May 25, 2000

Dr. Wade J. Richards, Director
McClellan Nuclear Radiation Center
5335 Price Avenue
McClellan AFB, CA 95652-2504

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-607/OL-00-01

Dear Dr. Richards:

During the week of April 17, 2000, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your UCD/McClellan NRC reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be placed in the NRC Public Document Room. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Warren Eresian at 301-415-1833 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. 50-607

Enclosures: 1. Initial Examination Report No. 50-607/OL-00-01
2. Examination and answer key

cc w/encls:
Please see next page

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ADAMS ACCESSION #: ML003714852 **TEMPLATE #: NRR-074**

OFFICE	**DIPM:IOLB**		**REXB:CE**		**REXB:BC**	
NAME	**EBarnhill**		**WEresian**		**LMarsh**	
DATE	**05/ 19 /2000**		**05/ 15 /2000**		**05/ 25 /2000**	

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cc:

Dr. Wade J. Richards
5335 Price Avenue, Bldg. 258
McClellan AFB, CA 95652-2504

Dr. Kevin Smith
Vice Chancellor
University of California - Davis
One Shields Avenue
Davis, CA 95616-8558

Test, Research, and Training
Reactor Newsletter
202 Nuclear Sciences Center
University of Florida
Gainesville, FL 32611

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

REPORT NO.:	50-607/OL-00-01
FACILITY DOCKET NO.:	50-607
FACILITY LICENSE NO.:	R-130
FACILITY:	University of California - Davis/McClellan NRC
EXAMINATION DATES:	April 19-20, 2000
EXAMINER:	Warren Eresian, Chief Examiner

SUBMITTED BY: ***/RA/*** 04/28/2000
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of April 17, 2000, the NRC administered operator licensing examinations to two Senior Reactor Operator (Upgrade) candidates and three Reactor Operator Candidates. Both Senior Reactor Operator (Upgrade) candidates passed the entire examination. One Reactor Operator candidate passed the entire examination, one Reactor Operator candidate failed Category B of the written examination but passed the operating test, and one Reactor Operator candidate failed Categories A and B of the written examination and also the operating test.

ENCLOSURE 1

REPORT DETAILS

1. Examiner: Warren Eresian, Chief Examiner

2. Results:

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

3. Exit Meeting:

Dr. Wade J. Richards, Director
Ms. Angelia Weeks, Training Manager
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, Category A. As a result of their comments, questions A3, A6, and A16 were deleted. These questions pertained to items which Reactor Operators either have not seen at this facility (fuel loading, differential rod worth) or do not perform (calorimetric).

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

FACILITY: University of California-McClellan Nuclear Radiation Center

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 04/19/00

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
17	29.8	______	____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20	35.1	______	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20	35.1	______	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
57	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 4.9% delta k/k is inserted into the core. 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) DELETED

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: 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) DELETED

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)

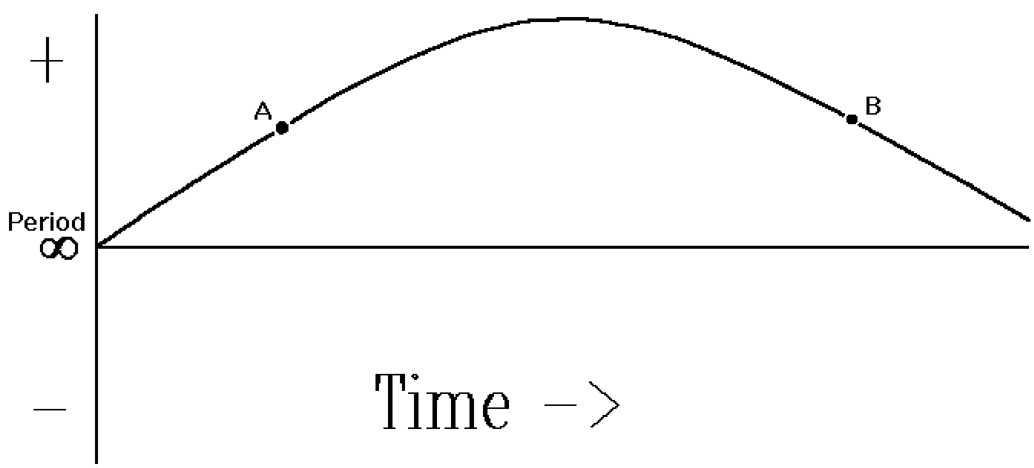
Shown below is a trace of reactor period as a function of time. Between points A and B, reactor power is:

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) DELETED

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 <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 β = 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.

d. Buildup of samarium in the core.

QUESTION: 019 (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. 10 to 12 hours after shutdown from 100% power.

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

d. 4 to 6 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. Scram time of a control rod = 1 second.

b. Depth of water above bottom of reactor tank = 23.5 feet.

c. Facility Stack Monitor out of service for maintenance.

d. Reactor room exhaust system out of service for maintenance.

QUESTION: 002 (1.00)

The measuring channel which is required to be operable in all modes of operation is the:

a. fuel temperature channel.

b. linear power channel.

c. log power channel.

d. safety channel.

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 (1.00)

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 <u>Operations Boundary</u> is defined as:

a. the reactor building and all connected structures.

b. the fence surrounding the facility.

c. the reactor room.

d. the control room.

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 the 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 who can perform prescribed instructions.

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

QUESTION: 007 (1.00)

At 8:00 am, prior to the start of reactor operation, a checkout procedure is performed in accordance with the MNRC Startup Checklist. The reactor is started up, operated, and then secured at 1:00 pm. At 4:00 pm, the reactor is started up again for an extended run into the next day. As a result:

a. a new Startup Checklist must be completed.

b. a new Startup Checklist does not need to be completed.

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

d. only the control rod interlocks need to be rechecked.

QUESTION: 008 (1.00)

“For the pulse mode of operation, the maximum insertion of reactivity shall be 1.23% delta k/k ($1.75).” 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)

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)

A RAM within the reactor facility has alarmed at a level exceeding the high set point. As a result, the reactor operator should____________ and ______________.

a. scram the reactor; manually activate the evacuation alarm.

b. notify the Senior Reactor Operator; notify Health Physics personnel.

c. evacuate the affected area; notify both Senior Reactor Operator and Health Physics Personnel.

d. scram the reactor, notify both Senior Reactor Operator and Health Physics Personnel.

QUESTION: 011 (1.00)

Following an unscheduled scram, the reactor may be restarted only after the cause of the scram has been determined by the:

a. MNRC Director.

b. Operations Supervisor.

c. Senior Reactor Operator.

d. Reactor Operator.

QUESTION: 012 (1.00)

The reactor parameter which is protected by Safety Limits is:

a. steady state power level.

b. fuel pellet temperature.

c. moderator level.

d. fuel clad temperature.

(***** 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 (1.00)

Match each of the following actions in Column A with the correct term from the Technical Specifications in Column B. Only one term from Column B may be used for each action in Column A.

	Column A		Column B
a.	Immersing a thermometer in an ice bath, then in boiling water and noting the readings.	1.	Channel Check
b.	Placing a source next to a radiation detector and observing meter movement.	2.	Channel Test
c.	Performing a determination of reactor power, then adjusting neutron instrumentation to correspond to measured power.	3.	Channel Calibration
d.	Observing the overlap between two different neutron detectors as power increases.		

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)

During fuel movement operations, the building evacuation horn annunciates. As the reactor operator in the control room, you should immediately:

a. ensure that all personnel have evacuated.

b. report to the assembly area.

c. report to the Operations Supervisor for instructions.

d. ensure that all fuel is logged in its authorized location.

QUESTION: 018 (1.00)

The removal of CAUTION tags is authorized by:

a. the SRO on duty.

b. the RO who performed the work.

c. the Maintenance System manager.

d. the individual who performed the work.

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

QUESTION: 019 (1.00)

Final approval to perform an experiment occurs when the SRO on duty signs the:

a. Experimenter Approval Request.

b. Experiment Request.

c. Reactor Facility Irradiation Summary.

d. Irradiation Request.

QUESTION: 020 (1.00)

A reactor core manipulation is any in-tank movement of:

a. fuel elements, control rods, graphite reflector elements, or in-tank beam tube assemblies.

b. fuel elements or control rods.

c. fuel elements, control rods, or graphite reflector elements.

d. fuel elements or graphite reflector elements.

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

QUESTION: 001 (1.00)

A portion of the primary cooling water is directed through a diffuser 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)

Low water level in the cooling tower is corrected by:

a. periodically filling from the city water supply.

b. adding the water via a hose after the tower has been drained and cleaned.

c. adding makeup water while the reactor is shutdown.

d. the opening of a float valve when level is low.

QUESTION: 003 (1.00)

Which ONE of the following is an interlock which prevents a control rod from driving out of the core?

a. Reactor power level below 1 kW in AUTO mode.

b. Reactor power level above 1 kW in MANUAL mode

c. Reactor power level below 1 kW in PULSE mode.

d. Two UP buttons pressed at the same time in SQUARE WAVE mode.

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

QUESTION: 004 (1.00)

In the event of a power failure, the emergency electrical generator provides:

a. emergency backup to the building.

b. emergency power to the ECCS pump, EF-1, and the temperature control panel.

c. 15 minutes of emergency power to the CSC, DAC, translators, RAMs and CAMs.

d. emergency electrical power for the AMUWS pump, EF-1 and the temperature control panel.

QUESTION: 005 (1.00)

After a reactor room CAM alarm has been cleared, the reactor room ventilation system is restored to normal operation by:

a. pressing the CAM reset button on the temperature control panel.

b. restarting AC-1.

c. switching the reactor room ventilation from the RECIRC mode back to the NORMAL mode.

d. restarting AC-2.

QUESTION: 006 (1.00)

During normal operations, the AMUWS pump is started:

a. locally at the AMUWS pump.

b. from panel 2C in the equipment room.

c. from the temperature control panel.

d. from panel 2A in the control room.

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

QUESTION: 007 (1.00)

The EF-2 audible alarm on the temperature control panels signifies that:

a. there is a loss of negative pressure in the reactor room.

b. EF-2 was stopped from the temperature control panel.

c. the stack damper cannot be closed.

d. the radiography bay exhaust fan is not operating.

QUESTION: 008 (1.00)

In order to enter the SQUARE WAVE mode, the reactor must be in which ONE of the following conditions?

a. Power = 800 W, period = 20 seconds, mode switch in MANUAL.

b. Power = 1500 W, period = 30 seconds, mode switch in AUTO.

c. Power = 600 W, period = 30 seconds, mode switch in MANUAL.

d. Power = 1200 W, period = 20 seconds, mode switch in AUTO.

QUESTION: 009 (1.00)

Secondary system pressure is maintained higher than primary system pressure in order to:

a. prevent primary water from entering the secondary system.

b. prevent primary water from entering the building water supply.

c. ensure proper flow direction in the heat exchanger.

d. prevent secondary system water from entering the primary system.

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

QUESTION: 010 (1.00)

In order to ensure that the secondary system pressure is higher than the primary system pressure, the heat exchanger _______________ is maintained at a higher pressure than the heat exchanger _________________.

a. primary outlet pressure; secondary inlet pressure.

b. primary outlet pressure; secondary outlet pressure.

c. primary inlet pressure; secondary inlet pressure.

d. primary inlet pressure; secondary outlet pressure.

QUESTION: 011 (1.00)

A propane electrical generator supplies backup power to the:

a. AMUWS pump, temperature control panel, EF-1, and reactor room damper controls.

b. AMUWS pump, temperature control panel, AC-1, and equipment room damper controls.

c. EF-1, AC-1, and temperature control panel.

d. reactor room damper controls, EF-1, EF-2, and temperature control panel.

QUESTION: 012 (1.00)

Helium gas is used to pressurize the in-tank beam tubes:

a. because helium is nonflammable.

b. because helium is inert, preventing the formation of corrosion inside the tubes.

c. to prevent water from leaking into the tubes.

d. to prevent the formation of Argon-41.

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

QUESTION: 013 (1.00)

The CRITICALITY ALARM annunciator alarms. The cause of this alarm is:

a. high radiation level in the equipment room.

b. the reactor is critical with only one control rod withdrawn.

c. high radiation level in the reactor room.

d. air contamination exhausted out the stack.

QUESTION: 014 (1.00)

Which ONE of the following describes a typical fuel element?

a. Fuel length = 15 inches, stainless steel clad, graphite end reflectors, 8.5% enriched U-235.

b. Fuel length = 22 inches, zirconium clad, beryllium end reflectors, 20% enriched U-235.

c. Fuel length = 15 inches, stainless steel clad, graphite end reflectors, 20% enriched U-235.

d. Fuel length = 22 inches, zirconium clad, beryllium end reflectors, 8.5% U-235 enriched.

QUESTION: 015 (1.00)

Which ONE of the following is the type of detector used in the MNRC RAMs?

a. Scintillation detector.

b. Ionization detector.

c. Proportional counter.

d. Geiger-Mueller detector.

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

QUESTION: 016 (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: 017 (1.00)

Thermocouples in an instrumented fuel element measure temperature at the:

a. interior surface of the cladding.

b. center of the zirconium rod.

c. outer surface of the fuel.

d. interior of the fuel.

QUESTION: 018 (1.00)

How does the NPP-1000 system compensate for the gamma flux at high powers?

a. A pulse-height discriminator is used to eliminate the gamma signals.

b. The gamma flux is not eliminated, but is part of the total signal from the NPP-1000 system.

c. The gamma flux is eliminated by creating an equal and opposite gamma current.

d. The microprocessor uses the Campbelling process to eliminate the gamma signals.

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

QUESTION: 019 (1.00)

The three-position switch for the first primary coolant pump on the motor controller in the equipment room is in the HAND position. As a result:

a. the second primary coolant pump will start without an eight-second time delay after the first pump is started.

b. after the first primary coolant pump is started from the temperature control panel, the second pump will start after an eight-second time delay.

c. the first primary coolant pump cannot be started from the temperature control panel.

d. the first primary coolant pump cannot be started until the three-position switch is moved to AUTO.

QUESTION: 020 (1.00)

Which ONE of the following is the purpose of the safety plate suspended below the lower grid plate of the core?

a. Prevents the control rods from dropping out of the core if the mechanical connections fail.

b. Provides structural support for the lower grid plate and the suspended core.

c. Provides a “catch plate” for any items dropped while working on the core.

d. Prevents the fuel elements from dropping out of the core if the lower grid plate separates from the core barrel.

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

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

QUESTION: 001 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Life Cycle.
When k_{eff} = 0.955, ρ = -0.047 delta k/k; 4.9% delta k/k = + 0.049 delta k/k
- 0.047 + 0.049 delta k/k = + 0.002 delta k/k, therefore reactor is supercritical.

QUESTION: 002 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Moderation.

QUESTION: 003 (1.00) DELETED
A.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Subcritical Multiplication.

QUESTION: 004 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Reaction Rate.

QUESTION: 005 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Interactions.

QUESTION: 006 (1.00) DELETED
B.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Control Rods.
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:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Reactor Kinetics.

QUESTION: 008 (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Subcritical Multiplication.

QUESTION: 009 (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Life Cycle.

QUESTION: 010 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Life Cycle.

ANSWER: 011 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Equation Sheet.
The time will be the longest for the largest ratio of P to P_o = 6/1.

ANSWER: 012 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Reactor Operation.

ANSWER: 013 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Prompt and Delayed Neutrons.

ANSWER: 014 (1.00)
A.
REFERENCE:
Since the period is always positive, power must be increasing.

ANSWER: 015 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Neutron Life Cycle; Subcritical Multiplication.

ANSWER: 016 (1.00) DELETED
C.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Normal, Abnormal and Emergency Procedures, Reactor Power Calibration.
Power = mcρT/ρt , where: m=106,000 gallons x 8.34 lbs/gal = 884,040 lb; c=1 Btu/°F-lb; ρT/ρt = 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:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Reactor Kinetics and Reactivity Summary.
The increase = $1x10^8$x1.001 = 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:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Xenon.

ANSWER: 020 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Nuclear Theory Learning Objectives, Reactivity Summary.
Since the coolant temperature increased, negative reactivity was added. Therefore, the rod must add positive reactivity, i.e. withdrawn. (5 deg. F)x(7×10^{-5} delta k/k/deg. F) / (8.75×10^{-5} delta k/k/inch) = 4 inches.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001   (1.00)
D.
REFERENCE:
MNRC Reactor Technical Specifications, Section 3.4.

ANSWER: 002   (1.00)
A.
REFERENCE:
MNRC Reactor Technical Specifications, Table 3.2.2.

ANSWER: 003   (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Radiation Control and Safety.
10 mrem/hr at 1 meter (100 cm.) = 111.1 mrem/hr at 30 cm.

ANSWER: 004   (1.00)
A,4; B, 2; C, 2; D,1.
REFERENCE:
MNRC Reactor Operator Training Program, Regulations and Administrative Controls, Selection and Training Plan.

ANSWER: 005   (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal and Emergency Procedures.

ANSWER: 006   (1.00)
B.
REFERENCE:
MNRC Reactor Technical Specifications, Section 6.1.3.

ANSWER: 007   (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Startup Checklist.

ANSWER: 008   (1.00)
C.
REFERENCE:
MNRC Reactor Technical Specifications, Section 3.1.2.

ANSWER: 009   (1.00)
B.
REFERENCE:
With the window closed, only gamma radiation penetrates the window.

ANSWER: 010   (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal and Emergency Procedures.

ANSWER: 011 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal and Emergency Procedures.

ANSWER: 012 (1.00)
D.
REFERENCE:
MNRC Reactor Technical Specifications, Section 2.1.

ANSWER: 013 (1.00)
C.
REFERENCE:
GM tubes cannot distinguish between gammas of different energy.

ANSWER: 014 (1.00)
A,2; B,2; C,3; D,1.
REFERENCE:
MNRC Reactor Technical Specifications, Section 1.3.

ANSWER: 015 (1.00)
A.
REFERENCE:
MNRC Selection and Training Plan.

ANSWER: 016 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal and Emergency Procedures.

ANSWER: 017 (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Emergency Plan and Procedures, Sample Questions.

ANSWER: 018 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Regulations and Administrative Controls.

ANSWER: 019 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Regulations and Administrative Controls.

ANSWER: 020 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Fuel, Fuel Handling and Overhead Cranes.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 002 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 003 (1.00)
C or D.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 004 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 005 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 006 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 007 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal, and Emergency Procedures.

ANSWER: 008 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Reactor Instrumentation and Control.

ANSWER: 009 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 010 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 011 (1.00)
A.
REFERENCE:
MNRC SAR, page 9-17.

ANSWER: 012 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 013 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Normal, Abnormal and Emergency Procedures.

ANSWER: 014 (1.00)
C.
REFERENCE:
MNRC SAR, Table 4-1.

ANSWER: 015 (1.00)
D.
REFERENCE:
MNRC Reactor Operator Training Program, Radiation Control and Safety.

ANSWER: 016 (1.00)
B.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 017 (1.00)
D.
REFERENCE:
MNRC SAR, page 4-8.

ANSWER: 018 (1.00)
B.
REFERENCE:
MNRC SAR, page 7-4.

ANSWER: 019 (1.00)
C.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

ANSWER: 020 (1.00)
A.
REFERENCE:
MNRC Reactor Operator Training Program, Design and Operating Characteristics.

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 _____	DELETED
004	a	b	c	d _____	
005	a	b	c	d _____	
006	a	b	c	d _____	DELETED
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 _____	DELETED
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 _____
019	a	b	c	d _____
020	a	b	c	d _____

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

EQUATION SHEET

$Q = m\ c_p\ \rho T$

$SUR = 26.06/\rho$

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

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

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

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

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

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

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

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

$DR = 6CiE/D^2$

1 Curie = 3.7×10^{10} dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

°F = 9/5°C + 32

1 Mw = 3.41×10^6 BTU/hr

°C = 5/9 (°F - 32)