June 14, 2002

Dr. B. Don Russell, Deputy Director
Texas Engineering Experiment Station
Nuclear Science Center, Bldg. 1095
Texas A&M University
College Station, TX 77843-3575

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-128/OL-02-02

Dear Dr. Russell:

During the week of May 20, 2002, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Texas A&M 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 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
Operating Reactor Improvements Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures: 1. Initial Examination Report No. 50-128/OL-02-02
2. Examination and answer key

cc w/encls:
Please see next page

cc:

Mayor, City of College Station
P.O. Box Drawer 9960
College Station, TX 77840-3575

Governor's Budget and
Planning Office
P.O. Box 13561
Austin, TX 78711

Bureau of Radiation Control
State of Texas
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College Station, TX 77843

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Please see next page

DISTRIBUTION w/encls.:
PUBLIC
MMendonca, PM
Facility File (EBarnhill)

DISTRIBUTION w/o encls.:
RORP/R&TR r/f
WEresian
PMadden

ADAMS ACCESSION #: ML021510156 **TEMPLATE #: NRR-074**

OFFICE	RORP:CE		IEHB:LA		RORP:SC	
NAME	WEresian		EBarnhill		PMadden	
DATE	06/ 03 /2002		06/ 12 /2002		06/ 13 /2002	

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

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

REPORT NO.: 50-128/OL-02-02

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: Texas A&M University

EXAMINATION DATES: May 21-23, 2002

EXAMINER: Warren Eresian, Chief Examiner

SUBMITTED BY: ***/RA/***   06/ 03 /2002
Warren Eresian, Chief Examiner   Date

SUMMARY:

During the week of May 20, 2002, the NRC administered operator licensing examinations to one Senior Reactor Operator (Instant) candidate, one Senior Reactor Operator (Upgrade) candidate, and three Reactor Operator candidates. One Reactor Operator candidate failed the examination. All other candidates passed the examinations.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**2/1**	**1/0**	**3/1**
Operating Tests	**2/1**	**2/0**	**4/1**
Overall	**2/1**	**2/0**	**4/1**

3. Exit Meeting:

Mr. Bill Asher, Manager of Operations
Warren Eresian, NRC Chief Examiner

The NRC thanked the facility staff for their cooperation during the examination. The facility provided comments on the written examination. As a result of their comments, the following questions were modified:

Category A

Question 016: Two correct answers, A and B. Both answers accepted.

Category C

Question 010: No correct answer (due to facility modification). Question deleted.

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

FACILITY: Texas A&M University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 05/21/02

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	34	______	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	34	______	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
19	32	______	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
59		______	_____% 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)

Reactor power is increasing by a factor of 10 every minute. The reactor period is:

a. 65 seconds.

b. 52 seconds.

c. 26 seconds.

d. 13 seconds.

QUESTION: 002 (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: 003 (1.00)

The neutron microscopic cross section for absorption, σ_a , generally:

a. increases as neutron energy increases.

b. decreases as neutron energy increases.

c. increases as the mass of the target nucleus increases.

d. decreases as the mass of the target nucleus increases.

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

QUESTION: 004 (1.00)

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

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

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

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

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

QUESTION: 005 (1.00)

During a reactor startup, the count rate is increasing on a straight line on a logarithmic scale, 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 supercritical.

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)

As a reactor continues to operate over a period of months, 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)

A reactor is operating at a constant power level of 250 kW. The fission rate of this reactor is approximately:

a. 0.78×10^{12} fissions/sec.

b. 1.56×10^{14} fissions/sec.

c. 0.78×10^{16} fissions/sec.

d. 3.90×10^{18} fissions/sec.

QUESTION: 009 (1.00)

Which ONE of the following statements correctly describes the influence of delayed neutrons during the neutron life cycle?

a. Delayed neutrons are more likely to cause fission after they become thermalized because they thermalize more quickly than prompt neutrons.

b. Delayed neutrons take longer to thermalize because they are born at a higher average energy than prompt neutrons.

c. Delayed neutrons increase the average neutron generation time.

d. Delayed neutrons are produced some time after prompt neutrons and make up the majority of neutrons produced by fissions.

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

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.

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 1×10^8 neutrons is operating with $K_{eff} = 1.001$. Considering only the <u>increase</u> 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)

<u>Inelastic scattering</u> 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)

The Moderating Ratio measures the effectiveness of a moderator by combining the scattering cross section, the absorption cross section, and the average energy loss per collision. The Moderating Ratio is expressed as:

a. (absorption cross section)x(scattering cross section)/(average energy loss per collision).

b. (absorption cross section)x(average energy loss per collision)/(scattering cross section).

c. (scattering cross section)x(absorption cross section)x(average energy loss per collision).

d. (average energy loss per collision)x(scattering cross section)/(absorption cross section).

QUESTION: 015 (1.00)

Refer to the Shim #3 Integral Rod Worth data, attached. The rod is at position 55.5. An experiment with a reactivity worth of $0.80 is inserted into the reactor, and as a result the rod is moved into the core. The experiment has a reactivity worth of ______ and the rod is at position______.

a. + $0.80; 78.0

b. + $0.80; 37.5

c. - $0.80; 78.0

d. - $0.80; 37.5

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

QUESTION: 016 (1.00)

Delayed neutron precursors decay by beta(-) decay. Which ONE reaction below is an example of beta(-) decay?

a. ${}_{35}Br^{87}$ -> ${}_{36}Kr^{87}$

b. ${}_{35}Br^{87}$ -> ${}_{36}Kr^{87}$

c. ${}_{35}Br^{87}$ -> ${}_{35}Kr^{88}$

d. ${}_{35}Br^{87}$ -> ${}_{35}Kr^{86}$

QUESTION: 017 (1.00)

A reactor is subcritical by 5% delta k/k with a count rate of 100 cps on the startup channel. Rods are withdrawn until the count rate is 1000 cps. Which ONE of the following is the condition of the reactor following the rod withdrawal?

a. Critical with k_{eff} = 1.000.

b. Subcritical with k_{eff} = 0.995.

c. Subcritical with k_{eff} = 0.950.

d. Supercritical with k_{eff} = 1.005.

QUESTION: 018 (1.00)

A reactor is operating at a constant power level with equilibrium xenon. Reactor power is then doubled. The equilibrium xenon level at the higher power level will be:

a. higher than its value at the lower power level, but not twice as high.

b. twice as high.

c. more than twice as high.

d. the same as at the lower power level.

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

QUESTION: 019 (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. Fast fission factor.

c. Thermal non-leakage probability.

d. Resonance escape probability.

QUESTION: 020 (1.00)

Which ONE of the following statements correctly describes a characteristic of subcritical multiplication?

a. The number of neutrons gained per generation doubles for each succeeding generation.

b. A constant neutron population is achieved when the total number of neutrons produced in one generation is equal to the number of source neutrons added in the next generation.

c. For equal reactivity additions, it requires less time for the equilibrium neutron population to be reached.

d. When the indicated count rate doubles, the margin to criticality has been reduced by approximately one-half.

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

QUESTION: 001 (1.00)

The SRO on duty has directed you to "secure the reactor." This is done by:

a. fully inserting all control rods and placing the rod control switches to NEUTRAL.

b. scramming the reactor.

c. removing all experiments.

d. removing the reactor key from the control console.

QUESTION: 002 (1.00)

You observe a loss of reactor pool water which can be controlled by adding makeup water. In accordance with the Emergency Plan, your first course of action is to:

a. assess the severity of the pool water loss by observing the leakage rate and reactor bridge area radiation monitor readings.

b. send a member of Reactor Operations to the west end of the pool and position the emergency cover over the 10-inch cooling exit line.

c. dispatch teams to take appropriate action to determine source of leakage and correct by valve manipulation if possible.

d. shutdown the reactor.

QUESTION: 003 (1.00)

Which ONE of the following conditions is NOT permissible when the reactor is operating, or about to be operated?

a. The reactivity worth of a single experiment = $1.00.

b. A control rod scram = 1.5 seconds.

c. An excess reactivity = $2.20.

d. The Continuous Air Radiation Monitor is inoperable due to maintenance.

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

QUESTION: 004 (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.

QUESTION: 005 (1.00)

An automatic scram signal which is NOT required by the Technical Specifications when operating in the steady state mode is:

a. short period.

b. high fuel temperature.

c. high power level.

d. loss of detector high voltage.

QUESTION: 006 (1.00)

In accordance with 10CFR55, a licensed operator must:

a. pass a comprehensive requalification written examination and an annual operating test during a 24-month period.

b. complete a minimum of six hours of shift functions each month.

c. have a medical examination during the six-year term of the license.

d. notify the NRC within 30 days following an arrest.

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

QUESTION: 007 (1.00)

Which ONE of the statements below describes the reason for maintaining bulk pool water chemistry (conductivity and pH)?

a. Reduce the corrosion of the pool liner.

b. Maintain water pH in the range 8.5 to 10.5.

c. Maintain water clarity to facilitate required surveillances.

d. Extend the longevity and integrity of the fuel cladding.

QUESTION: 008 (1.00)

"The temperature in a TRIGA-FLIP fuel element shall not exceed 2100°F (1150°C) under any conditions of operation." This is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

QUESTION: 009 (1.00)

An experiment with a reactivity worth of $0.40 is to be removed from the core. Prior to performing this operation:

a. reactor power must be less than 600 kW.

b. the reactor must be subcritical.

c. the reactor must be subcritical by at least $0.40.

d. the reactor must be shutdown.

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

QUESTION: 010 (1.00)

A reactor parameter which is protected by a Safety Limit is:

a. reactor power.

b. fuel element temperature.

c. fuel cladding temperature.

d. pool water level.

QUESTION: 011 (1.00)

A person has received a serious injury which does not involve contamination. In accordance with the Emergency Plan, your <u>first</u> course of action is to:

a. notify the SRO on duty.

b. call for an ambulance, briefly describe the injury and explain the type of accident.

c. go to the injured person and assess the extent of the injury.

d. shutdown the reactor.

QUESTION: 012 (1.00)

An Emergency Action Level is:

a. a condition which calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

b. a class of accidents for which predetermined emergency measures should be taken or considered.

c. a specific instrument reading or observation which may be used as a threshold for initiating appropriate emergency procedures.

d. a procedure that details the implementation actions and methods required to achieve the objectives of the emergency plan.

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

QUESTION: 013 (1.00)

A startup checklist has been completed and a startup performed. The reactor is then shutdown (scheduled.) During the shutdown, the bridge is moved. When the reactor is again started up on the same day:

a. another complete checklist is required.

b. the scram circuits must be checked.

c. only section A of the checklist is required.

d. only section D of the checklist is required.

QUESTION: 014 (1.00)

Which ONE of the statements below describes the reason the lab receivers in the pneumatic system are kept closed except when loading or unloading a sample?

a. Prolonged opening will introduce air into the system and result in high levels of radioactive Ar^{41}.

b. Prolonged opening will cause pool leakage into the transport hoses due to the pressure differential.

c. They remain closed for neutron shielding purposes during reactor core operation.

d. They remain closed to prevent any CO2 leakage past the isolation valve from entering the labs.

QUESTION: 015 (1.00)

The area radiation monitor at the pool level is out of service for maintenance. As a result:

a. the reactor cannot be operated.

b. the reactor can continue to operate.

c. the reactor can continue to operate only if the monitor is replaced with a portable gamma instrument with its own alarm.

d. the reactor can continue to operate only if the alarm setpoints of the remaining area radiation monitors are lowered.

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

QUESTION: 016 (1.00)

The reactivity worth of a particular experiment is determined to be $1.50. Which ONE of the statements below is correct concerning this experiment?

a. The experiment cannot be allowed in the core due to an excessive reactivity value.

b. The experiment can be placed in the core as a non-secured experiment.

c. The experiment is allowed in the core providing analysis indicates the worth is such that removal will not exceed the safety limit.

d. The experiment is allowed in the core but must be secured.

QUESTION: 017 (1.00)

Which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. Shutdown margin = 20 cents.

b. Steady state power level of 1.4 megawatts for purposes of testing and calibration.

c. A vacant lattice position on the periphery of the core assembly.

d. The Continuous Air Radiation Monitor and the Exhaust Gas Radiation Monitor are inoperable due to maintenance and have been replaced with gamma sensitive instruments with alarms.

QUESTION: 018 (1.00)

A Limited Access Worker must receive__________and is issued a _______ badge.

a. General Employee Training; green.

b. Radiation Worker Training and General Employee Training; yellow.

c. General Employee Training; orange.

d. Radiation Worker Training and General Employee Training; blue.

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

QUESTION: 019 (1.00)

The reactor was pulsed but the reactor was switched back to the steady state mode before the reactor operator logged the NVT and the pulse temperature values. The reactor operator should:

a. repeat the pulse.

b. look in the log book for a previous pulse of the same reactivity and use the NVT and pulse temperature values for that pulse.

c. shutdown the reactor and record a statement in the Operations Log to document the event.

d. record the pulse temperature from the fuel element temperature recorder and correlate that value to the pulse power.

QUESTION: 020 (1.00)

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

a. 83 mrem.

b. 125 mrem.

c. 277 mrem.

d. 417 mrem.

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

QUESTION: 001 (1.00)

When the reactor is being controlled by the servo controller:

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 log power channel signal.

d. the regulating rod moves out following a scram to try to maintain constant power.

QUESTION: 002 (1.00)

The reactor is in the "PULSE" mode when the TR fire button is depressed. As a result, the solenoid valve is:

a. energized, admitting air to the cylinder.

b. de-energized, admitting air to the cylinder.

c. de-energized, removing air from the cylinder.

d. energized, removing air from the cylinder.

QUESTION: 003 (1.00)

A safety plate assembly is installed beneath the reactor grid plate. Its purpose is to:

a. stop a standard fuel element from dropping more than 2 inches out of the core if it should become detached from its mounting.

b. stop a FLIP fuel element from dropping more than 2 inches out of the core if it should become detached from its mounting.

c. stop a control rod follower from dropping more than 2 inches out of the core if it should become detached from its mounting.

d. provide a stop for the grid plate if it should become detached from the suspension frame.

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

QUESTION: 004 (1.00)

Under emergency conditions, the master control panel located in the reception room may be used to:

a. scram the reactor.

b. operate the air handling systems.

c. operate the emergency pool fill system.

d. operate the emergency lighting system.

QUESTION: 005 (1.00)

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

a. The preset pulse 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 reactivity of the reactor prior to firing the pulse.

QUESTION: 006 (1.00)

When the stack particulate activity alarm sounds, which ONE of the following occurs?

a. The reactor scrams.

b. The evacuation alarm sounds.

c. The air handling system shuts down.

d. There are no automatic actions.

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

QUESTION: 007 (2.00)

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. Log Power Channel	1. Compensated Ion Chamber
b. Linear Power Channel	2. Uncompensated Ion Chamber
c. Safety Power Channel	3. Fission Chamber
d. Pulse Power Channel	4. G-M Tube

QUESTION: 008 (1.00)

The reactor is operating at 800 kW, with power being controlled by the servo control system. An experiment is inadvertently inserted into the core, causing reactor power to drop to 600 kW. As a result:

a. the regulating rod moves out of the core in an effort to restore power to 800 kW.

b. the reactor scrams.

c. regulating rod control shifts back to manual.

d. the regulating rod moves into the core to maintain power at 600 kW.

QUESTION: 009 (1.00)

The chemical feed system controls the chemical characteristics of the:

a. secondary cooling loop.

b. pool water cooling system.

c. purification system.

d. pool water transfer system.

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

QUESTION: 010 (1.00) QUESTION DELETED

Which ONE of the following statements correctly describes the purpose of the synchronous transmitter 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 to the electromagnet.

QUESTION: 011 (1.00)

Control rods have <u>fueled</u> followers in order to:

a. enhance their control characteristics.

b. gain excess reactivity and extend core life.

c. increase the effectiveness for reactor pulsing.

d. decrease the core excess reactivity.

QUESTION: 012 (1.00)

A 1 3/4 inch diameter hole through the grid plate is located at the southwest corner of the four rod fuel assemblies. The purpose of these holes is to:

a. accommodate a fuel followed control rod.

b. provide a mounting location for in-core experiments.

c. allow for accurate repositioning of the reactor core which is essential for numerous experiments.

d. provide a coolant flow path through the grid plate.

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

QUESTION: 013 (1.00)

An experimenter is attempting to open the door on beam port #5 while the reactor is in operation. As a result:

a. An alarm horn in the lower research area is activated to warn the experimenter that the reactor is in operation.

b. An annunciator occurs on the console in the control room indicating a beam port door is being opened.

c. The cameras in the lower research area are automatically scanned so the operator would observe the beam port door being opened.

d. Opening of the beam port door during operation will result in a scram.

QUESTION: 014 (1.00)

Which ONE of the following statements correctly describes system response for a gross leakage of water from the primary system?

a. Two float switches actuate. One stops the pool water recirculation pump and one energizes an alarm at the University Communications Room.

b. Two float switches actuate. Each stops the pool water recirculation pump and energizes an alarm at the University Communications Room.

c. One float switch actuates. This switch stops both the pool water recirculation pump and energizes an alarm at the University Communications Room.

d. One float switch actuates. This switch energizes an alarm at the University Communications Room. The pool water recirculation pump continues to operate.

QUESTION: 015 (1.00)

The FLIP fuel elements:

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

b. are about 70% enriched uranium with stainless steel clad and erbium burnable poison.

c. are about 20% enriched uranium with aluminum clad and erbium burnable poison.

d. are about 70% enriched uranium with aluminum clad and no burnable poison.

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

QUESTION: 016 (1.00)

Which ONE of the following is the method you should use (as the console operator) to sound the evacuation alarm if the solenoid valve which supplies air to the horn was inadvertently left shut in the reception room?

a. Use the normal switch on the control panel which should still work.

b. Open a "bypass" valve located in the control room.

c. Open a "bypass" valve located just inside the door leading out of containment.

d. Override the solenoid signal via a switch located in the back of the reactor console.

QUESTION: 017 (1.00)

On a decreasing pool level you are directed to line makeup to the pool via the demineralizer system at 100 gpm. SOP V-A cautions you not to exceed 70 gpm through the demineralizer. At the higher (100 gpm) rate you run the risk of:

a. blowing resin out of the demineralizer into the pool

b. creating channels through the demineralizer.

c. over pressuring the demineralizer.

d. blowing the filter upstream of the demineralizer into the demineralizer.

QUESTION: 018 (2.00)

Match the nuclear instrumentation channel in Column B that satisfies the control function in Column A. Items in column B may be used once, more than once or not at al.

Column A	Column B
a. Energizes interlock that prevents start-ups when less than 2 cps.	1. Log power channel
b. Energizes interlock that prevents pulsing operations when greater than 1 kw.	2. Linear power channel
c. Inputs reactor scram signal when power is greater than 125%.	3. Safety channel(s)
d. Inputs reactor scram signal in the event of a reactor period of 3 seconds or less.	

(***** 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 4-4.
$P/P_o = e^{t/T}$; $10 = e^{60/T}$; $\ln 10 = 2.303 = 60/T$; $T = 26$ seconds

ANSWER: 002 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-16.
In order to decrease K (return to critical), 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)
D.
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 5-18.

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

ANSWER: 008 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-51.
250 kW = 1.562×10^{18} Mev/sec. (From Equation Sheet)
(1.562×10^{18} Mev/sec)/(200 Mev/fission) = 0.78×10^{16} fissions/sec.

ANSWER: 009 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-27.

ANSWER: 010 (1.00)
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 2-62.

ANSWER: 015 (1.00)
B.
REFERENCE:
Control Rod Data (Annual Control Rod Calibration and Shutdown Margin Determination).

ANSWER: 016 (1.00)
A or B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-10.

ANSWER: 017 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pages 3-23, 5-23.
$CR_1 (1-K_1) = CR_2 (1-K_2)$; $\rho = (K - 1)/K$; $-0.05 = (K - 1)/K$; $K = 0.952$.
$100(1 - 0.952) = 1000(1 - K_2)$; $K_2 = 0.995$.

ANSWER: 018 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 8-8.

ANSWER: 019 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-16.

ANSWER: 020 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, page 3-16.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
D.
REFERENCE:
SOP Reactor Shutdown.

ANSWER: 002 (1.00)
D.
REFERENCE:
SOP Implementing Procedure For A Pool Level Alarm.

ANSWER: 003 (1.00)
B.
REFERENCE:
TA&M Technical Specifications, Section 3.2.3.

ANSWER: 004 (1.00)
D.
REFERENCE:
10CFR20.

ANSWER: 005 (1.00)
A.
REFERENCE:
TA&M Technical Specifications, Section 3.2.2.

ANSWER: 006 (1.00)
A.
REFERENCE:
TA&M Requalification Program.

ANSWER: 007 (1.00)
D.
REFERENCE:
TA&M Technical Specifications, Bases, Section 3.8.

ANSWER: 008 (1.00)
A.
REFERENCE:
TA&M Technical Specifications, Section 2.1.

ANSWER: 009 (1.00)
D.
REFERENCE:
SOP Steady State Operation.

ANSWER: 010 (1.00)
B.
REFERENCE:
Technical Specifications, Section 2.1.

ANSWER: 011 (1.00)
A.
REFERENCE:
SOP Implementing Procedure For A Personnel Injury.

ANSWER: 012 (1.00)
C.
REFERENCE:
Emergency Preparedness Plan, pg. 9.

ANSWER: 013 (1.00)
B.
REFERENCE:
SOP Reactor Startup.

ANSWER: 014 (1.00)
A.
REFERENCE:
SOP Pneumatic System Operation.

ANSWER: 015 (1.00)
C.
REFERENCE:
TA&M Technical Specifications, Section 3.5.1.

ANSWER: 016 (1.00)
D.
REFERENCE:
TA&M Technical Specifications, Section 3.6.1.

ANSWER: 017 (1.00)
C.
REFERENCE:
TA&M Technical Specifications, Section 3.1.4.

ANSWER: 018 (1.00)
C.
REFERENCE:
SOP NSC Access Control.

ANSWER: 019 (1.00)
D.
REFERENCE:
SOP Pulsing Operation.

ANSWER: 020 (1.00)
D.
REFERENCE:
$DR_1d_1^2 = DR_2d_2^2$; $(25)(100) = DR_2(9)$; DR_2 = 277 mrem/hour.
Total dose received = (277 mrem/hour)(1.5 hours) = 417 mrem.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
B.
REFERENCE:
SAR, page 93.

ANSWER: 002 (1.00)
A.
REFERENCE:
SAR, page 38.

ANSWER: 003 (1.00)
C.
REFERENCE:
SAR, page 14.

ANSWER: 004 (1.00)
B.
REFERENCE:
SAR, page 76.

ANSWER: 005 (1.00)
C.
REFERENCE:
SOP Pulsing Operation.

ANSWER: 006 (1.00)
C.
REFERENCE:
SAR, page 119.

ANSWER: 007 (2.00)
A,3; B,1; C,2; D,2
REFERENCE:
SAR, pages 91-96.

ANSWER: 008 (1.00)
C.
REFERENCE:
SAR, page 93.

ANSWER: 009 (1.00)
A.
REFERENCE:
SAR, page 65.

ANSWER: 010 (1.00) QUESTION DELETED
A.
REFERENCE:
SAR, page 26.

ANSWER: 011 (1.00)
B.
REFERENCE:
SAR pg. 10.

ANSWER: 012 (1.00)
A.
REFERENCE:
SAR, page 14.

ANSWER: 013 (1.00)
B.
REFERENCE:
SOP IV-D.2, Beam Port Experiments.

ANSWER: 014 (1.00)
C.
REFERENCE:
SAR pg. 112.

ANSWER: 015 (1.00)
B.
REFERENCE:
SAR, page 18.

ANSWER: 016 (1.00)
B.
REFERENCE:
SOP III-R, Evacuation Horn System Surveillance.

ANSWER: 017 (1.00)
B.
REFERENCE:
SOP V-A, Demineralizer System.

ANSWER: 018 (2.00)
A,1; B,1; C,3; D,1
REFERENCE:
SAR pg. 91-93.

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 ______
020	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 *****)

EQUATION SHEET

$Q = m\, c_p\, \Delta T$	$CR_1\,(1-K_1) = CR_2\,(1-K_2)$
$P = P_0\, 10^{SUR(t)}$	$P = P_0\, e^{(t/\tau)}$
$\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$	$\lambda_{eff} = 0.1$ seconds^{-1}
$DR_1 D_1^2 = DR_2 D_2^2$	$DR = DR_o e^{-\lambda t}$
$DR = 6CiE/D^2$	$\rho = (K - 1)/K$
1 Curie = $3.7\text{x}10^{10}$ dps	1 gallon water = 8.34 pounds
$°F = 9/5\,°C + 32$	1 Mw = $3.41\text{x}10^{6}$ BTU/hr
$°C = 5/9\,(°F - 32)$	1 Mev = $1.6\text{x}10^{-13}$ watt-sec