June 7, 2002

Mr. Stephen G. Frantz, Director
Reed Reactor Facility
3203 SE Woodstock Blvd.
Portland, OR 97202

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-288/OL-02-02,
REED COLLEGE

Dear Mr. Frantz:

During the week of April 29, 2002, the NRC administered examinations to employees of your facility who had applied for a license to operate your Reed College Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1.

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/indexs.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 Patrick Isaac at 301-415-1019.

Sincerely,

/RA/

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

Docket No. 50-288

Enclosures: 1. Initial Examination Report No. 50-288/OL-02-02
2. Facility Comments and NRC Resolution
3. Examination and answer key

cc w/enclosures:
Please see next page

Reed College Docket No. 50-288

cc:

Mayor of the City of Portland
1220 Southwest 5th Avenue
Portland, OR 97204

Reed College
ATTN: Dr. Peter Steinberger
Dean of the Faculty
3203 S.E. Woodstock Boulevard
Portland, OR 97202-8199

Reed College
ATTN: Dr. Steven S. Koblik
President
3203 S.E. Woodstock Boulevard
Portland, OR 97202-8199

Oregon Department of Energy
ATTN: David Stewart-Smith, Director
Division of Radiation Control
625 Marion Street, N.E.
Salem, OR 97310

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

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Please see next page

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ADAMS ACCESSION #: ML021500508 **TEMPLATE #: NRR-074**

OFFICE	RORP:CE		IEHB:LA		RORP:SC	
NAME	PIsaac:rdr		EBarnhill		PMadden	
DATE	05/30/2002		06/04/2002		06/ 06 /2002	

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

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

REPORT NO.: 50-288/OL-02-02

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: Reed College

EXAMINATION DATES: 04/29/2002 - 05/02/2002

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: ***/RA/*** 05/21/2002
Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of April 29, 2002, NRC administered Operator Licensing examinations to 9 Reactor Operator (RO) and 5 Senior Reactor Operator Upgrade (SROU) candidates. One RO candidate failed Section A of the written examinations. All other candidates passed the examinations.

REPORT DETAILS

1. Examiners:

Patrick Isaac, Chief Examiner
Paul Doyle

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**8/1**	**N/A**	**8/1**
Operating Tests	**9/0**	**5/0**	**14/0**
Overall	**8/1**	**5/0**	**13/1**

3. Exit Meeting:

Personnel attending:

Stephen G. Frantz, Director, Reed Reactor Facility
Eric Weis, SRO, Reed Reactor Facility
Rachel Barnett, SRO, Reed Reactor Facility
Paul Doyle, NRC
Patrick Isaac, NRC

The facility commented on a well constructed and fair examination. Mr. Frantz suggested some changes to the written examination answer key. These suggestions and the NRC's resolution to them are addressed in Enclosure 2. There were no generic concerns raised by the examiners.

FACILITY COMMENTS AND NRC RESOLUTION

Question B-5:
An experiment is being planned. The experiment requires the modification of the normal configuration of the central thimble. An experiment of this type has not been previously reviewed by the Reactor Operations Committee. Which one of the following is the classification of this experiment?

a. Routine Experiment

b. Modified Experiment

c. New Experiment

d. Special Experiment

Answer B-5: d

Facility Comment B-5:

There are two correct answers, options c and d. Technical Specification J.1 refers to such experiments as “new experiments” - option c. Administrative Procedure 4.2 refers to such experiments as “Special Experiments” - option d. In practice we call them Special Experiments, but they can also be called new experiments.

NRC Resolution B-5:

Comment accepted. The answer key will be modified to accept both options c and d as correct.

Question C-7:
Which one of the following describes the control rod position indication provided by the blue CONT light on the Reactor Control Console?

a. Blue light ON -- the connecting rod piston is fully lowered and the electromagnet has CLOSED the rod bottom limit switch.

b. Blue light ON -- the electromagnet is in contact with the armature and the rod is ONLY in the fully raised position.

c. Blue light OFF -- the electromagnet has been released from the armature and the rod will DROP to the fully inserted position.

d. Blue light OFF -- the connecting rod piston has been raised and is NO longer in contact with the rod bottom limit switch.

Answer C-7: c

Facility Comment C-7:

There are two correct answers, options a and c. The answer key lists option c, but option a seems more correct. Option c is only correct if the rod *has* dropped to the bottom, not "will drop". The blue light will only go off when the limit switches disagree, and that won't happen until the rod hits the bottom. The wording should be clarified.

NRC Resolution C-7:

Comment accepted. The answer key will be modified to accept both options a and c as correct.

Question C-8:

When reducing power in automatic, which one of the following describes the method by which the control rods will be positioned to continue the power reduction when the regulating rod approaches its lower limit?

a. The operator must shift the servo to manual, insert the regulating rod, and then insert the shim and safety rods.

b. The operator must shift the servo to manual, insert the shim and safety rods, withdraw the regulating rod a few positions and then return the servo to automatic.

c. Both the shim and the safety rods should automatically drive in to assist in the power reduction.

d. The operator should manually insert the shim or the safety rod to assist in power control with the servo in automatic.

Answer C-8: b

Facility Comment C-8:

The correct answer should be option d. Per SOP 3.7.8.5, the operator manually inserts the safe or shim rods while still in automatic; there is no need to shift the servo to manual.

NRC Resolution C-8:

Comment accepted. The answer key will be modified to accept option d as correct.

Question C-9:
A power increase is being performed with the control servo in the Automatic Mode. Which one of the choices below completes the following statement?

The control servo will increase reactor power at a constant period of _____ to match the reactor power detected by the _____.

a. +30 seconds; log-n channel

b. +30 seconds; linear channel

c. +10 seconds; log-n channel

d. +10 seconds; linear channel

Answer C-9: b

Facility Comment C-9:
The correct answer should be option d. Our automatic rod control maintains period at 10 seconds as reflected in SOP 3.5.11. The procedure used to say 30 seconds.

NRC Resolution C-9:
Comment accepted. The answer key will be modified to accept option d as correct.

Question C-19:
Which one of the following describes the expected response of the Reed Reactor Facility 24-hour telephone communications if 110 VAC power to the Reed College switchboard is lost?

a. The direct dial-in line and the special phone line will fail.

b. The direct dial-in line will fail, but the special phone line will be unaffected.

c. The direct dial-in line will shift to the special phone line.

d. The direct dial-in line will be re-powered by a backup generator and the special line will be unaffected.

Answer C-19: d

Facility Comment C-19:
There is no correct answer. Our phone system was changed several years ago and this question no longer applies. There is no “special phone.”

NRC Resolution C-19:
Comment accepted. Question C-19 will be deleted from the examination.

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

FACILITY: Reed College

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2002/04/29

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach all answer sheets to the examination. Point values 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
20.00	**33.9**	_____	____	**A.**	**REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS**
20.00	**33.9**	_____	____	**B.**	**NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS**
19.00	**32.2**	_____	____	**C.**	**FACILITY AND RADIATION MONITORING SYSTEMS**
59.00		_____	____	**% TOTALS**	
		FINAL GRADE			

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

_____
Candidate's Signature

ENCLOSURE 3

A. RX THEORY, THERMO & FAC OP CHARS

A N S W E R S H E E T

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/EMERG PROCEDURES & RAD CON

A N S W E R S H E E T

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. PLANT AND RAD MONITORING SYSTEMS

A N S W E R S H E E T

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 *****)
(********** END OF EXAMINATION **********)

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 neither received nor 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 and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

EQUATION SHEET

$\dot{Q} = \dot{m}\, c_p\, \Delta T$

$\dot{Q} = \dot{m}\, \Delta h$

$\dot{Q} = UA\, \Delta T$

$$SUR = \frac{26.06\ (\lambda_{eff}\rho)}{(\beta - \rho)}$$

$SUR = 26.06/\tau$

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

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

$$P = \frac{\beta(1-\rho)}{\beta-\rho} P_o$$

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

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

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0075$

$DR_1 D_1^2 = DR_2 D_2^2$

$Cp\ (H20) = 0.146\ \frac{kw}{gpm \cdot {}^\circ F}$

$$\text{Cycle Efficiency} = \frac{\text{Net Work (out)}}{\text{Energy (in)}}$$

$SCR = S/(1-Keff)$

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

$$M = \frac{(1-Keff)_0}{(1-Keff)_1}$$

$M = 1/(1-Keff) = CR_1/CR_0$

$SDM = (1-Keff)/Keff$

$I = I_o\ e^{-ux}$

$\ell^* = 1 \times 10^{-4}$ seconds

$\tau = \ell^*/(\rho-\bar{\beta})$

$R = 6\ C\ E\ n$

$$T_{1/2} = \frac{0.693}{\lambda}$$

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

$P = S / (1 - Keff)$

---

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

931 Mev = 1 amu

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

$°F = 9/5 °C + 32$

$°C = 5/9\ (°F - 32)$

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: 001 (1.00)
The reactor has been operating for 3 weeks at 230 KW, when a loss of cooling accident causes the reactor core to be completely uncovered. The core cannot be recovered with water and must remain cooled only by air.

According to the Safety Analysis Report (SAR), the main radiation hazard will be produced by the _____.

a. melting of the fuel cladding when its temperature exceeds the melting point of aluminum

b. rupture of the fuel cladding from the fission gas pressure buildup

c. unshielded fuel elements in the reactor core

d. activation of Argon-41 in the atmosphere of the reactor room

QUESTION: 002 (1.00)
The reactor is critical at 10 KW. The regulating rod is pulled to insert a positive reactivity of $0.18. Which one of the following will be the stable reactor period as a result of this reactivity insertion?

a. 10 seconds

b. 45 seconds

c. 55 seconds

d. 65 seconds

QUESTION: 003 (1.00)
An initial count rate of 100 is doubled five times during a startup. Assuming an initial Keff of 0.950, which one of the following is the new Keff?

a. 0.957

b. 0.979

c. 0.985

d. 0.998

QUESTION: 004 (1.00)
Consider two identical critical reactors, with the exception that one has a beta of 0.0072 and the other has a beta of 0.0060. Each reactor is operating a 10 watts. Which one of the following compares the response of the reactors to a +0.1% delta k/k reactivity insertion?

a. The resulting period will be shorter for the reactor with the 0.0072 beta fraction

b. The resulting period will be shorter for the reactor with the 0.0060 beta fraction

c. The resulting power level will be higher for the reactor with the 0.0072 beta fraction

d. The resulting power level will be higher for the reactor with the 0.0060 beta fraction

QUESTION: 005 (1.00)
Which one of the following materials in the reactor cause a "PROMPT" core reactivity addition when reactor power is changed?

a. Reactor coolant and graphite

b. Reactor coolant and ZrH

c. U-238 and ZrH

d. U-238 and graphite

QUESTION: 006 (1.00)
The reactor is critical and increasing in power. Power has increased from 20 watts to 80 watts in 60 seconds. How long will it take at this rate for power to increase from 0.080 KW to 160 KW?

a. 0.5 minute

b. 2.5 minutes

c. 5.5 minutes

d. 10.5 minutes

QUESTION: 007 (1.00)
Reactor power has just been increased to 200 KW, and the reactor is operating in the automatic mode. The fuel temperature increases from 220 degrees to 225 degrees C. Given the following information:

Fuel temperature coefficient is -0.01% delta k/k/degree C.
Regulating rod worth is 0.05% delta k/k/inch.

Which one of the following states HOW FAR and in WHAT DIRECTION the regulating rod moves? ASSUME none of the other control rods move.

a. Regulating Rod moves out 0.2 inch.

b. Regulating Rod moves in 0.2 inch.

c. Regulating Rod moves out 1.0 inch.

d. Regulating Rod moves in 1.0 inch.

QUESTION: 008 (1.00)
Given the following core data:

Core Excess Reactivity	1.56% delta k/k
Safety Rod Worth	2.75% delta k/k
Shim Rod Worth	2.84% delta k/k
Regulating Rod Worth	1.05% delta k/k
Xenon free, cold core	

Which one of the following is the shutdown margin that would be calculated to determine if the Technical Specification MINIMUM SHUTDOWN MARGIN is satisfied?

a. 1.28% delta k/k

b. 2.24% delta k/k

c. 4.03% delta k/k

d. 5.08% delta k/k

QUESTION: 009 (1.00)
Which one of the following is the PRIMARY reason that delayed neutrons are so effective at controlling reactor power?

a. Delayed neutrons make up a very large fraction of the fission neutrons in the core.

b. Delayed neutrons have a much longer mean lifetime than prompt neutrons.

c. Delayed neutrons are born at thermal energies.

d. Delayed neutrons are born at lower energies than prompt neutrons.

QUESTION: 010 (1.00)

Which one of the following is the principal source of heat in the reactor after a shutdown from extended operation at 200 KW?

a. Production of delayed neutrons

b. Photoneutron-induced fissions

c. Spontaneous fission of U-238

d. Decay of fission fragments

QUESTION: 011 (1.00)
Which one of the following defines the coolant temperature coefficient?

a. Moderator coefficient + void coefficient

b. Moderator coefficient + graphite coefficient

c. Bath coefficient + graphite coefficient

d. Bath coefficient + void coefficient

QUESTION: 012 (1.00)
A reactor startup is being conducted 15 hours after a reactor scram. Reactor power control is in MANUAL MODE. Reactor power is increased to 50 KW and all control rod motion is stopped. Which one of the following describes the response of reactor power, without any further operator actions, and the PRIMARY reason for its response?

a. Power increases due to the burnout of xenon.

b. Power increases due to the burnout of samarium.

c. Power decreases due to the buildup of xenon.

d. Power decreases due to the buildup of samarium.

QUESTION: 013 (1.00)
Which one of the following explains why the shim and safety control rods are worth more than the regulating rod?

a. The thermal neutron flux near the shim and safety rods is higher than the flux near the regulating rod.

b. The thermal neutron flux near the regulating rod is higher than the flux near the shim and safety rods.

c. The regulating rod is exposed to a lower fast neutron flux because it is located closer to the core reflector.

d. The regulating rod is exposed to a higher fast neutron flux because it is located closer to the core reflector.

QUESTION: 014 (1.00)
Which one of the following is the reason for withdrawing the safety and shim control rods a comparable amount during power operation?

a. To reduce the effect of fission product poisons by reducing xenon and samarium buildup in the center of the core

b. To maintain comparable safety and shim rod worths by evenly burning out the poison in the rods

c. To increase the regulating rod worth by increasing neutron flux near the regulating rod

d. To promote uniform fuel burnout by flattening the flux across the core

QUESTION: 015 (1.00)
Given the following core data:

Total Safety Rod Worth	2.75% delta k/k
Current Safety Rod Worth inserted	0.75% delta k/k
Total Shim Rod Worth	2.84% delta k/k
Current Shim Rod Worth inserted	0.80% delta k/k
Total Regulating Rod Worth	1.05% delta k/k
Current Regulating Rod Worth inserted	0.35% delta k/k
Total Worth of In-place Experiments	0.25% delta k/k

Which one of the following is the calculated core excess reactivity?

a. 0.60%

b. 1.65%

c. 1.90%

d. 2.15%

QUESTION: 016 (1.00)
An experiment to be placed in the central core thimble has been wrapped in cadmium. Which one of the following types of radiation will be most effectively blocked by the cadmium wrapping?

a. Thermal neutrons

b. Fast neutrons

c. Gamma rays

d. X-rays

QUESTION: 017 (1.00)
Graphite inserts are placed in the top and bottom of the fuel element can. Which one of the following describes the function of these inserts?

a. To absorb thermal neutrons

b. To reduce neutron leakage

c. To absorb fission product gases

d. To increase fast neutron flux

QUESTION: 018 (1.00)
Given the following core data:

Reactor is operating at 200 KW steady-state.
Total Shim Rod Worth is 2.84% delta k/k.
Shim rod is about 90% withdrawn and is currently inserting 0.20% delta k/k into the core.

Which one of the following describes the stable reactor period if the shim rod drops fully into the core and no operator action is taken?

a. -34 seconds due to the rapid decrease in prompt neutrons

b. -34 seconds due to the rapid decay of the short lived delayed neutron precursors

c. -80 seconds due to the slowing down length of prompt neutrons

d. -80 seconds due to the decay half life of the long lived delayed neutron precursors

QUESTION: 019 (1.00)
Which one of the following completes the statement?

As power level decreases, the Prompt Negative Temperature Coefficient (PNTC) causes:

a. the number of neutrons available for fission with Uranium 235 to decrease.

b. the hydrogen atoms in the ZrH2 to slow down more neutrons.

c. the U-235 thermal neutron resonance energy absorption peaks to broaden.

d. the U-238 fast neutron resonance energy absorption peaks to broaden.

QUESTION: 020 (1.00)
A power calibration is being performed per SOP 44, Power Calibration. Which one of the following conditions will result in the calculation of a reactor power that is less than actual power?

a. The reactor room temperature increases by 5 degrees during the calibration run.

b. The bulk water temperature meter is out of calibration and reading 5 degrees higher than actual temperature.

c. Water is added to the reactor tank to return tank level to normal.

d. Secondary inlet temperature of the cooling water to the primary heat exchanger decreases.

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

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 001 (1.00)
Following an irradiation of a specimen in the rotary specimen rack, the resulting radioisotope is expected to equal 2,000 curies. The radioisotope will decay by the emission of two gamma rays per disintegration with energies of 1.10 Mev and 1.29 Mev. Which one of the following is the radiation exposure rate (R/hr) at one (1) foot from the specimen with no shielding?

a. 17,028 R/hr

b. 28,680 R/hr

c. 34,056 R/hr

d. 57,360 R/hr

QUESTION: 002 (1.00)
Two operators (Operator "A" and Operator "B") have operated the reactor for the past week. Operator "B" is scheduled to perform a reactor startup today. The reactor's operating history is given below.

Yesterday: Two startups and two normal shutdowns performed by Operator "A".
2 days ago: One startup and one normal shutdown performed by Operator "A".
5 days ago: One startup and one normal shutdown performed by Operator "B".
7 days ago: One startup and one scram performed by Operator "A".

Which one of the following describes the REQUIRED review of the Main Log that must be performed by Operator "B" before beginning to fill in the Start-up Checklist, SOP-1?

a. Review yesterday's log entries beginning with the second reactor power run.

b. Review all log entries for yesterday.

c. Review the log entries beginning with the completion of the shutdown 5 days ago.

d. Review all log entries for the past 7 days.

QUESTION: 003 (1.00)
Which one of the following is the reason for allowing the primary pump to run for 15 minutes prior to checking the reactor water conductivity?

a. To allow the conductivity meter to warm up

b. To clear any standing water out of the system

c. To allow the reactor water temperature to stabilize

d. To ensure the water in the reactor tank is thoroughly mixed

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 004 (1.00)
Which one of the choices below completes the following statement?

The reactor was started up at 0900 this morning and shutdown at 2100.
The shutdown checklist must be completed and signed by the _____.

a. Reactor Operator before midnight

b. Senior Operator on duty before the Reactor Operator leaves the facility

c. Reactor Supervisor before the Senior Operator goes off duty

d. Reactor Operator and delivered to the Reactor Director's office before the operator goes off duty

QUESTION: 005 (1.00)
An experiment is being planned. The experiment requires the modification of the normal configuration of the central thimble. An experiment of this type has not been previously reviewed by the Reactor Operations Committee. Which one of the following is the classification of this experiment?

a. Routine Experiment

b. Modified Experiment

c. New Experiment

d. Special Experiment

QUESTION: 006 (1.00)
The reactor operator is required by Technical Specifications to shutdown the reactor when 120 degrees F (48.9 deg. C) is exceeded for the _____.

a. bulk water temperature

b. inlet reactor water temperature

c. outlet reactor water temperature

d. demineralizer inlet temperature

Section B Normal/Emergency Procedures and Radiological Controls

QUESTION: 007 (1.00)
In accordance with the Technical Specifications, the reactor will be considered shutdown with fixed experiments in place when sufficient control rods have been inserted to assure the reactor is subcritical by _____ in the cold, xenon-free condition.

a. 0.12% delta k/k

b. 0.4% delta k/k

c. 0.7% delta k/k

d. 2.25% delta k/k

QUESTION: 008 (1.00)
The reactor is shutdown and maintenance has been planned on the reactor power control servo. Which one of the following describes the MINIMUM requirement for the personnel that must be present during the performance of this maintenance?

a. One NRC-licensed Reactor Operator and one other person

b. One NRC-licensed Senior Reactor Operator and one other person

c. Two NRC-licensed Senior Reactor Operators

d. Two NRC-licensed Reactor Operators

QUESTION: 009 (1.00)
The Reed Reactor Facility Emergency Plan defines the term OFFSITE as the geographical area that is _____.

a. beyond the site boundary

b. 250 feet beyond the operations boundary

c. beyond the Reed College campus

d. 250 feet beyond the Reed College campus

QUESTION: 010 (1.00)
Startups following unscheduled shutdowns:

a. Need to be approved by the Reactor Operations Committee when the cause of the shutdown is unexplained.

b. Caused by power failures require complete pre-startup checks.

c. When not reportable can be initiated with SRO review in progress.

d. Need to be preceded by a scram check of all rods from 10%.

QUESTION: 011 (1.00)

Section B Normal/Emergency Procedures and Radiological Controls

Which one of the following is the location of the Emergency Support Center (ESC)?

a. Director's Office, Chemistry Building Room 102

b. Director's Office, Psychology Building Room 102

c. Health Physicist's Office, Psychology Building Room 415

d. Health Physicist's Office, Chemistry Building Room 415

QUESTION: 012 (1.00)
If the Radiation Area Monitor (RAM) failed and could be fixed within 2 hours, does T.S. allow reactor operations to continue, and if so, what is the minimum requirement?

a. No.

b. Yes, if replaced by a dose-sensitive monitor.

c. Yes, if replaced by a temporary gamma-sensitive monitor with alarm.

d. Yes, as long as the GSM is in service.

QUESTION: 013 (1.00)
Which one of the following describes the control of the emergency grab-bag during an emergency evacuation of the reactor facility in accordance with the Emergency Implementation Plan?

a. It is taken by the on-duty Senior Operator who is acting as the Emergency Coordinator.

b. It is taken by the first Reactor Assistant to use the exit corridor and turned over to the Health Physicist.

c. It is taken by the on-duty Reactor Operator when leaving the Control Room and turned over to the Health Physicist.

d. It is taken by the first staff person using the exit corridor and turned over to the Emergency Coordinator.

QUESTION: 014 (1.00)
In accordance with Radiation Work Permit (SOP 28), which one of the following describes the proper utilization of dosimetry monitoring devices by a worker that is performing work under a RWP and an extremity dose is likely?

a. Two PICs; one on the wrist of the dominant hand and one on the torso.

b. Two PICs; one on the neck and one on the front of the torso near the waist

c. One PIC on the front of the torso or the neck and a portable continuous radiation monitor near the worker's hands

d. One PIC on the dominant wrist and a portable continuous radiation monitor near the worker

QUESTION: 015 (1.00)
The reactor is operating at 100% power when the pneumatic transfer system blower is turned on to irradiate an experiment sample. Seconds later, the Gaseous Stack Monitor (GSM) high radiation alarm is received for several seconds, then clears as the GSM meter reading steadily decreases. Which one of the following is the action that the operator is expected to take?

a. Continue operations and observe that GSM reading returns to normal.

b. Shutdown the reactor, classify the emergency action level and notify the NRC.

c. Call the Health Physicists to determine the radioactivity release rate to the environment and notify the NRC.

d. Initiate procedure for an "Off-Normal Event" and immediately commence a reactor shutdown.

QUESTION: 016 (1.00)
The operator has just observed that the primary purification system flow rate is 9.0 gpm. Which one of the following describes the status of the primary purification system and the possible cause?

a. Flow rate is abnormally high because a sample is being taken at the demineralizer outlet.

b. Flow rate is abnormally high because the flow meter calibration is incorrect.

c. Flow rate is abnormally low because the primary water system orifice is partially clogged.

d. Flow rate is abnormally low because the primary filters are dirty.

QUESTION: 017 (1.00)
The preferred hospital for dealing with radiological injuries is:

a. Providence Hospital

b. Kaiser Permanente

c. Mount Sinai Hospital

d. Good Samaritan Hospital

QUESTION: 018 (1.00)
A small radioactive source is to be stored in the reactor bay with no shielding. The source reads 2 R/hr at 1 foot. A “Radiation Area” barrier would have to be erected approximately ___ from the source.

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

Section C Facility and Radiation Monitoring Systems

QUESTION: 019 (1.00)
Which one of the following Emergency classifications is NOT used at the Reed Reactor ?

a. Alert

b. Site Area Emergency

c. Non-Reactor Safety Related Event

d. Notification of Unusual Event

QUESTION: 020 (1.00)
Which one of the following describes the MAXIMUM power level at which the Reed Reactor is operated and the reason for this power limit, in accordance with SOP 3, Reactor Operations?

a. No operation above 240 KW to prevent any power fluctuations from causing the license limit to be exceeded.

b. No operation above 240 KW because this is the Technical Specification operating power limit.

c. No operation above 250 KW to prevent any power fluctuations from causing the license limit to be exceeded.

d. No operation above 250 KW because this is the Technical Specification operating power limit.

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

QUESTION: 001 (1.00)
The Normal Heating and Ventilation System is operating normally when a high radiation condition is detected by the continuous air monitor near the reactor pit. Which one of the following describes the expected response of the Heating and Ventilation System?

a. Reactor room supply and exhaust fans shutdown and the tight closing dampers close to isolate the reactor room.

b. Reactor room supply fan shuts down and the system dampers realign the suction of the exhaust fan to the reactor room through absolute filters.

c. Reactor room supply fan discharge is realigned to provide 1330 cubic feet per minute of dilution flow to the ventilation exhaust stack.

d. Reactor room exhaust fan shuts down and dampers realign the supply fan to provide positive pressure in the control room.

QUESTION: 002 (1.00)
Which component in the purification system is primarily responsible for maintenance of the pool water pH?

a. The skimmer

b. The filters

c. The demineralizer

d. Chemical additions

QUESTION: 003 (1.00)
The upper end fixture of each fuel element consists of a _____.

a. knob for attaching the fuel handling tool and a rectangular spacer to prevent the fuel handling tool from damaging the fuel cladding

b. knob for attaching the fuel handling tool and a triangular spacer to allow cooling water to flow through the upper grid plate

c. a rectangular spacer to allow the top grid to provide lateral support and a triangular opening to allow sampling for fuel element failure

d. a triangular spacer to allow the top grid to provide lateral support and a rectangular opening to allow sampling for fuel element failure

QUESTION: 004 (1.00)
Which one of the following describes the operation of the rotary specimen rack?

a. Can be turned remotely from the reactor control console using a motor drive. Specimens are loaded using a grapple into WET racks.

b. Can be turned remotely from the reactor control console using a motor drive. Specimens are loaded through a water-tight tube into DRY racks.

c. Can be turned manually from the top of the reactor. Specimens are loaded using a grapple into WET racks.

d. Can be turned manually from the top of the reactor. Specimens are loaded through a water-tight tube into DRY racks.

QUESTION: 005 (1.00)
Which one of the following describes the design of the Reactor Water and Purification System that reduces the radiation level at the top of the reactor tank?

a. The primary pump takes a suction three feet below the surface of the reactor pool to prevent Nitrogen-16 from reaching the pool surface.

b. The reactor water purification system takes a suction three feet below the surface of the reactor pool to prevent Argon-41 from reaching the pool surface.

c. The primary pump discharges through a diffuser nozzle directing water currents downward over the core to slow Nitrogen-16 from reaching the pool surface.

d. The reactor water purification system discharges through a diffuser nozzle directing water currents downward over the core to slow Argon-41 from reaching the pool surface.

Section C Facility and Radiation Monitoring Systems

QUESTION: 006 (1.00)
Which one of the following describes the purpose of the connecting rod piston and the vents in the rod drive barrel of the control rod drive system?

a. The piston and the small grated vents along the length of the rod barrel prevent excessive rod withdrawal speeds.

b. The piston and the small grated vents near the bottom of the rod barrel slow the rod speed before bottoming impact during scrams.

c. The piston weight holds the control rods fully inserted while the large slotted vents along the length of the rod barrel provide for unrestricted cooling water flow to the control rods.

d. The piston and the large slotted vents along the length of the rod barrel prevent excessive rod speeds during accidental rod drops while allowing unrestricted normal rod drive speeds.

QUESTION: 007 (1.00)
Which one of the following describes the control rod position indication provided by the blue CONT light on the Reactor Control Console?

a. Blue light ON -- the connecting rod piston is fully lowered and the electromagnet has CLOSED the rod bottom limit switch.

b. Blue light ON -- the electromagnet is in contact with the armature and the rod is ONLY in the fully raised position.

c. Blue light OFF -- the electromagnet has been released from the armature and the rod will DROP to the fully inserted position.

d. Blue light OFF -- the connecting rod piston has been raised and is NO longer in contact with the rod bottom limit switch.

QUESTION: 008 (1.00)
When reducing power in automatic, which one of the following describes the method by which the control rods will be positioned to continue the power reduction when the regulating rod approaches its lower limit?

a. The operator must shift the servo to manual, insert the regulating rod, and then insert the shim and safety rods.

b. The operator must shift the servo to manual, insert the shim and safety rods, withdraw the regulating rod a few positions and then return the servo to automatic.

c. Both the shim and the safety rods should automatically drive in to assist in the power reduction.

d. The operator should manually insert the shim or the safety rod to assist in power control with the servo in automatic.

QUESTION: 009 (1.00)
A power increase is being performed with the control servo in the Automatic Mode. Which one of the choices below completes the following statement?

The control servo will increase reactor power at a constant period of _____ to match the reactor power detected by the _____.

a. +30 seconds; log-n channel

b. +30 seconds; linear channel

c. +10 seconds; log-n channel

d. +10 seconds; linear channel

QUESTION: 010 (1.00)
Which one of the following describes a control rod interlock?

a. The shim rod cannot be driven in or out when the control servo is in the automatic mode.

b. The control servo cannot be placed in the automatic mode until the shim rod is partially withdrawn.

c. The rod drive motors are prevented from operating immediately following a scram.

d. Two control rods cannot be withdrawn simultaneously when in the manual mode.

QUESTION: 011 (1.00)
Which one of the following describes the colling mechanism of the Reed Reactor?

a. Forced convection.

b. Radiation.

c. Natural conduction.

d. Natural convection.

QUESTION: 012 (1.00)
Which one of the following describes the effect on core reactivity if the central thimble is replaced with a fuel element? (Assume the reactor is shutdown.)

a. The reactor will be critical with all rods inserted.

b. The reactor will be critical with the most reactive rod stuck fully out.

c. The core excess reactivity will exceed the Technical Specification limit.

d. The core excess reactivity will be within acceptable limits.

QUESTION: 013 (1.00)
Which one of the following describes how a sample is placed into the core for irradiation using the hollow sample element?

a. The sample is loaded under water using a grapple at the end of an electrical cable.

b. The hollow sample element is loaded while out of the core and then lowered into the core using the fuel-element handling tool.

c. The sample is loaded into the hollow sample element through a dry tube using a modified fishing pole.

d. The hollow sample element is loaded while out of the core and then transferred into the core using air pressure.

QUESTION: 014 (1.00)
Which one of the following is the reason for establishing 10 gpm through a purification system demineralizer?

a. To ensure an efficient ion exchange rate is maintained

b. To ensure the cation and anion resin layers are kept separated

c. To ensure the cation and anion resin beads are thoroughly mixed

d. To ensure the system flowmeter remains on scale

QUESTION: 015 (1.00)
Which one of the following would result from the continued operation of the reactor systems with reactor tank water level 8 inches BELOW normal?

a. Increase in depletion rate of demineralizers

b. Increase in control rod temperatures

c. Large increase in control rod drive speeds

d. Large increase in reactor water bulk temperature

QUESTION: 016 (1.00)
Which one of the following would indicate a fuel element failure?

a. A blue glow surrounding the fuel element

b. Increased production of Ar-41

c. Above average fuel element temperature as indicated by a temperature probe

d. Above average conductivity as indicated by a water sample at the exit of the fuel element

QUESTION: 017 (1.00)
Which one of the following will result in a reactor scram signal?

a. Log-n channel produces a 3 second period signal.

Section C Facility and Radiation Monitoring Systems

b. Linear channel exceeds 100% on its lowest range.

c. Log-n channel exceeds 110% of full power.

d. Bulk reactor water temperature monitor exceeds 120 degrees F.

QUESTION: 018 (1.00)
If the stack sampling pump fails, the _____ will be inoperable.

a. Air Particulate Monitor (APM)

b. Radiation Area Monitor (RAM)

c. Continuous Air Monitor (CAM) and Air Particulate Monitor (APM)

d. Continuous Air Monitor (CAM) and Radiation Area Monitor (RAM)

QUESTION: 019 (1.00)
Which one of the following describes the expected response of the Reed Reactor Facility 24-hour telephone communications if 110 VAC power to the Reed College switchboard is lost?

a. The direct dial-in line and the special phone line will fail.

b. The direct dial-in line will fail, but the special phone line will be unaffected.

c. The direct dial-in line will shift to the special phone line.

4. The direct dial-in line will be re-powered by a backup generator and the special line will be unaffected.

QUESTION: 020 (1.00)
Which one of the following is the MAXIMUM reactor pool level decrease that could occur from a large failure of the primary water system piping?

a. 5 inches

b. 15 inches

c. 36 inches

d. 48 inches

(***** END OF EXAMINATION *****)

Section A Rx Theory, Thermo & Fac. Operating Characteristics

ANSWER: 001 (1.00)
c.
REFERENCE:
SAR Section 2.1, and Section 7.3,

ANSWER: 002 (1.00)
b.
REFERENCE:
Reactivity added = $0.18 (.0075) = 0.00135
$\tau = (\beta-\rho)/\lambda_{eff}\rho = \frac{.0075 - .00135}{(.1)(.00135)} = 45.5$ seconds

ANSWER: 003 (1.00)
d.
REFERENCE:
CR1 (1-Keff1) = CR2 (1 - Keff2) or M1 (1-Keff1) = M2 (1 - Keff2)
CR2/CR1 = 32
CR1 (1-Keff1)/CR2 = 1 - Keff2)
100 (1-0.950)/3200 = 1 - Keff2
Keff2 = 1 - .0015625 = .998

ANSWER: 004 (1.00)
b.
REFERENCE:
Reed Reactor Facility Training Manual, Section 9.6.
Introduction to Nuclear Engineering, John R. Lamarsh, Section 12-2
Glasstone and Sesonske, edition copyrighted 1967, Section 5.27, equation 5.31

ANSWER: 005 (1.00)
c.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.5.1 and 10.5.2

ANSWER: 006 (1.00)
c.
REFERENCE:
Reed Reactor Facility Training Manual, Section 9.4
P = Poet/T
80 = 20e60 sec/T
T = 43.28 sec
1.6 x 105 watts = 80et/43.28
t = 329 sec = 5.5 minutes

ANSWER: 007 (1.00)
c.
REFERENCE:
SAR Appendix E
SAR Section 5.2.7
Reed Reactor Facility Training Manual, Section 10.5.1, pg 10-15
(-0.0001 delta k/k/degree C) X (5 degrees C) = -0.0005 delta k/k
therefore the rod must add +0.0005 dk/k to hold power stable:
(0.0005 dk/k) / (0.0005 dk/k/inch) = 1.0 inch out
ANSWER: 008 (1.00)
b.

Section A Rx Theory, Thermo & Fac. Operating Characteristics

REFERENCE:
Reed Reactor Facility Training Manual, Section 10.3
Tech Specs, Section F.3
SDM = (rod worth inserted) - (core excess reactivity) = (2.75 + 1.05) - 1.56 = 2.24%

ANSWER: 009 (1.00)
b.
REFERENCE:
Reed Reactor Facility Training Manual, Section 9.6

ANSWER: 010 (1.00)
d.
REFERENCE:
Nuclear Reactor Engineering, Glasstone & Sesonske, 1967, Section 2.187

ANSWER: 011 (1.00)
d.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.5.3

ANSWER: 012 (1.00)
a.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.4.2

ANSWER: 013 (1.00)
a.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.3

ANSWER: 014 (1.00)
d.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.3

ANSWER: 015 (1.00)
c.
REFERENCE:
Core excess reactivity = total rod worths remaining in core = 0.75 + 0.8 + 0.35 = 1.90%

ANSWER: 016 (1.00)
a.
REFERENCE:
Reed Reactor Facility Training Manual, Section 4.1

ANSWER: 017 (1.00)
b.
REFERENCE:
SAR Section 5.2.2, pg 5-,5
Mechanical Maintenance and Operating Manual, Section 2.3

ANSWER: 018 (1.00)
d.
REFERENCE:

Section A Rx Theory, Thermo & Fac. Operating Characteristics

Reed Reactor Facility Training Manual, Section 9.7
Glasstone and Sesonske, edition copyrighted 1967, Section 5.47
2.64% dk/k inserted is much larger than beta; therefore, maximum stable negative period of -80 seconds results.

ANSWER: 019 (1.00)
b.
REFERENCE:
Reed Reactor Facility Training Manual, Section 10.5.1 and figure 10.5

ANSWER: 020 (1.00)
c.
REFERENCE:
SOP 44, Section 44.7
SAR, Section 6.4.2

Section B Normal/Emergency Procedures and Radiological Controls

ANSWER: 001 (1.00)
b.
REFERENCE:
Reed Reactor Facility Training Manual, Section 5.4
SAR Section 7.6
R = 6 C E n = 6 (2000 ci) (1.10 + 1.29 Mev) (1 disintegration) = 28,680 R/hr

ANSWER: 002 (1.00)
c.
REFERENCE:
SOP 01, Section 1.4

ANSWER: 003 (1.00)
b.
REFERENCE:
SOP 01, Section 1.7.5.1.5

ANSWER: 004 (1.00)
b.
REFERENCE:
SOP 05, Section 5.7.6

ANSWER: 005 (1.00)
c. , d.
REFERENCE:
Tech Specs, Section I.3 and Administrative Procedures, Section IV, Step 4.2

ANSWER: 006 (1.00)
a.
REFERENCE:
Tech Specs, Section D.1

ANSWER: 007 (1.00)
c.
REFERENCE:
Tech Spec Definitions, Section A.1

ANSWER: 008 (1.00)
b.
REFERENCE:
Administrative Procedures, Section III, Step 3.1.14

ANSWER: 009 (1.00)
a.
REFERENCE:
Emergency Plan, Section 2.8

ANSWER: 010 (1.00)
a.
REFERENCE:
SOP 10.7.8.2

ANSWER: 011 (1.00)
a.

Section C Facility and Radiation Monitoring Systems

REFERENCE:
Emergency Plan, Section 8.1

ANSWER: 012 (1.00)
b.
REFERENCE:
T.S. Section G.

ANSWER: 013 (1.00)
d.
REFERENCE:
Emergency Implementing Plan

ANSWER: 014 (1.00)
a.
REFERENCE:
SOP 28, Section 28.4

ANSWER: 015 (1.00)
a.
REFERENCE:
SOP 90, Section 90.7.1.2

ANSWER: 016 (1.00)
d.
REFERENCE:
SOP 70, Section 70.7.8.3

ANSWER: 017 (1.00)
d.
REFERENCE:
E-Plan

ANSWER: 018 (1.00)
c
REFERENCE:

$$\frac{DR_1}{X_2^2} = \frac{DR_2}{X_1^2}X_2^2 = \frac{DR_1}{DR_2}\ X \qquad X_2^2 = \frac{2000}{5} \times 1^2 = 400ft^2 X_2 = 20fi$$

ANSWER: 019 (1.00)
b.
REFERENCE:
E-Plan

ANSWER: 020 (1.00)
a.
REFERENCE:
SOP 03, Section 3.5.4,

ANSWER: 001 (1.00)
b.
REFERENCE:
SAR Section 4.4

ANSWER: 002 (2.00)
c.
REFERENCE:
Mech. Manual 5.6

ANSWER: 003 (1.00)
b.
REFERENCE:
SAR, Section 5.2.2

ANSWER: 004 (1.00)
d.
REFERENCE:
SAR Section 5.2.5

ANSWER: 005 (1.00)
c.
REFERENCE:
SAR, Section 5.2.6

ANSWER: 006 (1.00)
b.
REFERENCE:
SAR, Section 5.2.8

ANSWER: 007 (1.00)
a. , c.
REFERENCE:
SAR, Section 5.2.8
SOP 01, Section 1.7.6.3

ANSWER: 008 (1.00)
d.
REFERENCE:
SOP 03, Section 3.7.8

ANSWER: 009 (1.00)
d.
REFERENCE:
SAR Section 5.3.2
SOP 03, Section 3.7.5

ANSWER: 010 (1.00)
d.
REFERENCE:
SAR, Section 5.3.4

ANSWER: 011 (1.00)
d.
REFERENCE:
T.S. D.1

ANSWER: 012 (1.00)

c.
REFERENCE:
SAR Section 7-7
T.S. Section E.2

ANSWER: 013 (1.00)
b.
REFERENCE:
TRIGA Mark I Reactor Mech. Maint. and Op. Manual, Section 4.10.1 and 4.10.2

ANSWER: 014 (1.00)
a.
REFERENCE:
TRIGA Mark I Reactor Mech. Maint. and Op. Manual, Section 5.11.1.2

ANSWER: 015 (1.00)
a.
REFERENCE:
TRIGA Mark I Reactor Mech. Maint. and Op. Manual, Section 5.11.3

ANSWER: 016 (1.00)
d.
REFERENCE:
TRIGA Mark I Reactor Mech. Maint. and Op. Manual, Section 5.13.7

ANSWER: 017 (1.00)
a.
REFERENCE:
Start-up Checklist

ANSWER: 018 (1.00)
a.
REFERENCE:
SOP 34, Section 34.7, pg 1 -- SOP 32, Section 32.4.2
Emergency Implementing Plan, Section 1.2

~~ANSWER: 019 (1.00)~~ *DELETED*
~~d.~~
~~REFERENCE:~~
~~Emergency Plan, Section 3.1.8~~

ANSWER: 020 (1.00)
c.
REFERENCE:
Tech Manual 5.11.10