August 22, 2000

Mr. Ray Tsukimura, President
Aerotest Operations, Inc.
3455 Fostoria Way
San Ramon, CA 94583

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-228/OL-00-01

Dear Mr. Tsukimura:

During the week of July 31, 2000, the NRC administered initial examinations to an employee of your facility who had applied for a license to operate your Aerotest Operations reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be 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/

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

Docket No. 50-228

Enclosures: 1. Initial Examination Report No. 50-228/OL-00-01
2. Examination and answer key

cc w/encls:
Please see next page

cc:

Director
Energy Facilities Siting Division
Energy Resources Conservation
and Development Commission
1516 9th Street
Sacramento, CA 95814

Mr. Steve Hsu
Radiological Health Branch
State Department of Health Services
P. O. Box 942732
Sacramento, CA 94234-7340

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cc w/encls:
Please see next page

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

DISTRIBUTION w/o encls.:
REXB r/f
WEresian
LMarsh/LHowell

ADAMS ACCESSION #: ML003741955 **TEMPLATE #: NRR-074**

OFFICE	DIPM:IOLB		REXB:CE		REXB:BC	
NAME	EBarnhill		WEresian		LMarsh	
DATE	08/22/2000		08/18/2000		08/22/2000	

C = COVER **E = COVER & ENCLOSURE** **N = NO COPY**
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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-228/OL-00-01

FACILITY DOCKET NO.: 50-228

FACILITY LICENSE NO.: R-98

FACILITY: Aerotest Operations, Inc.

EXAMINATION DATES: August 1-2, 2000

EXAMINER: Warren Eresian, Chief Examiner

SUBMITTED BY: _____ 08/ /2000
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of July 31, 2000, the NRC administered an operator licensing examination to one Senior Reactor Operator (Instant) candidate. The candidate passed the operating test, but failed Category B of the written examination.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

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

3. Exit Meeting:

Ms. Sandra Warren
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 question was modified:

Category B

Question 12: Accept C or D as correct answers.

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

FACILITY: Aerotest

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 08/02/00

REGION: 4

CANDIDATE:_____

INSTRUCTIONS TO CANDIDATE:

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

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

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20	34.5	_____	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	34.5	_____	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
18	31.0	_____	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
58	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 subcritical with a K_{eff} of 0.955. A positive reactivity of $1.00 is inserted into the core (β = 0.0073). At this point, the reactor is:

a. subcritical.

b. exactly critical.

c. supercritical.

d. prompt critical.

QUESTION: 002 (1.00)

Which ONE of the following isotopes is most likely to slow down neutrons quickly, i.e., produce the greatest energy loss per collision?

a. U-238.

b. Xe-135.

c. O-16.

d. H-1.

QUESTION: 003 (1.00)

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

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

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

a. 0.698

b. 0.702

c. 0.704

d. 0.708

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

QUESTION: 004 (1.00)

As a reactor continues to operate over time, for a constant power level, the thermal 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: 005 (1.00)

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

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

b. recoils 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. recoils with a higher kinetic energy, with the nucleus absorbing a gamma ray.

QUESTION: 006 (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. 48 cents/inch at 18.25 inches.

c. 48 cents/inch at 18.4 inches.

d. 14.4 cents/inch only between 18.1 and 18.4 inches.

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

QUESTION: 007 (1.00)

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

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The resulting period will be longer.

d. The resulting period will be shorter.

QUESTION: 008 (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 LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

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

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

QUESTION: 009 (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.

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

QUESTION: 010 (1.00)

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

a. absorption/(production + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. production/(absorption + leakage)

QUESTION: 011 (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: 012 (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.

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

QUESTION: 013 (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: 014 (1.00)

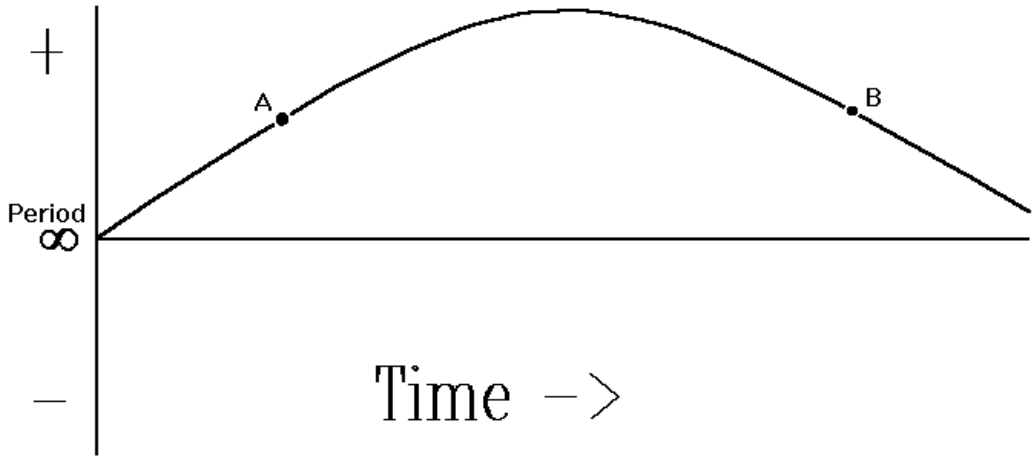
Shown below is a trace of reactor period as a function of time. Between points A and B, reactor power is:

a. continually increasing.

b. increasing, then decreasing.

c. continually decreasing.

d. constant.



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

QUESTION: 015 (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 out of the core.

QUESTION: 016 (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: 017 (1.00)

A reactor with an initial population of $1x10^8$ neutrons is operating with a $K_{eff} = 1.001$. Considering only the increase in neutron population, how many neutrons (of the increase) will be prompt when the neutron population changes from the current generation to the next. Assume $\beta = 0.007$.

a. 700.

b. 7,000.

c. 99,300.

d. 100,000.

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

QUESTION: 018 (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 at 90% power.

d. Buildup of samarium in the core.

QUESTION: 019 (1.00)

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

a. 15 to 20 hours after a startup to 100% power.

b. 6 to 8 hours after shutdown from 100% power.

c. 6 to 8 hours after a power decrease from 100% to 50%.

d. 15 to 20 hours after a power increase from 50% to 100%.

QUESTION: 020 (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} ρ k/k/deg. F and the differential rod worth of the regulating rod is 8.75×10^{-5} ρk/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.

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

QUESTION: 001 (1.00)

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

a. Bulk water temperature = 120 degrees F.

b. Depth of water above top of the active core = 15 feet.

c. Reactivity worth of a single independent experiment = $2.00.

d. A fuel element which is not in storage or in the core lattice.

QUESTION: 002 (1.00)

A Special Work Permit is required when:

a. work is to be performed in a high radiation area.

b. personnel will be performing work in radiation areas where they are not regularly assigned.

c. a person working in a radiation area has exceeded his/her quarterly limit.

d. performing any activity in an area where radiation monitoring is required.

QUESTION: 003 (1.00)

A radiation survey of an area reveals a general radiation reading of 1 mrem/hr. There is, however, a small pipe which reads 10 mrem/hr at one (1) meter. Assuming that the pipe can be considered a point source, which ONE of the following defines the posting requirements for the area in accordance with 10CFR Part 20?

a. Restricted Area.

b. Radiation Area.

c. High Radiation Area.

d. Grave Danger, Very High Radiation Area.

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

QUESTION: 004 (2.00)

Match the 10CFR 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

QUESTION: 005 (1.00)

The Operation Area is defined as:

a. the area inside the concrete shield.

b. the area within the site boundary.

c. the high bay area.

d. the area within the perimeter fence.

QUESTION: 006 (1.00)

Reactor operations are being conducted around the clock over the weekend, during which time the Reactor Operator (RO) becomes ill and is taken to a hospital. Only a Senior Reactor Operator (SRO) and an operator trainee remain in the facility. In accordance with the Technical Specifications, reactor operations:

a. must be discontinued because both an RO and an SRO must be present at the facility.

b. must be discontinued because there is only one licensed person available.

c. may continue until a replacement RO can arrive at the facility, up to a maximum of 30 minutes.

d. may continue since the SRO can operate the facility with a second person in the facility.

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

QUESTION: 007 (1.00)

At 8:00 am, prior to the start of reactor operation, the ARRR Startup Sheet is completed in accordance with the Operating Procedures. The reactor is started up, operated, and then shutdown at 1:00 p.m., with no further operations planned for that day. However, at 4:00 p.m., the reactor is started up again for another unplanned run. As a result:

a. a new Startup Sheet must be completed.

b. a new Startup Sheet does not need to be completed, since the new startup occurs on the same day.

c. only the scram checks need to be performed before the reactor can be restarted.

d. only the instrument calibrations need to be rechecked.

QUESTION: 008 (1.00)

The licensed maximum power level for the ARRR is 250 kilowatts thermal. This means that:

a. at no time may reactor power exceed 250 kilowatts.

b. the steady state power level should not exceed 250 kilowatts, but may be exceeded temporarily for a special experiment with permission from the Reactor Safeguards Committee.

c. the reactor must automatically scram when power exceeds 250 kilowatts.

d. the steady state power level may not exceed 250 kilowatts.

QUESTION: 009 (1.00)

A survey instrument with a window probe is used to measure low energy beta and gamma radiation. The measured dose rate is 100 mrem/hr with the window open and 60 mrem/hr with the window closed. The gamma dose rate is:

a. 100 mrem/hr.

b. 60 mrem/hr.

c. 40 mrem/hr.

d. 160 mrem hr.

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

QUESTION: 010 (1.00)

While the reactor is operating, the control room radiation monitor alarms at a level > 100 mR/hr. As a result, the reactor operator should_____ and _____.

a. scram the reactor; activate the evacuation alarm.

b. notify the Senior Reactor Operator; notify Radiological Safety Officer.

c. evacuate the affected area; notify both Senior Reactor Operator and Radiological Safety Officer.

d. scram the reactor, notify Radiological Safety Officer.

QUESTION: 011 (1.00)

Which ONE of the following events does NOT require the direct presence (i.e., supervision) of a Senior Reactor Operator?

a. Movement of fuel within the reactor pool.

b. Recovery from a significant power reduction.

c. Reactor power calibration.

d. Control rod removal.

QUESTION: 012 (1.00)

Which ONE of the following maintenance surveillances must be performed quarterly?

a. Heat exchanger power calibration.

b. Control rod reactivity worth calibrations.

c. Crane position indication.

d. Control rod drive checks.

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

QUESTION: 013 (1.00)

Two point sources have the same curie strength. Source A's gammas have an energy of 1 Mev, whereas Source B's gammas have an energy of 2 Mev. You obtain a reading from the same GM tube 10 feet from each source. Concerning the two readings, which ONE of the following statements is correct?

a. The reading from Source B is four times that of Source A.

b. The reading from Source B is twice that of Source A.

c. Both readings are the same.

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

QUESTION: 014 (2.00)

Match each of the core components or reactor parameters in Column A with the correct reactivity limit Column B. Limits in Column B may be used once, more than once, or not at all.

	Column A		Column B
a.	Maximum excess reactivity above cold, clean critical.	1.	$0.50
b.	Minimum shutdown margin.	2.	$1.00
c.	Reactivity of a single, independent experiment.	3.	$2.00
d.	Reactivity of a single, independent moveable experiment.	4.	$3.00

QUESTION: 015 (1.00)

In order to maintain an active reactor operator or senior reactor operator license, the license-holder must perform the functions of his/her position for at least:

a. four hours per calendar quarter.

b. three hours per calendar quarter.

c. one hour per month.

d. forty hours per year.

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

QUESTION: 016 (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 procedure that details the implementation actions and methods required to achieve the objectives of the Emergency Plan.

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

QUESTION: 017 (1.00)

Which ONE of the following safety system functions does NOT result in a scram?

a. Seismic disturbance.

b. Low neutron flux, Channel 3 & 4.

c. Low source level, Channel 1.

d. Building gas effluent monitor.

QUESTION: 018 (1.00)

During reassembly of the reactor core following removal of control rods, each fuel element must be replaced in its exact predisassembled position because:

a. there may be differences in the seating surfaces of the fuel elements.

b. the nuclear characteristics of the core are known for this configuration.

c. differences in fuel element geometry may interfere with control rod movement.

d. differences in fuel element geometry may change coolant flow.

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

QUESTION: 001 (1.00)

Primary cooling water is swirled in a spiral by the return outlet in order to:

a. enhance natural circulation flow.

b. lower radiation levels in the reactor room.

c. provide mixing of the coolant to promote heat transfer.

d. reduce the differential temperature across the core.

QUESTION: 002 (1.00)

The pool cooling water system is activated at crossover in order to:

a. delay the time required for induced radioactivity to reach the top of the pool.

b. ensure that the pool water radioactivity monitors are functioning properly.

c. cool the pool water at higher power levels.

d. ensure that makeup water is provided to maintain pool level.

QUESTION: 003 (1.00)

Which ONE of the following conditions will allow the regulating rod to drive out of the core?

a. Channel 1 < 120 cps.

b. Safety rod withdrawn halfway out of the core.

c. Safety rod control cable unplugged from the control chassis.

d. Both UP switches of the regulating rod and shim rod depressed.

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

QUESTION: 004 (1.00)

Which ONE of the following ventilation systems is NOT controlled by the Emergency Shutoff?

a. High Bay Air Conditioner.

b. High Bay Heaters.

c. Rest Room Vent Fan.

d. Quality Control Complex Air Conditioner.

QUESTION: 005 (1.00)

The suction for the primary cooling loop is located near the top of the reactor pool in order to:

a. ensure that cooling water does not bypass the core.

b. remove radioactive water from near the top of the pool.

c. prevent pumping water out of the pool to a level less than 16 feet above the core.

d. promote mixing of the pool water to ensure efficient heat transfer.

QUESTION: 006 (1.00)

Which ONE set of equations below describes the operation of the installed neutron source?

a. Am -> Np + alpha
Be + alpha -> C + neutron

b. Am -> Cm + beta
Be + beta -> Li + neutron

c. Am -> Np + alpha
B + alpha -> N + neutron

d. Am -> Cm + beta
B + beta -> Be + neutron

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

QUESTION: 007 (1.00)

In order to reduce coolant system losses in the primary or demineralizer system:

a. moisture sensors in the trench will cause the primary and demineralizer pumps to shut off.

b. radiation sensors in the trench will cause the primary and demineralizer pumps to shut off.

c. low pool level will cause the primary and demineralizer pumps to shut off.

d. moisture sensors in the trench will close primary and demineralizer system isolation valves.

QUESTION: 008 (1.00)

Demineralizer system flow rate is measured using a rotary vane flow switch installed:

a. at the suction of the demineralizer pump.

b. at the outlet of the demineralizer.

c. at the inlet to the string filter.

d. at the inlet to the demineralizer.

QUESTION: 009 (1.00)

When the primary pump is started manually:

a. the secondary pump must be started manually.

b. the secondary pump automatically starts.

c. the secondary pump starts automatically only if the primary coolant temperature is > 80 deg. F.

d. it will turn off when the primary coolant temperature is < 80 deg. F.

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

QUESTION: 010 (1.00)

Following a reactor scram, the control rod motor will drive the magnet down because:

a. contact is broken with the magnet up limit switch.

b. the contact switch between the magnet and armature opens, signaling that there is no longer contact between the magnet and armature.

c. the rod down switch is activated.

d. magnet current has been interrupted.

QUESTION: 011 (1.00)

The CRITICALITY monitor alarms. The probable cause of this alarm is:

a. high radiation in the pool water.

b. high radiation in the reactor bay.

c. high radiation at the roof vent.

d. high radiation within the demineralizer system.

QUESTION: 012 (1.00)

When the roof vent radiation monitor alarms, which ONE of the following occurs?

a. The reactor scrams.

b. The high bay air conditioner shuts off.

c. A siren sounds.

d. No action occurs.

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

QUESTION: 013 (1.00)

The main cooling tower fan operation is controlled by:

a. the temperature of secondary water in the cooling tower pool.

b. the temperature of primary water entering the heat exchanger.

c. the temperature of secondary water leaving the heat exchanger.

d. the temperature of primary water leaving the heat exchanger.

QUESTION: 014 (1.00)

Which ONE of the following describes the purpose of the potentiometer in the control rod rive system?

a. Provides a variable voltage to the rod drive motor.

b. Provides rod position indication.

c. Provides the voltage required to reset the magnet current.

d. Provides the voltage for activating the magnet and rod UP and DOWN limit switches.

QUESTION: 015 (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 limit switch.

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

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

QUESTION: 016 (1.00)

Which ONE of the following describes how a graphite reflector element can be distinguished from a fuel element?

a. The spacer block at the top of the element is colored blue.

b. The element is slightly longer.

c. The weight is different.

d. The top end fitting is machined to a unique shape.

QUESTION: 017 (2.00)

Match the scrams listed in Column A with the nuclear instrumentation detector types listed in Column B. Column B answers may be used once, more than once, or not at all.

	Column A		Column B
a.	Short period.	1.	Compensated Ion Chamber and Proportional Counter.
b.	Low count rate.	2.	Uncompensated Ion Chamber and Proportional Counter.
c.	High flux.	3.	Proportional Counter.
d.	Low flux.	4.	Compensated Ion Chamber and Uncompensated Ion Chamber.

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

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

QUESTION: 001 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-11.
When k_{eff} = 0.955, ρ = -0.0471 delta k/k; $1.00 = +0.0073 delta k/k.
-0.0471 + 0.0073 delta k/k = -0.0398 delta k/k, therefore reactor is subcritical.

QUESTION: 002 (1.00)
D.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-7.

QUESTION: 003 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-5.
Since negative reactivity is inserted, the value for thermal utilization must drop.

QUESTION: 004 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page 3.6.

QUESTION: 005 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 3, page 2.7.

QUESTION: 006 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 1, Section IV, page 4.
ρρ = 14.4 cents; ρx = 18.4 - 18.1 = 0.3 inches; ρρ/ρx = 48 cents/inch at the midpoint (18.25 inches).

QUESTION: 007 (1.00)
D.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-14.

QUESTION: 008 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-17.

QUESTION: 009 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-4.

QUESTION: 010 (1.00)
D.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-3.

ANSWER: 011 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-14.

ANSWER: 012 (1.00)
D.
REFERENCE:
ARRR Reactor Operator Training Manual, Glossary.

ANSWER: 013 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-17.

ANSWER: 014 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-14.
Since the period is always positive, power must be increasing.

ANSWER: 015 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-10.

ANSWER: 016 (1.00)
C.
REFERENCE:
Power = $mc\rho T/\rho t$, where: m=106,000 gallons x 8.34 lbs/gal = 884,040 lb; c=1 Btu/°F-lb; $\rho T/\rho t$ = 1.5 degrees/hour. Power = 1,326,060 Btu/hour; 3413 Btu/hour = 1 kW. Power = 1,326,060/3413 = 389 kW

ANSWER: 017 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-14.
The increase = $1x10^8x1.001$ = 100,000 neutrons. Delayed neutrons = 0.007x100,000 = 700. Prompt = 99,300.

ANSWER: 018 (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: 019 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 4, page 1-29.

ANSWER: 020 (1.00)
D.
REFERENCE:
Since the coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn. (5 deg. F)x($7x10^{-5}$ delta k/k/deg. F) / ($8.75x10^{-5}$ delta k/k/inch) = 4 inches.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (1.00)
B.
REFERENCE:
ARRR Technical Specifications, Section 4.0.

ANSWER: 002 (1.00)
B.
REFERENCE:
ARRR Radiological Safety Procedures.

ANSWER: 003 (1.00)
C.
REFERENCE:
Administrative Procedure VI, page 8.
10 mrem/hr at 1 meter (100 cm.) = 111.1 mrem/hr at 30 cm.

ANSWER: 004 (2.00)
A,4; B, 2; C, 2; D,1.
REFERENCE:
10 CFR 55

ANSWER: 005 (1.00)
C.
REFERENCE:
ARRR Emergency Plan, page 4.

ANSWER: 006 (1.00)
D.
REFERENCE:
ARRR Technical Specifications, Section 10.0.

ANSWER: 007 (1.00)
A.
REFERENCE:
ARRR Operating Procedures.

ANSWER: 008 (1.00)
D.
REFERENCE:
ARRR Facility License.

ANSWER: 009 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 5, page 8.
With the window closed, only gamma radiation penetrates the window.

ANSWER: 010 (1.00)
D.
REFERENCE:
ARRR General Emergency Procedures.

ANSWER: 011 (1.00)
C.
REFERENCE:
ARRR Critical Assembly and Power Calibration Procedures.

ANSWER: 012 (1.00)
C or D.
REFERENCE:
ARRR Maintenance Procedures.

ANSWER: 013 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page VIII-6.
GM tubes cannot distinguish between gammas of different energy.

ANSWER: 014 (2.00)
A,4; B,1; C,3; D,2.
REFERENCE:
ARRR Reactor Technical Specifications.

ANSWER: 015 (1.00)
A.
REFERENCE:
10 CFR 55.

ANSWER: 016 (1.00)
D.
REFERENCE:
ARRR Emergency Plan, Definitions.

ANSWER: 017 (1.00)
D.
REFERENCE:
ARRR Technical Specifications, Table 2.

ANSWER: 018 (1.00)
B.
REFERENCE:
ARRR Critical Assembly and Power Calibration Procedures, page 11.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page V-1.

ANSWER: 002 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page V-1.

ANSWER: 003 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page IX-7 and TS Table 2.

ANSWER: 004 (1.00)
D.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page II-3.

ANSWER: 005 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page V-3.

ANSWER: 006 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page III-11.

ANSWER: 007 (1.00)
A.
REFERENCE:
ARRR Maintenance Procedures, page 7.

ANSWER: 008 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, Figure V-3a.

ANSWER: 009 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page V-3.

ANSWER: 010 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page IX-6.

ANSWER: 011 (1.00)
B.
REFERENCE:
ARRR Technical Specifications, Section 7.0.

ANSWER: 012 (1.00)
D.
REFERENCE:
ARRR Technical Specifications, Section 7.2.

ANSWER: 013 (1.00)
A.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page V-5.

ANSWER: 014 (1.00)
B.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page III-15.

ANSWER: 015 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page IX-1.

ANSWER: 016 (1.00)
C.
REFERENCE:
ARRR Reactor Operator Training Manual, Volume 2, page III-13.

ANSWER: 017 (2.00)
A,1; B,3; C,4; D,4.
REFERENCE:
ARRR Technical Specifications, Table 2.

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 _____

(***** 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 _____

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

EQUATION SHEET

$Q = m\ c_p\ \rho T$

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

$SUR = 26.06/\rho$

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

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

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

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

$Doserate_1\ x\ D_1^2 = Doserate_2\ x\ D_2^2$

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

$DR = 6CiE/D^2$

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

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

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$°F = 9/5°C + 32$

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

$°C = 5/9\ (°F - 32)$