

a. Primary water temperature = 110° F.
b. Minimum shutdown margin = $0.87.
c. Maximum available reactivity above cold, clean condition = $2.20.
d. Pool water conductivity = 1.6 micromho/cm.

Answer: 009 b.
Reference: Technical Specifications, section E.5.

QUESTION B.010 [1.0 point] (10.0)
In accordance with Procedure No. 16, "Reactor Shutdown," an intentional safety system scram is accomplished by:

a. actuating the manual scram bar.
b. manually interrupting current flow to the control rod drive magnets.
c. manually adjusting a scram setpoint.
d. removing the console key.

Answer: 010 c.
Reference: Procedure No. 16.

QUESTION B.011 [1.0 point] (11.0)
Which ONE of the following statements is a condition for pulsing the KSU reactor?

a. In the Pulse mode, the reactor must be operated with a standard fuel TRIGA fuel element in the central thimble.
b. The fuel elements must be gauged after every pulse of magnitude greater than $1.00.
c. Pulsing operations must not be done from a subcritical configuration.
d. The peak fuel temperature of each pulse must be measured.

Answer: 011 d.
Reference: Experiment 23.

QUESTION B.012 [1.0 point] (12.0)
Which ONE of the following statements is FALSE? The Reactor Manager may authorize temporary changes to a procedure provided that:

a. the Reactor Safeguards Committee approves the changes.
b. the changes do not alter the original intent of the procedure.
c. all licensed individuals are informed of the changes.
d. the changes are noted in the operations logbook.

Answer: 012 a.
Reference: Administrative Plan, section 5.0.

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: 013 b.
Reference: Shim rod + Regulating rod = $3.15. Excess reactivity - $3.15 = -$1.10.

QUESTION B.014 [1.0 point] (14.0)
An irradiated sample having a half-life of 3 minutes provides a dose rate of 200 mrem/hr at 3 ft. Approximately how far from the sample must a Radiation Area sign be posted?

a. 6 ft.

b. 12 ft.

c. 18 ft.

d. 36 ft.

Answer: 014 c.
Reference: Radiation Protection Program, page A-9.
Radiation area > 5 mrem/hour. 200 mrem at 3 feet -> 5 mrem at 18.3 feet.

QUESTION B.015 [1.0 point] (15.0)
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: 015 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.016 [1.0 point] (16.0)
A small radioactive source is to be stored in the reactor facility. The source activity is estimated to be 25 curies and emits a 1.33 Mev gamma. Assuming no shielding is used, the dose rate from the source at a distance of 10 feet would be approximately:

a. 0.33 Rem/hour.

b. 2.0 Rem/hour.

c. 6.0 Rem/hour.

d. 20.0 Rem/hour.

Answer: 016 b.
Reference: Dose Rate = $6CiE/R^2$ = 6x25x1.33/100 = 2 Rem/hour.

QUESTION B.017 [1.0 point] (17.0)
Which ONE of the following statements describe 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 are to be considered.

d. No experiment shall be inserted or removed unless all control blades are fully inserted.

Answer: 017 a.
Reference: Technical Specifications, Section I.3.

QUESTION B.018 [1.0 point] (18.0)
In accordance with Experiment No. 1, "Isotope Production," removal of any material from a region of significant neutron flux must be done in the presence of:

a. the Reactor Supervisor.

b. a Senior Reactor Operator.

c. a representative of the University Radiation Safety Office.

d. a person approved by the Reactor Supervisor who is trained in the safe handling of radioactive materials.

Answer: 018 d.
Reference: Experiment No. 1, page 4.

QUESTION B.019 [1.0 point] (19.0)
In accordance with Procedure No. 8, "Calibration of Continuous Air Monitors," Technicium-99 is used as a source because:

a. its decay particles and energies are similar to Ar-41.
b. its decay particles and energies are similar to I-131.
c. its half-life is long enough so that it does not decay appreciably.
d. it produces count rates large enough to be measured.

Answer: 019 b.
Reference: Procedure No. 8, page 4.

QUESTION B.020 [1.0 point] (20.0)
Which ONE of the following is expressly forbidden by the Operations Manual?

a. Carbon tetrachloride in the reactor bay.
b. Gasoline in the reactor bay.
c. Acetone in the reactor.
d. Mercury-glass thermometer in the reactor pool.

Answer: 020 d.
Reference: Training Manual, page A2-6.

QUESTION C.004 [2.0 points, ¼ each] (2.0)
Identify the components labeled a through h on the figure of a Control Blade Drive Mechanism provided. (Note: Items are used only once. Only one answer per letter.)

a. ___	1. Foot
b. ___	2. Barrel
c. ___	3. Position Potentiometer
d. ___	4. Rod Down Limit Switch
e. ___	5. Drive Motor
f. ___	6. Pull Rod
g. ___	7. Armature
h. ___	8. Magnet

Answer: C.001 a. = 1; b. = 2; c. = 3; d. = 4; e. = 5; f. = 6; g. = 7; h. = 8
Reference: KSU Facility Description page A.1.19

QUESTION C.002 [1.0 point] (3.0)
What is the normal rod motion speed?

a. 16 inches per minute
b. 14 inches per minute
c. 12 inches per minute
d. 10 inches per minute

Answer: C.002 c.
Reference: KSU Facility Description page A.1.21

QUESTION C. 003 [1.0 point] (4.0)
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 differential pressure to measure flow through the deionizer.
b. provide a computer input for measuring system pressure.
c. measure primary pressure to ensure that it is always lower than secondary pressure.
d. measure the pressure drop across the filter to determine filter clogging.

Answer: C.003 d.
Reference: Training Manual, page A1-11.

QUESTION: C. 004 [1.0 point] (5.0)
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.004 b.
Reference: Training Manual, page A1-15.

QUESTION: C. 005 [1.0 point] (6.0)
The shim rod and the regulating rod are constructed of:

a. graphite with aluminum cladding.

b. boron and carbon with aluminum cladding.

c. boron and carbon with stainless steel cladding.

d. graphite and boron with aluminum cladding.

Answer: C.005 b.
Reference: Training Manual, page A1-6.

QUESTION: C. 006 [1.0 point] (7.0)
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.006 a.
Reference: Training Manual, page A1-7.

QUESTION: C. 007 [1.0 point] (8.0)
The outside air temperature is -15°F. The KSU TRIGA MKII reactor is operating at 100% power when the primary coolant temperature probe fails low. Which ONE of the following actions is performed by the secondary automatic control system if the temperature of the secondary cooling water is 62°F?

a. The cooling tower fan goes to slow speed and the secondary coolant flow bypasses the cooling tower.

b. The cooling tower fan goes to high speed and the secondary coolant flows to the cooling tower.

c. The cooling tower fan goes to slow speed and the secondary coolant flows to the cooling tower.

d. The cooling tower fan remains off and the secondary coolant flow bypasses the cooling tower.

Answer: C.007 d.
Reference: Training Manual, page A1-11.

QUESTION: C.008 [1.0 point] (9.0)
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.008 d.
Reference: Training Manual, page A1-18.

QUESTION: C.009 [1.0 point] (10.0)
It is desired to perform a reactor startup, but to raise power to only 10 kW. For this situation:

a. both the primary system and percent power channel must be operable.

b. the primary system need not be operable.

c. the percent power channel need not be operable.

d. neither the primary system nor the percent power channel is required to be operable.

Answer: C.009 a.
Reference: Procedure No. 15, Triga MkII Reactor Startup.

QUESTION: C.010 [1.0 point] (11.0)
The cooling tower fan speed (off, low speed, high speed) is controlled by:

a. the temperature of secondary water entering the cooling tower.

b. the temperature of primary water entering the heat exchanger.

c. the temperature of secondary water leaving the cooling tower.

d. the temperature of primary water leaving the heat exchanger.

Answer: C.010 c.
Reference: KSU Training Manual, "General Characteristics," Coolant System.

QUESTION: C.011 [1.0 point] (12.0)
Fuel element temperature is measured with:

a. a compensated bridge circuit.

b. a resistance-temperature detector (RTD).

c. a chromel-alumel thermocouple.

d. a temperature probe.

Answer: C.011 c.
Reference: KSU Training Manual, "General Characteristics," Reactor Instrumentation.

QUESTION: C.012 [1.0 point] (13.0)
Coolant flow in the demineralizer loop of the reactor coolant system is measured by:

a. differential pressure across the filter.

b. a flow meter at the outlet of the demineralizer.

c. an orifice at the inlet to the heat exchanger.

d. a flowmeter at the inlet of the primary pump.

Answer: C.012 b.
Reference: KSU Training Manual, General Characteristics, Section 6, Coolant System, Figure 5.

QUESTION: C.013 [2.0 points, ½ each] (15.0)
Select from column B the actual rod movement that would result from attempting to simultaneously move the combination of rods in column A. (Items in column B may be used once, more than once or not at all. Only one answer may occupy a space in column A.) Four (4) answers required at 0.50 points each.

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 shim and reg rods (steady state mode).	2. Reg rod moves up.
c. Attempt to withdraw pulse and reg rod (steady state mode).	3. Shim and reg rods move up.
d. Shim rod is up 250 units and attempt to raise pulse rod (steady state mode).	4. Pulse rod moves up.
	5. No rod motion.

Answer: C.013 a. = 5; b. = 5; c. = 4; d.= 4
Reference: Procedure No. 5, Part 1, Semi-Annual Check of Minimum Interlocks

QUESTION: C.014 [1.0 point] (16.0)
Coolant flow in the demineralizer loop of the reactor coolant system is measured by:

a. differential pressure across the filter.

b. a flow meter at the outlet of the demineralizer.

c. an orifice at the inlet to the heat exchanger.

d. a flowmeter at the inlet of the primary pump.

Answer: C.014 b.
Reference: KSU Training Manual, General Characteristics, Section 6, Coolant System, Figure 5.

QUESTION: C.015 [1.0 point] (17.0)
Thermocouples in an instrumented TRIGA fuel element measure temperature at the:

a. interior of the fuel.

b. outer surface of the fuel.

c. center of the zirconium rod.

d. interior surface of the cladding.

Answer: C.015 a.
Reference: KSU Training Manual, General Characteristics, Section 7.1, Measurement.

QUESTION: C.016 [1.0 point] (18.0)
Which ONE of the following is the purpose of the mechanical filter installed in the cleanup loop?

a. Maintain a neutral pH and optical transparency of the water.

b. Maintain low electrical conductivity of the water and a neutral pH.

c. Maintain optical transparency and minimal radioactivity of the water.

d. Maintain minimal radioactivity and low electrical conductivity of the water.

Answer: C.016 c.
Reference: KSU Training Manual, General Characteristics, Section 6, Coolant System.

QUESTION: C.017 [1.0 point] (19.0)
The continuous air monitor (CAM) is 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.017 d.
Reference: Procedure No. 8.

QUESTION: C.018 [1.0 point] (20.0)
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.018 b.
Reference: Training Manual, page A1-11.