August 2, 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-00-02

Dear Mr. Tinkler:

During the week of July 3, 2000, the NRC administered an initial retake 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 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-00-02
2. Examination and answer key (RO)

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

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Please see next page

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ADAMS ACCESSION #: ML003731771 **TEMPLATE #: NRR-056**

OFFICE	DIPM:IOLB		REXB:CE		REXB:BC	
NAME	EBarnhill		WEresian		LMarsh	
DATE	07/ 18 /2000		07/ 14 /2000		08/ 02 /2000	

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

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

REPORT NO.: 50-188/OL-00-02

FACILITY DOCKET NO.: 50-188

FACILITY LICENSE NO.: R-88

FACILITY: Kansas State University

EXAMINATION DATES: July 7, 2000

EXAMINER: Warren Eresian, Chief Examiner

SUBMITTED BY: ***/RA/*** 07/12/2000
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of July 3, 2000, the NRC administered retake Operator Licensing Examinations to two Reactor Operator candidates. One candidate took Category A of the written examination, and the other candidate took Category B. Both candidates passed the examination.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

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

3. Exit Meeting:

There was no exit meeting. The examination was prepared by the NRC, mailed to the staff at Kansas State University and administered by them.

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 07/07/00

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% is required to pass the examination.

Examinations will be picked up one (1) hour after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20	100	_____	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS

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.

QUESTION: 001 (1.00)

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.

QUESTION: 002 (1.00)

Which ONE of the following describes the term prompt jump?

a. The instantaneous change in power level due to withdrawing a control rod.

b. A reactor which has attained criticality on prompt neutrons alone.

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

d. A negative reactivity insertion which is less than β_{eff}.

QUESTION: 003 (1.00)

Which ONE of the following is the major source of energy released due to thermal fission of a U-235 atom?

a. Kinetic energy of the fission neutrons.

b. Prompt gamma rays.

c. Fission product decay.

d. Kinetic energy of the fission fragments.

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

QUESTION: 004 (1.00)

Which ONE of the following is the principal source of energy (heat generation) in the reactor 15 minutes following a reactor shutdown from extended operation at 100% power?

a. Production of delayed neutrons.

b. Subcritical multiplication.

c. Spontaneous fission of U-238.

d. Decay of fission products.

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.

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.

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

QUESTION: 007 (1.00)

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

QUESTION: 008 (1.00)

Delayed neutrons are considered to be more “effective” than prompt neutrons because delayed neutrons have a:

a. higher reproduction factor.

b. higher resonance escape probability.

c. lower thermal utilization factor.

d. higher thermal utilization factor.

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.

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

QUESTION: 010 (1.00)

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.

QUESTION: 011 (1.00)

Starting with a critical reactor at low power, a control rod is withdrawn from position X and reactor power starts to increase. Neglecting any temperature effects, in order to terminate the increase with the reactor again critical but at a higher power, the control rod must be:

a. inserted deeper than position X.

b. inserted, but not as far as position X.

c. inserted back to position X.

d. inserted, but exact position depends on power level.

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 $\beta = 0.007$.

a. 700.

b. 7,000.

c. 99,300.

d. 100,000.

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

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?

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)

A reactor is being started up, and has a count rate of 45 cps when 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

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

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.

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.

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

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.

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)

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

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
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.

ANSWER: 002 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-21.

ANSWER: 003 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-5.

ANSWER: 004 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 4-23.

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 2-45.

ANSWER: 008 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-12.

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

ANSWER: 010 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 8-3.

ANSWER: 011 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations.

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)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 5-24.

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.

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 *****)

EQUATION SHEET

$Q = m\ c_p\ \rho T$

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

$SUR = 26.06/\rho$

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

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

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

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

$DR_1 D_1^{\ 2} = DR_2 D_2^{\ 2}$

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

$DR = 6CiE/D^2$

$\rho = (Keff\text{-}1)/Keff$

$1\ eV = 1.6x10^{-19}$ watt-sec.

$1\ Curie = 3.7x10^{10}$ dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$°F = 9/5°C + 32$

$1\ Mw = 3.41x10^6$ BTU/hr

$°C = 5/9\ (°F - 32)$

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 07/07/00

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% is required to pass the examination.

Examinations will be picked up one (1) hour after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20	100	_____	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS

FINAL GRADE _____%

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

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QUESTION: 001 (1.00)

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 fuel elements

c. Tornado damage to facility.

d. Ongoing security compromise

QUESTION: 002 (1.00)

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.

QUESTION: 003 (1.00)

In accordance with Procedure No. 2, "Annual Power Level Calibration," after power level has been determined:

a. the linear power channel meter and recorder are adjusted to give the correct power indication.

b. the high voltage to the linear power channel neutron detector is adjusted to give the correct power indication.

c. the compensating voltage of the compensated ion chamber is adjusted to give the proper power indication.

d. the position of the compensated ion chamber is adjusted to give the proper power indication.

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

QUESTION: 004 (1.00)

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.

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)

In accordance with the KSU Fitness-For-Duty policy, which ONE of the following statements is NOT true?

a. An arrest for possession or distribution of a controlled substance will result in the permanent loss of access to the Nuclear Reactor Facility.

b. Consumption of alcohol is prohibited for 5 hours preceding any scheduled activity within the Facility.

c. Extended use of prescription or over-the-counter drugs is to be reported to the examining physician during employment physicals.

d. Consumption of alcohol during an abstinence period need not necessarily preclude responding to an emergency.

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

QUESTION: 007 (1.00)

In accordance with Procedure No. 1, “Biennial Control Rod Inspection,” upon reinstallation of the assembly:

a. a new integral rod worth curve must be measured.

b. rod-drop measurements from full withdrawal to full insertion must be made.

c. a new differential rod worth curve must be measured.

d. the reactivity insertion rate must be measured.

QUESTION: 008 (1.00)

In accordance with the Emergency Plan, the "Site Boundary" is:

a. the reactor facility, Room 110 of Ward Hall.

b. Ward Hall and adjacent fenced areas.

c. Facility Control Center.

d. KSU campus boundary.

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.

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

QUESTION: 010 (1.00)

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.

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. it is necessary to reduce the peak power level attained during the pulse.

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)

The reactor facility must be evacuated due to high radiation readings as a result of an accident. Contaminated personnel will assemble at:

a. the lobby of Ward Hall.

b. the University Student Health Center.

c. the Ward Hall basement restroom area.

d. the North Hall Emergency Supplies area.

(***** 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.

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

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

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 *****)
(***** END OF EXAMINATION *****)

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
B.
REFERENCE:
Emergency Plan, page 9.

ANSWER: 002 (1.00)
D.
REFERENCE:
Experiment No. 1, page 4.

ANSWER: 003 (1.00)
D.
REFERENCE:
Procedure No. 2, Basis.

ANSWER: 004 (1.00)
B
REFERENCE:
Procedure No. 8.

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

ANSWER: 006 (1.00)
A.
REFERENCE:
KSU Fitness-For-Duty Policy.

ANSWER: 007 (1.00)
B.
REFERENCE:
Procedure No. 1, page 3.

ANSWER: 008 (1.00)
B.
REFERENCE:
Emergency Plan.

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

ANSWER: 010 (1.00)
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.

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

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

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

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

ANSWER: 015 (1.00)
C.
REFERENCE:
Emergency Plan, page 6.

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.

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 *****)

EQUATION SHEET

$Q = m\ c_p\ \rho T$

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

$SUR = 26.06/\rho$

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

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

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

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

$DR_1 D_1^{\ 2} = DR_2 D_2^{\ 2}$

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

$DR = 6CiE/D^2$

$\rho = (Keff\text{-}1)/Keff$

$1\ eV = 1.6x10^{-19}$ watt-sec.

$1\ Curie = 3.7x10^{10}$ dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$°F = 9/5°C + 32$

$1\ Mw = 3.41x10^6$ BTU/hr

$°C = 5/9\ (°F - 32)$