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

REPORT NO.:	50-128/OL-99-02
FACILITY DOCKET NO.:	50-128
FACILITY LICENSE NO.:	R-83
FACILITY:	Texas A&M University
EXAMINATION DATES:	October 6-8, 1999
EXAMINER:	Warren J. Eresian, Chief Examiner
SUBMITTED BY:	Warren J. Eresian, Chief Examiner — Date: 11/1/99

SUMMARY:

The NRC administered initial license examinations to two Senior Reactor Operator (Upgrade) applicants, two Reactor Operator applicants, one Senior Reactor Operator (Instant) applicant, and two Reactor Operator retake applicants. One Reactor Operator retake applicant failed the examination, all other applicants passed the examination.

REPORT DETAILS

1. Examiner:

   Warren J. Eresian, Chief Examiner

2. Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	Total (Pass/Fail)
NRC Grading:	3/1	3/0	6/1

3. Written Examination:

   The written examination was waived for the two Senior Reactor Operator (Upgrade) applicants. One Reactor Operator retake applicant failed the written examination. All other applicants passed the examination.

4. Operating Test:

   The operating test was waived for the two Reactor Operator retake applicants. All other applicants passed the operating test.

5. Exit Meeting:

   An exit meeting was held on October 7, 1999. Present were:

   Warren J. Eresian, NRC Chief Examiner
   Alfred Sanchez, Texas A&M Reactor Supervisor

   The NRC thanked the staff of the reactor facility for their cooperation during the examinations. Mr. Sanchez provided comments on the written examination.

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

FACILITY: Texas A&M University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 10/06/99

REGION: 4

CANDIDATE:_____

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers one side ONLY. Attach any answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each category is required to pass the examination.

Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20	33.3	_____	_____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	33.3	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20	33.3	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60			_____% FINAL GRADE	

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

_____
Candidate's Signature

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 - going from 1% to 6% of rated power.

b. 10% of rated power - going from 10% to 20% of rated power.

c. 30% of rated power - going from 20% to 50% of rated power.

d. 50% of rated power - going from 50% to 100% of rated power.

QUESTION: 002 (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 full power?

a. Production of delayed neutrons.

b. Subcritical multiplication of neutrons.

c. Spontaneous fission of U-238.

d. Decay of fission products.

QUESTION: 003 (1.00)

A reactor with an initial population of 24000 neutrons is operating with $K_{eff} = 1.01$. 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. 25

b. 238

c. 2500

d. 24240

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

QUESTION: 004 (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 precursors, which is approximately:

a. 20 seconds.

b. 40 seconds.

c. 55 seconds

d. 80 seconds.

QUESTION: 005 (1.00)

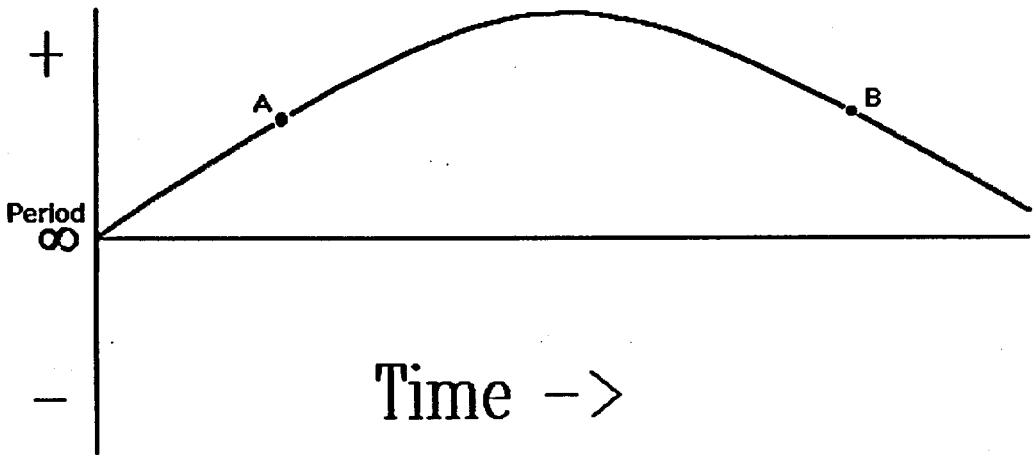
Shown below is a trace of reactor period as a function of time. Between points A and B, reactor power is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



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

QUESTION: 006 (1.00)

You enter the control room and observe that the neutron instrumentation indicates a steady neutron level with no rods in motion. Which ONE condition below CANNOT be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source is in the core.

QUESTION: 007 (1.00)

Which ONE of the following describes the response of the reactor to EQUAL amounts of reactivity insertion as the reactor approaches critical (K_{eff} =1.0)?

a. The change in neutron population per reactivity insertion is smaller, and it requires a longer time to reach a new equilibrium count rate.

b. The change in neutron population per reactivity insertion is larger, and it requires a longer time to reach a new equilibrium count rate.

c. The change in neutron population per reactivity insertion is larger, and it takes an equal amount of time to reach a new equilibrium count rate.

d. The change in neutron population per reactivity insertion is smaller, and it requires a shorter time to reach a new equilibrium count rate.

QUESTION: 008 (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 factor 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: 009 (1.00)

A reactor pool contains 106, 000 gallons of water at 90 degrees F, and it heats up to 93 degrees F in two hours. Assuming no ambient losses, the calculated power level is:

a. 93 kW.

b. 259 kW.

c. 389 kW.

d. 777 kW.

QUESTION: 010 (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.

QUESTION: 011 (1.00)

Neutrons released by fission are called fast neutrons because they:

a. appear immediately following the fission.

b. are responsible for fast fissions.

c. decay rapidly to stable levels.

d. are at a high kinetic energy level.

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

QUESTION: 012 (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: 013 (1.00)

Which ONE of the following parameter changes will require control rod INSERTION to maintain constant power level following the change?

a. Removal of an experiment containing cadmium.

b. Insertion of a void into the core.

c. Pool water temperature increase.

d. Buildup of samarium in the core.

QUESTION: 014 (1.00)

Which ONE of the following is the time period during which the MAXIMUM amount of Xenon-135 will be present in the core?

a. 10 to 12 hours after a startup to 100% power.

b. 4 to 6 hours after a power increase from 50% to 100%.

c. 4 to 6 hours after a power decrease from 100% to 50%.

d. 10 to 12 hours after shutdown from 100% power.

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

QUESTION: 015 (1.00)

The reactor is operating in the automatic mode at 50% power. A problem in the secondary cooling system causes the primary coolant temperature to increase by 5 degrees F. Given that the primary coolant temperature coefficient is -7.0×10^{-5} Δ k/k/deg. F and the differential rod worth of the regulating rod is 8.75×10^{-5} Δk/k/inch, the change in the position of the regulating rod will be:

a. eight (8) inches in.

b. eight (8) inches out.

c. four (4) inches in.

d. four (4) inches out.

QUESTION: 016 (1.00)

A reactor is operating at a steady-state power level of 1.000 kW. Power is increased to a new steady-state value of 1.004 kW. At the higher power level, K_{eff} is:

a. 1.004

b. 1.000

c. 0.004

d. 0.000

QUESTION: 017 (1.00)

FLIP fuel contains a higher enrichment of U^{235}. Which ONE of the following is the reason for the addition of Erbium to FLIP fuel?

a. Erbium has a high scattering cross-section thereby increasing the amount of neutrons absorbed by U^{238} in the epithermal range.

b. Erbium has a high absorption cross-section for thermal neutrons, thereby, increasing the relative worth of neutrons absorbed by U^{238} in the epithermal range.

c. Erbium has a high absorption cross-section for epithermal neutrons, thereby compensating for the reduction in U^{238}.

d. Erbium has a low absorption cross-section for thermal neutrons, thereby increasing the relative worth of the control rods.

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

QUESTION: 018 (1.00)

During fuel loading, which ONE of the following will have NO effect on the shape of the 1/M plot?

a. The order of fuel placement.

b. The source strength.

c. The location of the source in the core.

d. The location of the detector (or detectors) in the core.

QUESTION: 019 (1.00)

Two critical reactors are identical except that Reactor 1 has a beta fraction of 0.0072 and Reactor 2 has a beta fraction of 0.0060. An equal amount of positive reactivity is inserted into both reactors. Which ONE of the following will be the response of Reactor 2 compared to Reactor 1?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be longer.

d. The resulting period will be shorter.

QUESTION: 020 (1.00)

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

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

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

a. 0.698

b. 0.702

c. 0.704

d. 0.708

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

QUESTION: 001 (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.

QUESTION: 002 (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: 003 (1.00)

The dose rate from a mixed beta-gamma source is 100 mrem/hour at a distance of one (1) foot, and is 0.1 mrem/hour at a distance of twenty (20) feet. What percentage of the source consists of beta radiation?

a. 20%.

b. 40%.

c. 60%.

d. 80%.

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

QUESTION: 004 (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: 005 (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: 006 (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 and 10.5.

c. Maintain water clarity to facilitate completion of Tech. Spec. required surveillances.

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

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

QUESTION: 007 (1.00)

Which ONE of the people below can authorize the removal of red tags?

a. Any NSC staff member.

b. The senior reactor operator.

c. Either the senior reactor operator or reactor operator.

d. Any member of NSC management.

QUESTION: 008 (1.00)

Two point sources have the same curie strength. Source A's gammas have an energy of 1 MEV whereas Source B's gamma have an energy of 2 MEV. You obtain a reading from the same Geiger counter 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. Both readings are the same.

d. The reading from Source B is half that of Source A.

QUESTION: 009 (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: 010 (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: 011 (1.00)

You observe a loss of reactor pool water which can be controlled by adding makeup water. In accordance with the Emergency Plan, the 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: 012 (1.00)

A system or component is defined as "operable" by Technical Specifications if:

a. a channel check has been performed.

b. it is capable of performing its intended function.

c. it has no outstanding testing requirements.

d. a functional test has been performed.

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

QUESTION: 013 (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 time = 1.5 seconds.

c. An excess reactivity = $2.20.

d. Steady state power level of 1.2 megawatts for purposes of testing.

QUESTION: 014 (2.00)

Select the MODE (steady state, pulse) from Column II when the Safety Channels from Column I are required to be operable. Modes may be used once, more than once, or not at all.

	Column I (Safety Channel)	Column II (Mode)
a.	Fuel Element Temperature	1. Steady State only
b.	Preset timer	2. Both modes
c.	Transient Rod Position	3. Pulse only
d.	Log Power	

QUESTION: 015 (1.00)

In accordance with the Emergency Classification Guide, all alarms from the Facility Air Monitor System are classified as Operational Events with the exception of:

a. Stack Particulate Monitor.

b. Building Gas Monitor.

c. Fission Gas Monitor.

d. Stack Gas Monitor.

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

QUESTION: 016 (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 with reactivity worths greater than $1.00.

d. removing the reactor key from the control console.

QUESTION: 017 (1.00)

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

a. Shutdown margin = 20 cents.

b. Entry door to reactor building open to bring in equipment.

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)

Limiting Safety System Settings used to prevent exceeding a Safety Limit:

a. must actuate automatically before the limit is exceeded.

b. can be exceeded during transients.

c. can be changed by the Reactor Safety Board.

d. apply only in the steady state mode of operation.

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

QUESTION: 019 (1.00)

Which ONE of the following does not require the direct supervision (i.e., presence) of an SRO?

a. Movement of the reactor bridge.

b. Initiation of a pulse.

c. Removal of a control rod.

d. Performance of a power calibration of the Linear Power Channel.

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

QUESTION: 001 (1.00)

The fuel temperature signal for the fuel temperature scram is determined by:

a. an instrumented fuel rod located on the periphery of the core that has three thermocouples imbedded in the fuel.

b. an instrumented fuel rod that has three thermocouples imbedded in the fuel. The three thermocouples are averaged to determine fuel temperature.

c. an instrumented fuel rod that has three thermocouples imbedded in the fuel. One of the three thermocouples can be selected by disconnects at the reactor bridge.

d. three instrumented fuel rods that each have a single thermocouple inserted in the instrumented rod. The rod to be used for monitoring fuel temperature can be selected by disconnects at the reactor bridge.

QUESTION: 002 (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: 003 (1.00)

A shutdown of the air handler units has occurred causing a facility isolation. Which ONE of the air monitoring systems below initiated this response?

a. Stack Fission Product monitor

b. Building Particulate Activity

c. Building Gas Activity

d. Stack Particulate Activity

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

QUESTION: 004 (1.00)

Which ONE of the following identifies the fuel element design parameter that is different between FLIP fuel and standard TRIGA fuel?

a. U-235 enrichment.

b. Uranium content of the fuel (percent).

c. Fuel-moderator material.

d. Cladding material.

QUESTION: 005 (1.00)

A leak has developed in the heat exchanger during operation with both the primary and secondary pumps in operation. As a result:

a. level in the reactor pool will increase and automatic level control will makeup water to the secondary.

b. level in the reactor pool will be maintained by automatic makeup and level in the cooling tower basin will increase.

c. level in the reactor pool will increase and water will have to be made up to the secondary to makeup for losses to the primary.

d. level in the reactor pool will decrease and the level in the cooling tower basin will increase.

QUESTION: 006 (1.00)

Which ONE of the following statements correctly describes system response for a pool level drop to less than 90%?

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.

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

QUESTION: 007 (1.00)

Control rods have fueled followers in order to:

a. enhance their control characteristics.

b. provide excess reactivity and extend core life.

c. increase the effectiveness for reactor pulsing.

d. decrease the core excess.

QUESTION: 008 (1.00)

The facility is divided into three zones of negative pressure for isolation of contaminated area. Rate each of the three areas given (beam ports (BP), control room (CR) and main research areas (MRA) from LEAST negative pressure to MOST negative pressure.

a. CR, MRA, BP

b. BP, MRA, CR

c. BP, CR, MRA

d. CR, BP, MRA

QUESTION: 009 (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.

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

QUESTION: 010 (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. regulating rod control shifts back to manual.

b. the reactor scrams.

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

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

QUESTION: 011 (1.00)

Assume a reactor scram has occurred from an initial shim-safety rod position of 45.0%. Which one of the following correctly describes the indications the RO would expect to see on the shim-safety rod #3 control unit immediately following the scram? Assume no operator action.

a. ENGAGED light off, ROD DOWN light energized, CARR DOWN light off, digital indication 0.0%.

b. ENGAGED light off, ROD DOWN light energized, CARR DOWN light off, digital indication 45.0%.

c. ENGAGED light off, ROD DOWN light energized, CARR DOWN light energized, digital indication 45.0%.

d. ENGAGED light energized, ROD DOWN light off, CARR DOWN light off, digital indication 0.0%.

QUESTION: 012 (1.00)

Which ONE of the following is the purpose of the graphite slugs located at the top and bottom of each fuel rod?

a. To absorb neutrons, thereby reducing neutron embrittlement of the upper and lower guide plates.

b. To absorb neutrons, thereby reducing neutron leakage from the core.

c. To reflect neutrons, thereby reducing neutron leakage from the core.

d. To couple neutrons from the core to the nuclear instrumentation, thereby decreasing neutron shadowing effects.

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

QUESTION: 013 (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. accomodate 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.

QUESTION: 014 (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: 015 (1.00)

More than 95% of the facility's Ar-41 is produced:

a. in the beam ports.

b. in the pneumatic system.

c. in the reactor building atmosphere.

d. in the reactor pool.

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

QUESTION: 016 (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.

QUESTION: 017 (1.00)

IRRADIATED fuel elements are stored in which one of the following locations?

a. Fuel storage room in approved shipping containers.

b. Fuel storage room in cadmium lined Aluminum tubes.

c. Radioisotope storage pits on the floor of the pool.

d. Storage racks on the floor of the pool.

QUESTION: 018 (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.

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

QUESTION: 019 (2.00)

Match the nuclear instrumentation channel in column B that satisfies the control function in column A. (the items in column B may be used once, more than once or not at all; and only a single answer may occupy one answer space in column A)

Column A (control function)		Column B (nuclear instrument)
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 & FACILITY OPERATING CHARACTERISTICS

ANSWER SHEET

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

001	a	b	c	d_____
002	a	b	c	d_____
003	a	b	c	d_____
004	a	b	c	d_____
005	a	b	c	d_____
006	a	b	c	d_____
007	a	b	c	d_____
008	a	b	c	d_____
009	a	b	c	d_____
010	a	b	c	d_____
011	a	b	c	d_____
012	a	b	c	d_____
013	a	b	c	d_____
014	a	b	c	d_____
015	a	b	c	d_____
016	a	b	c	d_____
017	a	b	c	d_____
018	a	b	c	d_____
019	a	b	c	d_____
020	a	b	c	d_____

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

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER SHEET

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

001 a b c d_____

002 a b c d_____

003 a b c d_____

004 a b c d_____

005 a b c d_____

006 a b c d_____

007 a b c d_____

008 a b c d_____

009 a b c d_____

010 a b c d_____

011 a b c d_____

012 a b c d_____

013 a b c d_____

014 a_____b_____ c_____ d_____

015 a b c d_____

016 a b c d_____

017 a b c d_____

018 a b c d_____

019 a b c d_____

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

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER SHEET

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

001 a b c d_____

002 a b c d_____

003 a b c d_____

004 a b c d_____

005 a b c d_____

006 a b c d_____

007 a b c d_____

008 a b c d_____

009 a b c d_____

010 a b c d_____

011 a b c d_____

012 a b c d_____

013 a b c d_____

014 a b c d_____

015 a b c d_____

016 a b c d_____

017 a b c d_____

018 a b c d_____

019 a_____b_____ c_____ d_____

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

EQUATION SHEET

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

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

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

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

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

$DR_1D_1^2 = DR_2D_2^2$

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

$DR = 6CiE/D^2$

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

$1 \text{ ft}^3 \text{ (water)} = 7.48 \text{ gallons}$

1 kW = 3413 Btu/hour

1 gallon (water) = 8.34 pounds

°F = 9/5°C + 32

°C = 5/9 (°F - 32)

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-4. Largest value of $P/P_o = e^{t/\tau}$.

ANSWER: 002 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-23.

ANSWER: 003 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-11.
24000 neutrons in current generation X 1.01 = 24240 neutrons in next generation.
24240 neutrons in next generation - 24000 neutrons in current generation = 240 neutrons added.
240 neutrons added - 0.7% delayed neutron fraction = 238 prompt neutrons added.

ANSWER: 004 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-13.

ANSWER: 005 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-4.
Since the period is always positive, power must be increasing.

ANSWER: 006 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-21.

ANSWER: 007 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 5-7.

ANSWER: 008 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-15.

ANSWER: 009 (1.00)
C.
REFERENCE:
Power = $mc\Delta T/\Delta t$, where: m=106,000 gallons x 8.34 lbs/gal = 884,040 lb; c=1 Btu/°F-lb; $\Delta T/\Delta t$ = 1.5 degrees/hour. Power = 1,326,060 Btu/hour; 3413 Btu/hour = 1 kW. Power = 1,326,060/3413 = 389 kW

ANSWER: 010 (1.00)
C.
REFERENCE:
TA&M SAR, Figure 3-21.

ANSWER: 011 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-32.

ANSWER: 012 (1.00)
C.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 2-39.

ANSWER: 013 (1.00)
A.
REFERENCE:
Insertion of a control rod inserts negative reactivity to balance the positive reactivity added when removing a neutron absorber. All other answers add negative reactivity.

ANSWER: 014 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 8-10.

ANSWER: 015 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 8-10.
Since the coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn. $7x5x10^{-5}/8.75x10^{-5} = 4$ inches.

ANSWER: 016 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-21.

ANSWER: 017 (1.00)
C.
REFERENCE:
TA&M SAR, pg. 50.

ANSWER: 018 (1.00)
B.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 5-18.

ANSWER: 019 (1.00)
D.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-33.

ANSWER: 020 (1.00)
A.
REFERENCE:
R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 3-13.
Since K_{eff} is being reduced from supercritical to critical, the thermal utilization factor must be less than its original value.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
D.
REFERENCE:
SOP II-D.6, Steady State Operation.

ANSWER: 002 (1.00)
B.
REFERENCE:
SOP II-C.5, Reactor Startup.

ANSWER: 003 (1.00)
C.
REFERENCE:
At twenty feet, the dose rate consists only of gamma radiation. The gamma dose rate at one foot is: $DR_1d_1^2 = DR_2d_2^2$; $(DR_1)(1) = (0.1)(400)$; $DR_1 = 40$ mrem/hour.
The beta dose rate at one foot is 60 mrem/hour = 60%.

ANSWER: 004 (1.00)
A.
REFERENCE:
TA&M Technical Specifications, Table 1.

ANSWER: 005 (1.00)
A.
REFERENCE:
SOP IV-C.2, Pneumatic System Operation.

ANSWER: 006 (1.00)
D.
REFERENCE:
TA&M Technical Specifications, Section 3.8, Bases.

ANSWER: 007 (1.00)
B.
REFERENCE:
SOP VI-D.5, System Tagout Procedure.

ANSWER: 008 (1.00)
C.
REFERENCE:
GM tubes are not sensitive to energy.

ANSWER: 009 (1.00)
C.
REFERENCE:
TA&M Technical Specifications, Section 3.5.1.

ANSWER: 010 (1.00)
D.
REFERENCE:
TA&M Technical Specifications, Section 3.6.1.

ANSWER: 011 (1.00)
D.
REFERENCE:
SOP IX-D, Implementing Procedure For A Pool Level Alarm.

ANSWER: 012 (1.00)
B.
REFERENCE:
TA&M Technical Specifications, Section 1.18.

ANSWER: 013 (1.00)
B.
REFERENCE:
TA&M Technical Specifications, Section 3.2.3.

ANSWER: 014 (2.00)
A,2; B,3; C,1; D,2
REFERENCE:
TA&M Technical Specifications, Table 1.

ANSWER: 015 (1.00)
C.
REFERENCE:
SOP IX-A, Emergency Classification Guide.

ANSWER: 016 (1.00)
D.
REFERENCE:
SOP II-F.2, Reactor Shutdown.

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

ANSWER: 018 (1.00)
A.
REFERENCE:
TA&M Technical Specifications, Section 2.2.

ANSWER: 019 (1.00)
D.
REFERENCE:
SOP II-J, Power Calibration.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
C.
REFERENCE:
SAR pgs. 18, 96, & 97.

ANSWER: 002 (1.00)
B.
REFERENCE:
SOP IV-D.2, Beam Port Experiments.

ANSWER: 003 (1.00)
D.
REFERENCE:
SAR pg. 119.

ANSWER: 004 (1.00)
A.
REFERENCE:
SAR pg. 18.

ANSWER: 005 (1.00)
D.
REFERENCE:
SAR pg. 65.

ANSWER: 006 (1.00)
C.
REFERENCE:
SAR pg. 112.

ANSWER: 007 (1.00)
B.
REFERENCE:
SAR pg. 10.

ANSWER: 008 (1.00)
A.
REFERENCE:
SAR pg. 79.

ANSWER: 009 (1.00)
B.
REFERENCE:
SOP III-R, Evacuation Horn System Surveillance.

ANSWER: 010 (1.00)
A.
REFERENCE:
SAR pg. 93.

ANSWER: 011 (1.00)
B.
REFERENCE:
SAR pgs. 26-29, 99.

ANSWER: 012 (1.00)
C.
REFERENCE:
SAR pg. 14.

ANSWER: 013 (1.00)
A.
REFERENCE:
SAR pg. 14.

ANSWER: 014 (1.00)
C.
REFERENCE:
SAR pg. 38.

ANSWER: 015 (1.00)
D.
REFERENCE:
SAR pg. 116.

ANSWER: 016 (1.00)
A.
REFERENCE:
SAR pg. 65.

ANSWER: 017 (1.00)
D.
REFERENCE:
SAR pg. 107.

ANSWER: 018 (1.00)
B.
REFERENCE:
SOP V-A, Demineralizer System.

ANSWER: 019 (2.00)
A,1; B,1; C,3; D,1
REFERENCE:
SAR pg. 91-93.