February 10, 2005

Mr. Paul M. Whaley
Facility Manager
Kansas State University
112 Ward Hall
Manhattan, KS 66506

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-188/OL-05-01, KANSAS STATE UNIVERSITY

Dear Mr. Whaley:

During the week of January 10, 2005, 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 examination questions and 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. Warren Eresian at 301-415-1833 or internet e-mail wje@nrc.gov.

Sincerely,

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-188

Enclosures: 1. Initial Examination Report No. 50-188/OL-05-01
2. Examination and answer key

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

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DISTRIBUTION:

PUBLIC	RNRP\R&TR r/f	PIsaac, PM	PYoung
Facility File (EBarnhill)	WEresian	PMadden	

EXAMINATION PACKAGE NO.: ML050330131
EXAMINATION REPORT ACCESSION #: ML050330217 **TEMPLATE #: NRR-074**

OFFICE	RNRP:CE	IROB:LA	RNRP:SC
NAME	WEresian	EBarnhill	PMadden
DATE	02/04/2005	02/09/2005	02/10/2005

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

REPORT NO.: 50-188/OL-05-01

FACILITY DOCKET NO.: 50-188

FACILITY LICENSE NO.: R-88

FACILITY: Kansas State University

EXAMINATION DATES: January 10-12, 2005

EXAMINERS: Warren Eresian, Chief Examiner

SUBMITTED BY: **/RA/** 02/10/2005
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of January 10, 2005, the NRC administered operator licensing examinations to six Reactor Operator candidates and one Senior Reactor Operator (Upgrade) candidate. All candidates passed the examination.

ENCLOSURE 1

REPORT DETAILS

1. Examiners: Warren Eresian, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**6/0**	**N/A**	**6/0**
Operating Tests	**6/0**	**1/0**	**7/0**
Overall	**6/0**	**1/0**	**7/0**

3. Exit Meeting:

Warren Eresian, 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.

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

FACILITY: Kansas State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 01/10/05

REGION: 2

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	_____	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	33	_____	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20	33	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60	100	_____	_____	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)

A reactor is slightly supercritical, with the thermal utilization factor = 0.700. 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. 0.700.

c. 0.702.

d. 0.704.

QUESTION: 002 (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: 003 (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.

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

QUESTION: 004 (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: 005 (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: 006 (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)

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

QUESTION: 007 (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: 008 (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: 009 (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: 010 (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: 011 (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: 012 (1.00)

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

a. higher reproduction factor.

b. higher fast non-leakage probability.

c. lower thermal utilization factor.

d. higher thermal utilization factor.

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

QUESTION: 013 (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: 014 (1.00)

Which ONE of the following conditions would INCREASE the shutdown margin of a reactor?

a. Inserting an experiment which adds positive reactivity.

b. Lowering the moderator temperature, if the moderator temperature coefficient is negative.

c. Depletion of burnable poison.

d. Depletion of uranium fuel.

QUESTION: 015 (1.00)

A reactor is operating at criticality. Instantaneously, all of the delayed neutrons are suddenly removed from the reactor. The K_{eff} of the reactor in this state would be approximately:

a. 1.007

b. 1.000

c. 0.993

d. 0.000

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

QUESTION: 016 (1.00)

A reactor is critical at 50% of rated power, with reactivity = zero. A control rod is withdrawn and the power increases to a higher steady-state value. The reactivity of the reactor at the higher power level is zero because:

a. the positive reactivity due to the fuel temperature decrease balances the negative reactivity due to the control rod withdrawal.

b. the negative reactivity due to the fuel temperature decrease equals the positive reactivity due to the control rod withdrawal.

c. the positive reactivity due to the fuel temperature increase balances the negative reactivity due to the control rod withdrawal.

d. the negative reactivity due to the fuel temperature increase equals the positive reactivity due to the control rod withdrawal.

QUESTION: 017 (1.00)

Which ONE of the following does NOT affect the Effective Multiplication Factor $K_{eff?}$

a. The moderator-to-fuel ratio.

b. The moderator temperature.

c. The physical dimensions of the core.

d. The strength of an installed neutron souce.

QUESTION: 018 (1.00)

The reactor is to be pulsed. The projected pulse will add TWICE as much reactivity as the last pulse performed. In relation to the last pulse, for the projected pulse peak power will be:

a. about four times larger and the energy released will be about four times larger.

b. about two times larger and the energy released will be about four times larger.

c. about four times larger and the energy released will be about two times larger.

d. about two times larger and the energy released will be about two times larger.

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

QUESTION: 019 (1.00)

Which ONE of the following is the reason for operating with thermal neutrons rather than fast neutrons?

a. Probability of fission is increased since thermal neutrons are less likely to leak out of the core.

b. As neutron energy increases, neutron absorption in non-fuel materials increases exponentially.

c. The absorption cross-section of U-235 is much higher for thermal neutrons.

d. The fuel temperature coefficient becomes positive as neutron energy increases.

QUESTION: 020 (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.

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

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 are to be considered.

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

QUESTION: 002 (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: 003 (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.

b. Primary water temperature = 110 deg. F.

c. Pool water conductivity = 2 micromho/cm.

d. Fuel temperature = 400 deg. C.

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

QUESTION: 004 (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: 005 (1.00)

In accordance with the Technical Specifications, which Reactor Safety System scrams are required to be operable in BOTH the Steady-State and Pulse modes?

a. Fuel temperature scram, manual scram.

b. Linear channel high power scram, power supply failure scram.

c. Manual scram, power supply failure scram.

d. Fuel temperature scram, period scram.

QUESTION: 006 (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.

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

QUESTION: 007 (1.00)

A survey instrument with a window probe is used to measure the beta-gamma dose rate from an irradiated experiment. The dose rate is 100 mrem/hour with the window open and 60 mrem/hour with the window closed. The gamma dose rate is:

a. 100 mrem/hour.

b. 60 mrem/hour.

c. 40 mrem/hour.

d. 160 mrem/hour.

QUESTION: 008 (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: 009 (1.00)

The Total Effective Dose Equivalent (TEDE) is defined as the sum of the deep-dose equivalent and the committed effective dose equivalent. The deep-dose equivalent is related to:

a. the dose to organs or tissues.

b. the external exposure to the skin or an extremity.

c. the external exposure to the lens of the eye.

d. the external whole-body exposure.

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

QUESTION: 010 (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.

QUESTION: 011 (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.

QUESTION: 012 (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 the adjacent fenced areas.

c. Facility Control Center.

d. KSU campus boundary.

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

QUESTION: 013 (1.00)

The dose rate 10 feet from a point gamma source is 25 mR/hr. A person working for 1.5 hours at 3 feet from the source will receive a dose of:

a. 83 mR.

b. 125 mR.

c. 278 mR.

d. 417 mR.

QUESTION: 014 (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: 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 (1.00)

In accordance with the Emergency Plan, which ONE of the following is the definition of an UNUSUAL EVENT classification? Events are in progress or have occurred which:

a. have resulted or could result in radiation levels in excess of 100 mrem/hr at the operations boundary.

b. indicate a potential degradation of the safety of the reactor facility with no release of radioactive material requiring offsite response.

c. have resulted or could result in exposures at the facility boundary in excess of 10CFR20 limits.

d. involve an actual or potential substantial degradation of the level of safety of the facility.

QUESTION: 017 (1.00)

Which ONE of the following conditions is permissible when the reactor is operating?

a. Continuous air monitor in reactor bay inoperable due to maintenance.

b. A pulse reactivity insertion of $2.50.

c. Startup with the period scram bypassed.

d. Operating in steady state mode with the linear power channel inoperable.

QUESTION: 018 (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 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: 019 (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: 020 (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

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

QUESTION: 001 (1.00)

When the reactor is operating at full power, the highest thermal neutron flux occurs at:

a. the F-ring rabbit terminus.

b. the rotary specimen rack.

c. the E-ring.

d. the central thimble.

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 wide range log channel signal.

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

QUESTION: 003 (1.00)

When the reactor is in the steady state mode, two or more control rods may not be withdrawn simultaneously. The purpose of this interlock is to:

a. prevent the possibility of a sourceless startup.

b. prevent the inadvertent pulsing of a reactor in the steady state mode.

c. prevent violation of the maximum reactivity insertion rate.

d. minimize the possibility of pulsing a supercritical reactor.

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

QUESTION: 004 (1.00)

Which ONE of the following controls the amount of reactivity that is inserted by the transient rod during pulse operations?

a. The timer setting that vents the pneumatic piston.

b. The pressure of the air applied to the pneumatic piston.

c. The position of the cylinder.

d. The initial power level of the reactor prior to firing the pulse.

QUESTION: 005 (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: 006 (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.

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.

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

QUESTION: 007 (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: 008 (1.00)

Upon receipt of a scram signal, the regulating rod:

a. magnet is de-energized, and the rod falls into the core.

b. remains where it is, and must be manually driven into the core.

c. automatically drives into the core.

d. magnet and drive both fall into the core.

QUESTION: 009 (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.

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.

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

QUESTION: 010 (1.00)

Which ONE of the following is the approximate total worth of the shim, regulating and transient rods?

a. $5.00.

b. $5.75.

c. $6.40.

d. $7.25.

QUESTION: 011 (1.00)

The following conditions exist in the primary and secondary cooling systems:

Outside air temperature = 0 deg. F
Temperature of secondary flow from cooling tower = 60 deg. F
Primary temperature = 105 deg. F
Set control temperature = 100 deg. F

Under these conditions:

a. the cooling tower fan is operating at low speed.

b. the cooling tower fan is operating at high speed.

c. the cooling tower fan is not operating.

d. the cooling tower fan operates at low speed until the primary temperature drops below the set control temperature.

QUESTION: 012 (1.00)

Which ONE of the following is the flow through the primary loop and the cleanup loop?

a. 120 gpm total flow with 10 gpm through the cleanup loop

b. 110 gpm total flow with 10 gpm through the cleanup loop

c. 120 gpm total flow with 20 gpm through the cleanup loop

d. 110 gpm total flow with 20 gpm through the cleanup loop

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

QUESTION: 013 (1.00)

The purpose of the diffuser above the core during operation is to:

a. reduce dose rate at the pool surface from N-16.

b. enhance heat transfer across all fuel elements in the core.

c. better distribute heat throughout the pool.

d. ensure consistent water chemistry in the pool.

QUESTION: 014 (1.00)

Which ONE of the following describes the neutron source utilized at the KSU reactor?

a. 2-curie americium beryllium.

b. 2-curie antimony beryllium.

c. 4-curie americium beryllium.

b. 4-curie antimony beryllium.

QUESTION: 015 (1.00)

Select from Column B the measuring channel that 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.)

Column A		Column B	
a.	< 2 cps rod withdraw inhibit	1.	Wide Range Log
b.	1 kW pulse inhibit	2.	Multi-Range Linear
c.	Period scram	3.	Percent Power
d.	Automatic control	4.	Pulse Channel

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

QUESTION: 016 (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 occurs?

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.

QUESTION: 017 (1.00)

Of all the automatic scrams available for the reactor, the only one that remains operable in the pulse mode is:

a. high fuel temperature.

b. short reactor period.

c. linear multi-range power.

d. percent power.

QUESTION: 018 (1.00)

Match the neutron measuring channel in Column A with the type of detector in Column B. Detectors in Column B may be used once, more than once, or not at all.

	Column A		Column B
a.	Wide Range Log Channel	1.	Compensated Ion Chamber
b.	Multi-Range Linear Channel	2.	Uncompensated Ion Chamber
c.	Percent Power Channel	3.	Fission Counter
d.	Pulse Channel	4.	BF_3 Chamber

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

QUESTION: 019 (1.00)

Actuation of the amber light on the control console associated with the pulse rod drive indicates that:

a. the solenoid valve has been de-energized.

b. the air supply for the pulse rod drive has dropped below approximately 45 psig.

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

d. the variable timer has timed out.

QUESTION: 020 (1.00)

All primary power to the TRIGA instrumentation is supplied by a line conditioner. Upon a loss of building power:

a. the line conditioner continues to supply power for a period of one hour, after which the line conditioner ceases to supply power until building power is restored.

b. the line conditioner de-energizes, but automatically energizes again when building power is restored.

c. the line conditioner de-energizes, but must be manually reset when building power is restored.

d. the line conditioner will continue to supply power to the radiation monitoring equipment only. When building power is restored, it must be manually reset to supply the remaining instrumentation.

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

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
A.
REFERENCE:
DOE Fundamentals Handbook, Module 3, page 10.

ANSWER: 002 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 12.

ANSWER: 003 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 3, page 52.

ANSWER: 004 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 2.

ANSWER: 005 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 3, page 10.

ANSWER: 006 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 3, page 8.

ANSWER: 007 (1.00)
A.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 7.

ANSWER: 008 (1.00)
A.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 14.

ANSWER: 009 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 1, page 61.

ANSWER: 010 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 33.

ANSWER: 011 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 2, page 24.

ANSWER: 012 (1.00)
B.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 12.

ANSWER: 013 (1.00)
B.
REFERENCE:
DOE Fundamentals Handbook, Module 3, page 35.

ANSWER: 014 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 28.
Anything which adds negative reactivity increases the shutdown margin.

ANSWER: 015 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 2, page 30.

ANSWER: 016 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 28.

ANSWER: 017 (1.00)
D.
REFERENCE:
DOE Fundamentals Handbook, Module 3, pages 2-9.

ANSWER: 018 (1.00)
C.
REFERENCE:
Training Manual, page C4-5

ANSWER: 019 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 2, page 9.

ANSWER: 020 (1.00)
C.
REFERENCE:
DOE Fundamentals Handbook, Module 4, page 6.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

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

ANSWER: 002 (1.00)
B.
REFERENCE:
Emergency Plan, Section 5.2.

ANSWER: 003 (1.00)
A.
REFERENCE:
Technical Specifications, Section D.2.

ANSWER: 004 (1.00)
D.
REFERENCE:
Experiment No. 1, page 4.

ANSWER: 005 (1.00)
C.
REFERENCE:
Technical Specifications, Table I.

ANSWER: 006 (1.00)
B.
REFERENCE:
Procedure No. 8, page 4.

ANSWER: 007 (1.00)
B.
REFERENCE:
Beta radiation cannot pass through window. With window closed, gamma = 60.

ANSWER: 008 (1.00)
C.
REFERENCE:
Procedure No. 9, page 1.

ANSWER: 009 (1.00)
D.
REFERENCE:
Training Manual, Part B1, Definitions.

ANSWER: 010 (1.00)
C.
REFERENCE:
Emergency Plan, Section 3.5.

ANSWER: 011 (1.00)
A.
REFERENCE:
Training Manual, page A6-1.

ANSWER: 012 (1.00)
B.
REFERENCE:
Emergency Plan, Section 1.1.

ANSWER: 013 (1.00)
D.
REFERENCE:
$DR_1D_1^2 = DR_2D_2^2$; Dose rate at 3 feet = 278 mR/hr.; 278 mR/hr x 1.5 hr = 417 mR.

ANSWER: 014 (1.00)
C.
REFERENCE:
Experiment 30.

ANSWER: 015 (1.00)
D.
REFERENCE:
Training Manual, page A2-6.

ANSWER: 016 (1.00)
B.
REFERENCE:
Emergency Plan, Section 5.1.

ANSWER: 017 (1.00)
C.
REFERENCE:
Procedure No. 11.

ANSWER: 018 (1.00)
D.
REFERENCE:
Procedure No. 2.

ANSWER: 019 (1.00)
C.
REFERENCE:
Experiment 42.

ANSWER: 020 (1.00)
A,4; B,2; C,2; D,1.
REFERENCE:
Training Manual, page B4-1.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
D.
REFERENCE:
Training Manual, page A1-11.

ANSWER: 002 (1.00)
B.
REFERENCE:
Procedure No. 23.

ANSWER: 003 (1.00)
C.
REFERENCE:
Training Manual, page A1-18.

ANSWER: 004 (1.00)
C.
REFERENCE:
Training Manual, page A1-21.

ANSWER: 005 (1.00)
D.
REFERENCE:
Procedure No. 16.

ANSWER: 006 (1.00)
C.
REFERENCE:
Training Manual, page A1-20.

ANSWER: 007 (1.00)
A.
REFERENCE:
Training Manual, page A1-21.

ANSWER: 008 (1.00)
A.
REFERENCE:
Training Manual, page A1-18.

ANSWER: 009 (1.00)
C.
REFERENCE:
SAR, page 7-13.

ANSWER: 010 (1.00)
C.
REFERENCE:
Training Manual, page A1-8.

ANSWER: 011 (1.00)
C.
REFERENCE:
Training Manual, page A1-14.

ANSWER: 012 (1.00)
B.
REFERENCE:
SAR, page 5-3.

ANSWER: 013 (1.00)
A.
REFERENCE:
SAR, page 5-10.

ANSWER: 014 (1.00)
A.
REFERENCE:
SAR, page 4-8.

ANSWER: 015 (1.00)
A, 1; B,1; C,1; D,2.
REFERENCE:
Training Manual, pages A1-15 - 17.

ANSWER: 016 (1.00)
A.
REFERENCE:
Training Manual, page A1-17.

ANSWER: 017 (1.00)
A.
REFERENCE:
Technical Specifications, Table I.

ANSWER: 018 (1.00)
A,3; B,1; C,2; D,4.
REFERENCE:
Training Manual, page A1-15.

ANSWER: 019 (1.00)
B.
REFERENCE:
Training Manual, page A1-22.

ANSWER: 020 (1.00)
C.
REFERENCE:
SAR, page 8-2.

A. REACTOR THEORY, THERMODYNAMICS & 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 _____

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 _____

020 a_____b_____c_____d _____

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 _____

019 a b c d _____

020 a b c d _____

EQUATION SHEET

$Q = m\, c_p\, \Delta T$

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

$SUR = 26.06/\tau$

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

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

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

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

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = 6CiE/D^2$

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

1 Curie = 3.7×10^{10} dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$EF = 9/5EC + 32$

1 Mw = 3.41×10^6 BTU/hr

$EC = 5/9\,(EF - 32)$

1 w = 1 Joule/sec.

1 ev = 1.602×10^{-19} Joule