April 27, 2000

Mr. Dan Tinkler
Nuclear Reactor Facility
112 Ward Hall
Kansas State University
Manhattan, KS 66506-5204

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-188/OL-00-01

Dear Mr. Tinkler:

During the week of March 13, 2000, the NRC administered an initial examination 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 examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be placed in the NRC Public Document Room. 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. Warren J. Eresian at 301-415-1833.

Sincerely,

/RA/

Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-188

Enclosures: 1. Initial Examination Report No. 50-188/OL-00-01
2. Examination and answer key (RO)

cc w/encls:
Please see next page

April 27, 2000

Mr. Dan Tinkler
Nuclear Reactor Facility
112 Ward Hall
Kansas State University
Manhattan, KS 66506-5204

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-188/OL-00-01

Dear Mr. Tinkler:

During the week of March 13, 2000, the NRC administered an initial examination 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 examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be placed in the NRC Public Document Room. 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. Warren J. Eresian at 301-415-1833.

Sincerely,

/RA/

Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-188

Enclosures: 1. Initial Examination Report No. 50-188/OL-00-01
2. Examination and answer key (RO)

cc w/encls:
Please see next page

DISTRIBUTION w/ encl.:
PUBLIC
TMichaels, PM
Facility File (EBarnhill)

DISTRIBUTION w/o encls.:
REXB r/f
DMatthews
LTremper, LFDCB (T9-E0)

DOCUMENT NAME: ML003696261 **TEMPLATE #: NRR-056**
***Please see previous concurrence**

OFFICE	**DIPM:IOLB**		**REXB:CE**		**REXB:BC**	
NAME	***EBarnhill**		***WEresian**		**LMarsh**	
DATE	**04/ 24 /2000**		**04/ 17 /2000**		**04/ 27 /2000**	

C = COVER **E = COVER & ENCLOSURE** **N = NO COPY**
OFFICIAL RECORD COPY

cc:

Office of the Governor
State of Kansas
Topeka, KS 66612

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

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

REPORT NO.:	50-188/OL-00-01
FACILITY DOCKET NO.:	50-188
FACILITY LICENSE NO.:	R-88
FACILITY:	Kansas State University
EXAMINATION DATES:	March 15-16, 2000
EXAMINER:	Warren Eresian, Chief Examiner

SUBMITTED BY:	***/RA/***	03/28/2000
	Warren Eresian, Chief Examiner	Date

SUMMARY:

During the week of March 13, 2000, the NRC administered Operator Licensing Examinations to three Reactor Operator candidates. One candidate passed all portions of the examination. Two candidates each failed one section of the written examination, but passed the operating test.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

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

3. Exit Meeting:

Mr. Dan Tinkler, KSU
Warren Eresian, NRC Chief Examiner

The NRC thanked the facility staff for their cooperation during the examinations. The facility provided comments on the written examination which were incorporated into the results. The following changes to the written examination were made:

Question A008: Accept answers “a” or “b” as correct.
Question A010: Accept answers “a” or “b” as correct.
Question A015: Accept answers “b” or “d” as correct.
Question B008: Accept answers “a” or “c” as correct.
Question B013: Accept answers “b” or “c” as correct.

The examination answer key was modified accordingly.

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 03/15/00

REGION: 4

CANDIDATE:___________________________

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 category 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	33.3	______	____	A. REACTOR THEORY, THERMODYNAMICS, AND
FACILITY				OPERATING
CHARACTERISTICS				
20	33.3	______	____	B. NORMAL AND
EMERGENCY				OPERATING
PROCEDURES AND				RADIOLOGICAL
CONTROLS				
20	33.3	______	____	C. FACILITY AND
RADIATION				MONITORING SYSTEMS
60		______% FINAL GRADE		

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

____
Candidate's Signature

ENCLOSURE 2

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. Print your name in the upper right-hand corner of the answer sheets.

7. The point value for each question is indicated in parentheses after the question.

8. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK. NOTE: partial credit will NOT be given on multiple choice questions.

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

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

11. 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.

EQUATION SHEET

$Q = m\ c_p\ \Delta T$

$SUR = 26.06/\beta$

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

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

$DR = DR_o e^{-\beta t}$

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

1 Curie = 3.7×10^{10} dps

1 Btu = 778 ft-lbf

1 Mw = 3.41×10^{6} BTU/hr

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

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

$\beta = (\ell^*/\beta) + [(\beta-\beta)/\beta_{eff}\beta]$

$DR_1 D_1^2 = DR_2 D_2^2$

$DR = 6CiE/D^2$

1 eV = 1.6×10^{-19} watt-sec.

1 gallon water = 8.34 pounds

$^\circ F = 9/5^\circ C + 32$

$^\circ C = 5/9\ (^\circ F - 32)$

ENCLOSURE 2

QUESTION: 001 (1.00)

A reactor is subcritical with a K_{eff} of 0.955. Seven dollars ($7.00) of positive reactivity is inserted into the core
(β = 0.007). At this point, the reactor is:

a. subcritical.

b. exactly critical.

c. supercritical.

d. prompt critical.

QUESTION: 002 (1.00)

A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula:

Fast fission factor =	1.03
Fast non-leakage probability =	0.84
Resonance escape probability =	0.96
Thermal non-leakage probability =	0.88
Thermal utilization factor =	0.70
Reproduction factor =	1.96

A control rod is inserted to bring the reactor back to critical. Assuming all other factors remain unchanged, the new value for the thermal utilization factor is:

a. 0.698

b. 0.702

c. 0.704

d. 0.708

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

QUESTION: 003 (1.00)

The neutron microscopic cross section for absorption, β_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.

QUESTION: 004 (1.00)

Which ONE of the reactions below is an example of a photoneutron source?

a. $_{51}Sb^{123} + n \rightarrow {}_{51}Sb^{124} + \beta$

b. $_{92}U^{238} \rightarrow {}_{35}Br^{87} + {}_{57}La^{148} + 3n + \beta$

c. $_{1}H^{2} + \beta \rightarrow {}_{1}H^{1} + n$

d. $_{4}Be^{9} + \beta \rightarrow {}_{6}C^{12} + n$

QUESTION: 005 (1.00)

During a reactor startup, the count rate is increasing linearly with time, with no rod motion. This means that:

a. the reactor is subcritical and the count rate increase is due to the buildup of delayed neutron precursors.

b. the reactor is critical and the count rate increase is due to source neutrons.

c. the reactor is subcritical and the count rate increase is due to source neutrons.

d. the reactor is critical and the count rate increase is due to the buildup of delayed neutron precursors.

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

QUESTION: 006 (1.00)

A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded 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.

QUESTION: 007 (1.00)

As a reactor continues to operate over time, for a <u>constant</u> power level, the average neutron flux:

a. decreases, due to the increase in fission product poisons.

b. decreases, because fuel is being depleted.

c. increases, in order to compensate for fuel depletion.

d. remains the same.

QUESTION: 008 (1.00)

Fuel is being loaded into the core. The operator is using a 1/M plot to monitor core loading. Which ONE of the following conditions would result in a non-conservative prediction of core critical mass (i.e., the reactor would become critical <u>before</u> the predicted number of fuel elements are loaded)?

a. The detector is too far from the source.

b. The detector is too close to the source.

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

c. Excessive time is allowed between fuel elements being loaded.

d. A fuel element is placed between the source and the detector.

QUESTION: 009 (1.00)

During the minutes following a reactor scram, reactor power decreases on a negative 80 second period, corresponding to the half-life of the longest lived delayed neutron precursor, which is approximately:

a. 20 seconds.

b. 40 seconds.

c. 55 seconds.

d. 80 seconds.

QUESTION: 010 (1.00)

The moderator-to-fuel ratio describes the relationship between the number of moderator atoms in a volume of core to the number of fuel atoms. A reactor which is:

a. undermoderated will have a positive moderator temperature coefficient.

b. undermoderated will have a negative moderator temperature coefficient.

c. overmoderated will have a constant moderator temperature coefficient.

d. overmoderated will have a negative moderator temperature coefficient.

QUESTION: 011 (1.00)

Which ONE statement below describes a positive fuel temperature coefficient?

a. When fuel temperature increases, positive reactivity is added.

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

b. When fuel temperature decreases, positive reactivity is added.

c. When fuel temperature increases, negative reactivity is added.

d. When fuel temperature increases, reactor power decreases.

QUESTION: 012 (1.00)

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.

QUESTION: 013 (1.00)

Inelastic scattering can be described as a process whereby a neutron collides with a nucleus and:

a. reappears with a lower kinetic energy, with the nucleus emitting a gamma ray.

b. reappears with the same kinetic energy it had prior to the collision.

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

d. reappears with a higher kinetic energy, with the nucleus absorbing a gamma ray.

QUESTION: 014 (1.00)

A reactor is critical at 18.1 inches on a controlling rod. The controlling rod is withdrawn to 18.4 inches. The reactivity inserted is 14.4 cents. What is the differential rod worth?

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

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.

QUESTION: 015 (1.00)

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.

QUESTION: 016 (1.00)

Which ONE of the following describes the response of the subcritical reactor to equal insertions of positive reactivity as the reactor approaches critical? Each reactivity insertion causes:

a. a SMALLER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

b. a SMALLER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

c. a LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

d. a LARGER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

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

QUESTION: 017 (1.00)

A reactor fuel consisting of only U-235 and U-238 is 20% enriched. This means that:

a. 20% of the volume of the fuel consists of U-235.

b. 20% of the weight of the fuel consists of U-235.

c. the ratio of the number of U-235 atoms to the number of U-238 atoms is 0.20 (20%).

d. 20% of the total number of atoms in the fuel consists of U-235.

QUESTION: 018 (1.00)

During the neutron cycle from one generation to the next, several processes occur that may increase or decrease the available number of neutrons. Which ONE of the following factors describes an INCREASE in the number of neutrons during the cycle?

a. Thermal utilization factor.

b. Resonance escape probability.

c. Thermal non-leakage probability.

d. Fast fission factor.

QUESTION: 019 (1.00)

The fuel temperature coefficient of reactivity is -1.25E-4 delta K/K/deg.C. When a control rod with an average rod worth of 0.1 % delta K/K/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, the fuel temperature has:

a. increased by 80 deg C.

b. decreased by 80 deg C.

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

c. increased by 8 deg C.

d. decreased by 8 deg C.

QUESTION: 020 (1.00)

The effective neutron multiplication factor, K_{eff}, is defined as:

a. absorption/(production + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. production/(absorption + leakage)

QUESTION: 001 (1.00)

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 is to be considered.

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

QUESTION: 002 (1.00)

In accordance with the Technical Specifications, which ONE condition below is NOT permissible when the reactor is operating?

a. Maximum available reactivity above cold, clean condition = $3.00.

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

b. Primary water temperature = 110 deg. F.

c. Pool water conductivity = 2 micromho/cm.

d. Fuel temperature = 400 deg. C.

QUESTION: 003 (1.00)

Automatic scram signals are initiated by 1) loss of high voltage to nuclear instrumentation, 2) high linear channel power, 3) high safety channel power, 4) high fuel temperature, and 5) short reactor period. Of these, the scram signals required by the Technical Specifications are:

a. short period, high linear channel power, high safety channel power, high fuel temperature.

b. high linear channel, high safety channel power, high fuel temperature, loss of high voltage.

c. high linear channel power, loss of high voltage, short period, high fuel temperature.

d. high safety channel power, short period, high fuel temperature, loss of high voltage.

QUESTION: 004 (1.00)

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.

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

QUESTION: 005 (1.00)

Which ONE of the following requires the direct supervision (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.

QUESTION: 006 (1.00)

When the reactor is operating, no person may enter the reactor bay:

a. when a beam port or thermal column is open.

b. unless he/she has signed in the log book.

c. without the permission of the reactor operator on duty at the console.

d. without the permission of the senior reactor operator.

QUESTION: 007 (1.00)

In accordance with the Emergency Plan, a Medical Incident is defined 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.

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

QUESTION: 008 (1.00)

A group of five (5) visitors plus an escort is going to enter the reactor bay. In accordance with Procedure No. 9, "Entrance to the Reactor Bay - Visitor Control," which ONE of the following is correct?

a. If the reactor is operating, each member of the group must have a TLD badge or pocket dosimeter.

b. If the reactor is operating, the group cannot enter the reactor bay without the approval of the Reactor Facility Director.

c. If the reactor is not operating, there must be at least two TLD badges or pocket dosimeters for the group.

d. If the reactor is not operating, the group may enter the reactor bay with the permission of the Reactor Operator on duty at the console.

QUESTION: 009 (1.00)

In accordance with Technical Specifications, which ONE of the following interlocks 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.

QUESTION: 010 (1.00)

In order to find a leak which may have developed in the rotary specimen rack, a gas source is used to pressurize the rack. Which ONE of the following statements is true regarding the selection of gas to be used?

a. Oxygen is the most desirable gas to use since it has a very low neutron activation cross-section.

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

b. Argon is preferred since the continuous air monitor is already calibrated for the detection of activated argon.

c. Nitrogen or carbon dioxide is preferred, but oxygen could be used if neither of the other two are available.

d. Only nitrogen or carbon dioxide gas may be used.

QUESTION: 011 (1.00)

The 5 R/hr evacuation alarm has sounded. In addition, the gamma radiation level in the hallway outside the reactor control room is 150 mR/hr. Which ONE of the following actions should be taken?

a. The Site Boundary area shall be evacuated.

b. All personnel in the Operations Boundary area shall assemble at Ward Hall Emergency Assembly Area 1 or 2.

c. The University Radiation Safety Officer should be immediately summoned to confirm the radiation levels.

d. All personnel in the Site Boundary area shall assemble in the Operations Boundary area.

QUESTION: 012 (1.00)

In accordance with the Technical Specifications, which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. Continuous air monitor out of service, but replaced by a portable monitor.

b. A shim rod drop time = 2 seconds.

c. A reactivity insertion rate of a standard control rod = $0.87 per second.

d. A pulse reactivity insertion = $2.20.

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

QUESTION: 013 (1.00)

In accordance with Experiment No. 30, "Pulsed Operation, Amended," the reactor is pulsed starting from a subcritical configuration when:

a. it is desired to pulse over a wider range of power.

b. the reactor cannot be made critical.

c. the available excess reactivity is less than the worth of the pulse rod.

d. the time required to reach criticality might adversely affect the purpose of the pulse experiment.

QUESTION: 014 (1.00)

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.

QUESTION: 015 (1.00)

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.

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

QUESTION: 016 (2.00)

Select the MODE from Column II when the Scrams/Interlocks from Column I are required to be effective. Modes in Column II may be used once, more than once, or not at all.

Column I (Scrams/Interlocks)	Column II (Mode)
a. Safety Channel at 110% of full power.	1. Steady State only
b. Fuel Temperature at 450 deg. C.	2. Pulse Only
c. Ion Chamber Power Supply Failure	3. Both Pulse and Steady State
d. Simultaneous manual withdrawal of two rods.	4. Fuel loading only

QUESTION: 017 (1.00)

In accordance with procedure "Experiment 42- Operation of Sample Rapid Transfer System (Rabbit)" which ONE of the following actions should the reactor operator take, if an irradiated rabbit sample becomes stuck?

a. Notify the reactor supervisor then purge the rabbit system by firing helium into the reactor bay from NAAL.

b. Notify the reactor supervisor then reduce reactor power to less than 500W and check gamma radiation levels in the reactor bay terminal.

c. Scram the reactor and notify the reactor supervisor.

d. Align the switching coupling in the reactor bay with the reactor bay terminal and notify the reactor supervisor.

QUESTION: 018 (1.00)

Match the 10 CFR Part 55 requirements listed in Column A for an actively licensed operator with the correct time period from Column B. Column B answers may be used once, more than once, or not at all.

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

	Column A	Column B	
a.	License Expiration	1.	1 year
b.	Medical Examination	2.	2 years
c.	Requalification Written Examination	3.	3 years
d.	Requalification Operating Test	4.	6 years

QUESTION: 019 (1.00)

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.

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

QUESTION: 001 (1.00)

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.

QUESTION: 002 (1.00)

When the mode switch is placed in the "AUTO" mode:

a. the period scram is bypassed.

b. the regulating rod moves in response to the linear channel signal.

c. the regulating rod moves in response to the percent power channel signal.

d. the regulating rod will not fall into the core following a scram.

QUESTION: 003 (1.00)

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.

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

QUESTION: 004 (1.00)

When the amber light on the control console associated with the pulse rod is extinguished, this indicates that:

a. the solenoid valve has been de-energized.

b. the shock absorber is located at its highest position.

c. the variable timer has timed out.

d. the air supply pressure is above 45 psig.

QUESTION: 005 (1.00)

During a loss of building electrical power:

a. power to reactor instrumentation will not be lost due to a fast transfer (less than 50 msec) to the reserve supply.

b. power to reactor instrumentation will be restored following a 5 second time delay as transfer to the reserve supply occurs.

c. power will be lost to reactor instrumentation but will be automatically restored when building power returns.

d. power will be lost to reactor instrumentation and will not return until building power returns and the line conditioner is manually reset.

QUESTION: 006 (1.00)

The reactor is in the steady state mode with the transient rod shock absorber fully inserted (full down) and no air applied. The shock absorber is moved upward, and the operator then attempts to apply air to the transient rod. Which ONE of the following results?

a. The air solenoid blocks air to the transient rod.

b. The transient rod moves up until it reaches the shock absorber.

c. The shock absorber returns to its full down position.

d. The shim rod moves into the core.

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

QUESTION: 007 (2.00)

Select from column B the measuring channel which provides the actions 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 (Actions)	Column B (Channel)
a. < 2 cps rod withdraw inhibit	1. Wide Range Log
b. 1 kW pulse inhibit	2. Multi-Range Linear
c. Period scram	3. % Power
d. Pulse power measurement	

QUESTION: 008 (2.00)

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

QUESTION: 009 (1.00)

Coolant flow in the demineralizer loop of the reactor coolant system is measured by:

a. differential pressure across the filter.

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

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.

QUESTION: 010 (1.00)

Which ONE of the following statements correctly describes the purpose of the potentiometer in the control rod drive assembly.

a. Provides rod position indication when the electromagnet engages the connecting rod armature.

b. Provides a variable voltage to the rod drive motor for regulating control rod speed.

c. Provides potential voltage as required for resetting the electromagnet current.

d. Provides the potential voltage to relatch the connecting rod.

QUESTION: 011 (1.00)

Thermocouples in an instrumented TRIGA fuel element measure temperature at the:

a. interior surface of the cladding.

b. interior of the fuel.

c. outer surface of the fuel.

d. center of the zirconium rod.

QUESTION: 012 (1.00)

Which ONE of the following describes the purpose of the Pull Rod in the control rod drive assembly?

a. Provides rod full out position indication.

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

b. Provides a means for manually adjusting the rod position by pulling rod out.

c. Actuates the rod down microswitch.

d. Automatically engages the control rod on a withdraw signal.

QUESTION: 013 (1.00)

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.

QUESTION: 014 (1.00)

Which ONE of the following is the approximate worth of all the control rods?

a. $1.80

b. $2.50

c. $4.50

d. $6.50

QUESTION: 015 (1.00)

Which ONE of the following is the purpose of the mechanical filter installed in the cleanup loop?

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

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

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

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

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

QUESTION: 016 (1.00)

In accordance with Procedure No. 16, “TRIGA MKII Reactor Shutdown,” the reactor can be shut down using an intentional safety system scram. This is accomplished by:

a. driving the control rods to their down positions and actuating the manual scram bar.

b. actuating the manual scram bar.

c. raising reactor power to the scram setpoint.

d. manually adjusting a scram setpoint until a scram condition is reached.

QUESTION: 017 (1.00)

The MIII fuel elements are about:

a. 20% enriched uranium with stainless steel clad and no burnable poison.

b. 38% enriched uranium with stainless steel clad and no burnable poison.

c. 20% enriched uranium with aluminum clad and no burnable poison.

d. 20% enriched uranium with stainless steel clad and samarium burnable poison

QUESTION: 018 (1.00)

Which ONE of the following describes the action of the rod control system to drive the magnet draw tube down after a dropped rod?

a. Deenergizing the rod magnet initiates the down motion of the draw tube.

b. MAGNET DOWN limit switch initiates the down motion of the draw tube.

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

c. ROD DOWN limit switch initiates the down motion of the draw tube.

d. Deenergized contact light (DS317) and MAGNET UP limit switch initiate the down motion of the draw tube.

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

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-21.
Shutdown reactivity = (K-1)/K = -0.047 delta K/K. $7.00 added = 7(0.007) = +0.049 delta K/K.
-0.047 + 0.049 = + 0.002, i.e. supercritical.

ANSWER: 002 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-16.
In order to decrease K, thermal utilization must decrease.

ANSWER: 003 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-36.

ANSWER: 004 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-3.

ANSWER: 005 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-25.

ANSWER: 006 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-14.

ANSWER: 007 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-50.

ANSWER: 008 (1.00)
A or B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-21.

ANSWER: 009 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-13.

ANSWER: 010 (1.00)
A or B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 6-8.

ANSWER: 011 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 6-5.

ANSWER: 012 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-11.
Increase = $1.001 \times 10^8 - 1 \times 10^8 = 1 \times 10^5$. Prompt neutron population = $0.993 \times 1 \times 10^5$ = 99,300.

ANSWER: 013 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-28.

ANSWER: 014 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 7-4.

ANSWER: 015 (1.00)
B or D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-9.

ANSWER: 016 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-7.

ANSWER: 017 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-51.

ANSWER: 018 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, Page 3-15.

ANSWER: 019 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 6-5.

ANSWER: 020 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, Page 3-15.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
A.
REFERENCE:
Technical Specifications, I.3(a).

ANSWER: 002 (1.00)
A.
REFERENCE:
Technical Specifications, D.2

ANSWER: 003 (1.00)
B.
REFERENCE:
Technical Specifications, Table I.

ANSWER: 004 (1.00)
A
REFERENCE:
KSU Operation, Test, and Maintenance Procedures, Procedure No. 21.

ANSWER: 005 (1.00)
C.
REFERENCE:
Experiment No. 23.

ANSWER: 006 (1.00)
C.
REFERENCE:
KSU Operation, Test, and Maintenance Procedures, Procedure No. 9.

ANSWER: 007 (1.00)
C.
REFERENCE:
Emergency Plan, 4.1.

ANSWER: 008 (1.00)
A or C.
REFERENCE:
KSU Operation, Test, and Maintenance Procedures, Procedure No. 9.

ANSWER: 009 (1.00)
B.
REFERENCE:
Technical Specifications, Table II

ANSWER: 010 (1.00)
D.
REFERENCE:
Experiment No. 31.

ANSWER: 011 (1.00)
B.
REFERENCE:
Emergency Plan, 3.5.

ANSWER: 012 (1.00)
D.
REFERENCE:
Technical Specifications, E.4.

ANSWER: 013 (1.00)
B or C.
REFERENCE:
Experiment No. 30.

ANSWER: 014 (1.00)
A.
REFERENCE:
Experiment No. 42.

ANSWER: 015 (1.00)
D.
REFERENCE:
Reactor Facility Operations, 8.1.5.

ANSWER: 016 (2.00)
A,1; B,2; C,3; D,3.
REFERENCE:
Technical Specifications, Table II.

ANSWER: 017 (1.00)
C.
REFERENCE:
Experiment No. 42.

ANSWER: 018 (1.00)
A,4; B,2; C,2; D,1.
REFERENCE:
10 CFR 55.

ANSWER: 019 (1.00)
D.
REFERENCE:
GM tube cannot distinguish between energies.

C. FACILITY AND RADIATION MONITORING SYSTEMS

QUESTION: 001 (1.00)
A.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 15.

QUESTION: 002 (1.00)
B.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 23.

QUESTION: 003 (1.00)
C.
REFERENCE:
KSU Training Manual, General Characteristics, Section 6.2, Secondary Loop.

QUESTION: 004 (1.00)
D.
REFERENCE:
KSU Training Manual, General Characteristics, Section 9, Transient Rod Drive Mechanisms.

QUESTION: 005 (1.00)
D.
REFERENCE:
KSU Training Manual, General Characteristics, Section 7, Reactor Instrumentation.

QUESTION: 006 (1.00)
A.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 5, Part 1.

QUESTION: 007 (2.00)
A,1; B,1; C,1; D,3.
REFERENCE:
KSU Training Manual, General Characteristics, Section 7.1, Measurement.

QUESTION: 008 (2.00)
A,5; B,5; C,4; D,4.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 5, Part 1.

QUESTION: 009 (1.00)
B.
REFERENCE:
KSU Training Manual, General Characteristics, Section 6, Coolant System, Figure 5.

QUESTION: 010 (1.00)
A.
REFERENCE:
KSU Training Manual, General Characteristics, Section 8.1, Mechanical Operation.

QUESTION: 011 (1.00)
B.
REFERENCE:
KSU Training Manual, General Characteristics, Section 7.1, Measurement.

QUESTION: 012 (1.00)
C.
REFERENCE:
KSU Training Manual, General Characteristics, Section 8.2, Circuit Operations.

QUESTION: 013 (1.00)
D.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 8.

QUESTION: 014 (1.00)
D.
REFERENCE:
KSU Training Manual, General Characteristics, Section 4.6, Control Rods.

QUESTION: 015 (1.00)
B.
REFERENCE:
KSU Training Manual, General Characteristics, Section 6, Coolant System.

QUESTION: 016 (1.00)
D.
REFERENCE:
KSU Operation, Test and Maintenance Procedures, Procedure No. 16.

QUESTION: 017 (1.00)
A.
REFERENCE:
KSU Training Manual, General Characteristics, Section 4.1, Fuel Elements.

QUESTION: 018 (1.00)
C.
REFERENCE:
KSU Training Manual, General Characteristics, Section 8.2, Circuit Operations.

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

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 *****)

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

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 _____

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

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)
If you change your answer, write your selection in the blank.

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 ______

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