ENCLOSURE 1

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

REPORT NO.: 50-288/OL-94-01

FACILITY DOCKET NO.: 50-288

FACILITY LICENSE NO.: R-112

FACILITY: REED REACTOR FACILITY

EXAMINATION DATES: January 31 - February 2, 1994

EXAMINER: Patrick J. Isaac, (Chief Examiner)

SUBMITTED BY: Patrick J. Isaac 2/18/94
Chief Examiner Date

APPROVED BY: Jose Ibarra 3/3/94
José Ibarra, Chief Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Reactor Controls
and Human Factors
Office of Nuclear Reactor Regulation

SUMMARY:

NRC administered written examination and operating tests to three Reactor Operator (RO) applicants. Operating tests were also administered to three Senior Reactor Operator (SROU) Applicants. All applicants passed the applicable portions of the examination and have been issued the appropriate licenses.

REPORT DETAILS

1. Examiner:

Patrick J. Isaac, Chief Examiner
Paul V. Doyle, Examiner

2. Examination Results:

RO (Pass/Fail)	SRO (Pass/Fail)	TOTAL (Pass/Fail)
3/0	3/0	6/0

3. Written Examination:

The written examination was administered on January 31, 1994 to three RO candidates. At the conclusion of the examination, the Chief Examiner immediately secured the master examination answer key and all of the candidate answer sheets. A copy of the master "as given" examination with answer key was forwarded to the licensee's training staff for their formal review.

The facilities written examination comments and the NRC's resolution to those comments are found in Enclosure 2.

All three RO applicants passed the written examination.

4. Operating Tests:

Operating Tests were administered on February 1 and 2, 1994 to 3 RO and 3 SROU candidates. All the candidates passed this portion of the examination.

5. Exit Meeting:

Personnel attending:

Michael Pollock, Director, Reed Reactor Facility
Patrick J.Isaac, NRC
Paul V. Doyle, NRC

The facility examination comments were discussed as noted in Enclosure 2. There were no generic concerns raised by the examiners. NRC noted the good physical condition of the plant.

ENCLOSURE 2

NRC RESOLUTIONS - WRITTEN EXAMINATION

Question A. 015:

Given the following conditions:

-- Reactor A has a rod speed of 30 inches per minute.
-- Reactor B has a rod speed of 20 inches per minute.
-- Rod worth for Reactor A is the same as Reactor B.
-- Source range counts for both reactors is 10 counts per second.
-- Reactor A and Reactor B have identical fuel loading and initial starting reactivities.

Which of the following describes how the two reactors will relate when taken critical based on the stated conditions?

a. Reactor A and Reactor B will be critical at the same power level with Reactor A at a higher rod height.

b. Reactor A rod height is higher than Reactor B with Reactor B power higher than Reactor A.

c. Reactor A and Reactor B will be critical at the same rod height with Reactor B at a higher power level.

d. Reactor B rod height is higher than Reactor A with Reactor A power higher than Reactor B.

Answer A. 015:

c.

Reference A. 015:

RRF Training Manual, page 8-12 and page 9-2. The candidates knowledge of subcritical multiplication and reactivity should lead him/her to the correct answer.

Facility Comment A. 015:

This is a poorly worded question which I believe, in the context of our reactor could not be reasonably answered by the candidates. It was unclear to me, until after considerable discussion with Mr. Isaac, that the correct answer is reached only if it is assumed that the control rods are withdrawn exactly the same distance (exact criticality) and withdrawal is halted at that point. These conditions were not stated in the problem and this is not the routine manner in which our reactor is operated.

Resolution: Delete question.

NRC Resolution A. 015:

Comment accepted. This question will be deleted from the examination.

Question B. 015:

Which one of the following is the MINIMUM number of personnel required to perform a fuel element inspection per SOP-40?

a. 2 to handle fuel plus an RO and an SRO in the control room.

b. 2 to handle fuel. An RO, who must not be directly involved in fuel handling, at the reactor console.

c. 4 to handle fuel and an RO at the reactor console.

d. 4 to handle fuel. An RO must be at the reactor console and an SRO must be present in the facility.

Answer B. 015:

d.

Reference B. 015:

Reed, SOP 40, Section 40.3, page 1.

Facility Comment B. 015:

In drafting this question, the examiner's choice of words "4 to handle fuel" in the answer could confuse a candidate. The minimum requirement, as stated in the attached copy of a page from SOP-40, is "four people shall be available to move fuel." Of these, two (persons 1 & 3) are actually required to Handle fuel while person 2 must be available to assist person 1 at all times including handling fuel, if required; person 4 must be an RO monitoring the console in the control room. In addition, the SOP requires an SRO to be present but this person may, or may not be, one of the four described above. Thus, a better answer would have been "3 to handle fuel. An RO must be at the console and an SRO must be present in the facility". Given the choices available to the candidates, answer d. (as indicated in the key) is the best answer.
Resolution: Keep question, revise answer options before placing in question bank.

NRC Resolution B. 015:

Comment accepted. No change to the answer key is required.

Question C. 011:

Each fuel-moderator element has a colored spacer at the top. Which one of the following describes the fuel loading of a particular element when the spacer is RED?

a. Fully loaded.

b. 3/4 of full load.

c. 1/2 of full load.

d. Graphite Dummy.

Answer C. 011:

c.

Reference C. 011:

Reed, Mech. Maint. and Operating Manual, Page 11.

Facility Comment C. 011:

The colored spacers and groves machined in the tops of fuel elements described on pages 11-13 of the General Atomic Manual are designed to help identify the loading of an element when it is first received at a reactor. Once these elements have been in The core for several years, the color is impossible to detect at a distance and the groves are covered by the fuel handling tool during inspections. In a facility like ours where receiving new fuel is unlikely to occur during an operators tenure, such knowledge is irrelevant.
Resolution: Delete question.

NRC Resolution C. 011:

Comment accepted. This question will be deleted from the examination.

Question: C. 012

During an inspection of the top area of the reactor two wires running out of the top of an instrumented fuel-moderator element are observed to be disconnected. One wire is yellow and the other one is red. Which one of the following describes what these leads are from?

The wires lead from:

a. a fission chamber.

b. a ion chamber.

c. a self powered neutron detector (SPND).

d. a thermocouple.

Answer C. 012:

d.

Reference C. 012:

Reed, Mech. Maint. and Operating Manual, Page 13.

Facility Comment C. 012:

Note that we do not have any instrumented fuel elements in our facility. We have discussed these with candidates and may obtain one in the future so they should have been able to answer the question .
Resolution: Keep question

NRC Resolution C. 012:

Comment noted. This question will not be uploaded into the exam question bank.

Question C. 017:

Which one of the following describes the radiation to which the Ion Chamber, Model RO-2 is sensitive?

a. Beta only.

b. Beta and Gamma only.

c. Beta, Gamma and X-ray only.

d. Beta, Gamma, X-ray and Alpha only.

Answer C. 017:

c.

Reference C. 017:

Reed, Survey Instrument Instruction Manuals, Model RO-2, page 1.

Facility Comment C. 017:

The answer given in the key (c.) is technically correct. However, the only X-ray sources available at Reed are industrial type crystallography units which are likely to emit only very narrow beams of x-rays. Candidates have been taught that the RO-2 may easily miss or, at the least, severely underestimate doses from such a source and, hence, it is not an appropriate instrument for such monitoring. It is possible that a knowledgeable candidate could also choose b.
Resolution: Accept either b) or c).

NRC Resolution C. 017:

Comment accepted. The answer key has been modified to accept either b. or c. as correct.

Question C. 020:

Which one of the following describes the performance of the Reactor Water System circulating pump as the filter in the system becomes clogged?

a. Pump discharge flow decreases and discharge pressure increases.

b. Pump amps increases and pump NPSH increases.

c. Pump discharge flow increases and discharge pressure decreases.

d. Pump amps decreases and NPSH decreases.

Answer C. 020:

a.

Reference C. 020:

Standard pump performance theory.

Facility Comment C. 020:

The abbreviation NPSH which appears in two of the answers was not defined in the question, is not discussed in any of our documentation, and was not familiar to the reviewer. All pump maintenance is done by campus maintenance personnel, not operators. In fact, our pump does not operate with a Net Positive Suction Head. Discussions with the candidates after the exam revealed that they, as a group, had encountered a similar question on a previous NRC exam where NPSH was defined and they had discussed and understood the concept. Thus they should have been able to figure out the correct answer.
Resolution: Keep the question. In the future, define abbreviations used in questions where they are not routinely used in the training materials.

NRC Resolution C. 020:

Comment noted.

ENCLOSURE 3

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

FACILITY: Reed Inst.

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1994/01/31

REGION: V

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each section 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
19.0	32.8	_____	_____	A.	REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.0	34.5	_____	_____	B.	NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
19.0	32.8	_____	_____	C.	PLANT AND RADIATION MONITORING SYSTEMS
58.0		_____ FINAL GRADE	_____ %		TOTALS

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

_____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil only to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet.

6. Fill in the date on the cover sheet of the examination (if necessary).

7. Print your name in the upper right-hand corner of the first page of each section of your answer sheets.

8. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

9. The point value for each question is indicated in parentheses after the question.

10. Partial credit will NOT be given.

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

12. 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.

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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

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

B. NORMAL/EMERG PROCEDURES & RAD CON

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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

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

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER SHEET

Multiple Choice (Circle or X your choice)

If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

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

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

*QUESTION (A.1) [1.0]

A neutron has struck a nucleus and formed a compound nucleus.

Which of the following describes the type of "cross section" this example illustrates?

a. The MICROSCOPIC cross section for absorption.

b. The MICROSCOPIC cross section for fission.

c. The MACROSCOPIC cross section for absorption.

d. The MACROSCOPIC cross section for fission.

*QUESTION (A.2) [1.0]

Select one of the following statements which correctly describes the influence of delayed neutrons on the neutron life cycle.

Delayed neutrons:

a. decrease the period of a reactivity addition because they thermalize more quickly than prompt neutrons.

b. take longer to thermalize because they are born at higher energies than prompt neutrons.

c. cause the length of the average neutron generation time to increase and reactor period to increase.

d. increase the value of beta effective because they are born at higher energies than prompt neutrons.

*QUESTION (A.3) [1.0]

With the reactor on a constant period, which transient requires the LONGEST time to occur? A reactor power change 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. 15% of rated power - going from 20% to 35% of rated power

d. 20% of rated power - going from 40% to 60% of rated power

*QUESTION (A.4) [1.0]

Given the following conditions:

-- Initial reactor power is 10 watts.
-- Final reactor power is 100 watts.
-- The time to reach the final power level from the initial power level was 150 seconds.

Which of the following is the reactor period for these conditions.

a. 33 seconds

b. 65 seconds

c. 150 seconds

d. 345 seconds

*QUESTION (A.5) [1.0]

Which of the following is a factor which is included in the six factor formula but is NOT part of the four factor formula?

a. The fast fission factor.

b. The thermal utilization factor.

c. The resonance escape probability.

d. The non-leakage probability.

*QUESTION (A.6) [1.0]

If we assume that the core excess reactivity is worth $2.85, which one of the following is the amount of negative reactivity that must be inserted to assure that the reactor is "shutdown" as defined per Tech. Specs.

a. $2.85

b. $3.39

c. $3.55

d. $3.79

*QUESTION (A.7) [1.0]

Reactor power is 100 kw with equilibrium Xenon (Xe) concentration. The reactor scrams (reactor power is instantly reduced to 0 kw).

What will the Xenon concentration graph look like?

a. Xenon concentration will decrease initially, then increase to a new equilibrium concentration.

b. Xenon concentration will increase to peak in 8-12 hours then decay to zero.

c. Xenon concentration will increase initially, then decrease to a new equilibrium concentration.

d. Xenon concentration will decrease to a new equilibrium concentration.

*QUESTION (A.8) [1.0]

Which one of the following statements describes the effect of an increase in fuel temperature in a TRIGA fuel element.

a. The probability that a thermal neutron will lose energy in a collision with an excited state hydrogen atom in UZrHx increases.

b. The probability that a neutron will escape from the element before being captured in the fuel meat increases.

c. A shift in the thermal neutron spectrum, towards lower energies, occurs in the fuel element.

d. The mean free path for fast neutrons in the fuel element in decreased.

*QUESTION (A.9) [1.0]

Which of the following completes the statement?

The largest amount of recoverable energy from fission of uranium 235 is due to the kinetic energy of the:

a. fission neutrons.

b. fission gammas.

c. beta decay particles.

d. fission fragments.

*QUESTION (A.10) [1.0]

A small, self-contained neutron source has been made using an alpha producing isotope and a suitable target material. The equation for this interaction is; (alpha particle) + (X) = (Carbon) + (neutron) + (energy).

Which of the following is the most common and efficient target material, (X) in the above equation, for this source?

a. Plutonium

b. Americium

c. Radium

d. Beryllium

*QUESTION (A.11) [1.0]

A rod pull for 10 seconds was performed. The operator is now waiting for subcritical multiplication to affect his source range count rate. Source range count rate is 10 counts per second (cps). Reactivity in the core (p) is -0.010. Keff is 0.99. Which of the following is the value of the subcritical multiplication factor (M)?

a. 1

b. 10

c. 100

d. 1000

*QUESTION (A.12) [1.0]

1/M plots are used to predict reactor criticality. Which of the following describes how criticality is indicated from the graph when the 1/M plot is extrapolated?

a. The plot indicates a certain amount of reactivity added when 1/M equals zero.

b. The plot indicates zero reactivity added when 1/M equals infinity.

c. The plot indicates a constant, horizontal line.

d. The plot indicates a constant, vertical line.

*QUESTION (A.13) [1.0]

Which of the following completes the statement if Keff is 0.995 and a positive reactivity of 0.005 delta k/k is added to the core.

The reactor:

a. shutdown margin (SDM) is $0.66.

b. is approximately critical.

c. is super critical.

d. period is 5 seconds.

*QUESTION (A.14) [1.0]

When a reactor is critical on prompt neutrons alone, it is said to be prompt critical.

If Keff equals 1.0, how much reactivity must be added to make the reactor prompt critical?

The amount of reactivity added equals:

a. the beta fraction.

b. the amount to make Keff equal to 1.1.

c. the amount to make the reactor period infinite.

d. the amount needed to increase the mean neutron lifetime to 0.080 seconds.

*QUESTION (A.15) [1.0] DELETED

Given the following conditions:

-- Reactor A has a rod speed of 30 inches per minute.
-- Reactor B has a rod speed of 20 inches per minute.
-- Rod worth for Reactor A is the same as Reactor B.
-- Source range counts for both reactors is 10 counts per second.
-- Reactor A and Reactor B have identical fuel loading and initial starting reactivities.

Which of the following describes how the two reactors will relate when taken critical based on the stated conditions?

a. Reactor A and Reactor B will be critical at the same power level with Reactor A at a higher rod height.

b. Reactor A rod height is higher than Reactor B with Reactor B power higher than Reactor A.

c. Reactor A and Reactor B will be critical at the same rod height with Reactor B at a higher power level.

d. Reactor B rod height is higher than Reactor A with Reactor A power higher than Reactor B.

*QUESTION (A.16) [1.0]

Which of the following completes the statement?

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

a. Uranium 238 to absorb neutrons over a wider range, thus decreasing the number of neutrons available for fission with Uranium 235.

b. Doppler resonance effects to increase.

c. Less thermal neutron absorption by the moderator.

d. The hydrogen atoms in the ZrH_2 to slow down more neutrons.

*QUESTION (A.17) [1.0]

Assuming that you pull the safety rod at the maximum reactivity insertion rate allowed per Technical Specifications. How long would it take to add $2.00 worth of reactivity? (Assume a linear rod worth.)

a. 1.87 secs

b. 12.5 secs

c. 16.7 secs

d. 17.5 secs

*QUESTION (A.18) [1.0]

With the addition of U-238 to the core, which of the following factors in the "six factor" formula is the most strongly affected?

a. The fast fission factor

b. The thermal utilization factor

c. The resonance escape probability

d. The fuel utilization factor

*QUESTION (A.19) [1.0]

Assume the following rod worths: Safety and Shims are $4.25 each, Reg. is $1.75 and Core excess is $2.85. Calculate the Shutdown Reactivity with the Shim rod stuck all the way out.

a. $1.75

b. $3.15

c. $6.00

d. $7.40

*QUESTION (A.20) [1.0]

The reactor is subcritical with a Keff of 0.95 and a source range count rate of 15 counts per second. Control rods are withdrawn until the source range count rate equals 45 counts per second.

Which of the following is the Keff of the core after the control rod withdrawal?

a. 0.953

b. 0.970

c. 0.983

d. 0.995

(*** End of Section A ***)

*QUESTION (B.1) [1.0]

While performing SOP 01, The Start-up Checklist, the operator places the Count Rate Channel switch to one of the calibrate positions and attempts to raise a control rod. The Source light illuminates and rod motion is noted to occur. Which one of the following describes what was just observed?

The operator checked the:

a. Source Interlock is inoperable.

b. Source Interlock is operable.

c. Rod Raising Interlock is inoperable.

d. Rod Raising Interlock is operable.

*QUESTION (B.2) [1.0]

You are designated as "Checker" for the Start-up checklist just completed. Under the Console Section of the checklist, the following data is observed:

	Calibration Pt.	Scram Pt.
Linear Channel	100%	276 kW
Percent Power Channel	102%	273 kW
Period Channel	5 secs	3.5 secs

Which one of following describes the response made to this data?

As checker, you conclude that:

a. all data is within acceptable ranges.

b. the Linear Channel Scram Point exceeds the maximum allowable limit.

c. the Percent Power Channel Calibration Point exceeds the maximum allowable limit.

d. the Period Channel Scram Point exceeds the maximum allowable limit.

*QUESTION (B.3) [1.0]

The reactor has been started up in accordance with SOP 02, Start-up and Core Excess Check. The operator is on Step 2.7.1.12 of the procedure which requires establishing equilibrium conditions in the reactor to record critical rod positions. Which one of the following meets the MINIMUM definition of equilibrium conditions for this step?

a. 5 minutes of operation at 5 watts with minimal rod corrections.

b. 5 minutes of operation at 5 watts with the Regulating rod backed in below 50% of full range.

c. 2 minutes of operation at 5 watts with the Regulating rod backed in below 50% of full range.

d. 2 minutes of operation at 5 watts with minimal rod corrections.

*QUESTION (B.4) [1.0]

After the reactor is at power from an initial start-up, Core-excess reactivity is calculated to complete SOP 02, Start-up and Core Excess Check. The calculation indicates the core excess reactivity is 0.021 delta k/k. Which one of the following is the correct action for this excess reactivity?

If the core excess reactivity value:

a. is less than the allowable maximum, operation may continue.

b. is greater than recent past values but less than maximum, the reactor must be shutdown and the NRC informed prior to the next reactor startup.

c. is greater than recent past values but less than maximum, the reactor must be shutdown, even though the reason has been determined.

d. is above the allowable maximum, the reactor must be shutdown.

*QUESTION (B.5) [1.0]

For training purposes, reactor power was increased from 400 watts to an equilibrium power 98% of the license limit in accordance with SOP 03, Reactor Operations. Which one of the following describes this power increase?

a. The power increase is within all prescribed procedures and Tech. Specs.

b. The power increase is within all prescribed procedures and Tech. Specs. but violates good practice.

c. It violates SOP 03, but not Tech. Specs.

d. It violates SOP 03 and Tech. Specs.

*QUESTION (B.6) [1.0]

In reviewing the main log prior to assuming the position as Reactor Operator, an entry was made the day before in green ink. Which one of the following is the significance of the green ink?

Green ink is used:

a. to indicate only unexplained scrams.

b. to indicate only inadvertent scrams.

c. to indicate all unexplained and inadvertent scrams.

d. to indicate all unexplained and inadvertent scrams that require the Director's permission for restart.

*QUESTION (B.7) [1.0]

Who has the responsibility for locating and properly marking off any "high radiation" areas found within RRF?

a. Any operator.

b. Only the Health Physicist.

c. Only the Director of RRF.

d. Only the Director of RRF or the Health Physicist.

*QUESTION (B.8) [1.0]

Select the MINIMUM amount of time that must be spent performing license activities in order to maintain your license active.

a. 4 hours per month

b. 8 hours per month

c. 4 hours per quarter

d. 8 hours per quarter

*QUESTION (B.9) [1.0]

The REED TRIGA reactor has been shutdown due to a fuel element leak. Which one of the following radioactive gases poses the most significant hazard during the search for the leaking fuel element?

a. Nitrogen 16

b. Tritium

c. Xenon 135

d. Argon 41

*QUESTION (B.10) [1.0]

In accordance with the Reed Emergency Implementation procedures, which one of the following is the minimum number and type of portable survey meters required for operations to be allowed?

a. 1 GM and 1 Scintillation.

b. 1 GM and 1 Ion chamber.

c. 2 GM and 1 Scintillation.

d. 2 GM and 1 Ion chamber.

*QUESTION (B.11) [1.0]

Whose approval is necessary before radioactive material can be transferred to personnel of another department?

a. The Senior Reactor Operator on duty.

b. The Reactor Supervisor.

c. The Reactor Operations Committee.

d. The Director.

*QUESTION (B.12) [1.0]

The following paragraph is a Reed Facility Emergency Plan definition.

> ...that boundary, not necessarily having restrictive barriers, including the adjoining Chemistry Building and extending 250 feet in every direction from the operations boundary.

Which one of the following terms matches the above definition?

a. Restricted Area.

b. Site Boundary.

c. Emergency Planning Zone (EPZ).

d. Offsite Geographical Area.

*QUESTION (B.13) [1.0]

Which one of the following approvals are necessary for the experiment type defined in the following paragraph?

> Those (experiments) which may be performed under the Technical Specifications and are not routine or modified routine experiments.

a. Performed at the discretion of the Director with no further review necessary.

b. Performed at the discretion of the Director providing no new hazards are present beyond those allowed in Tech. Specs.

c. Performed at the discretion of the Director providing any hazards present beyond those allowed by Tech. Specs are approved by the Reactor Operations Committee.

d. Performed at the discretion of the Director after approval from the Reactor Operations Committee.

*QUESTION (B.14) [1.0]

A change to SOP 40, Fuel Element Inspection, is required at Step 40.7.1, Procedure for Moving Fuel from the Core to the Viewing Periscope. Which one of the following is required for the procedure change to be implemented?

a. Implement immediately with Reactor Supervisor concurrence.

b. Implement immediately with Director's concurrence.

c. Implement after Director's approval with Reactor Safety Committee approval within 14 days.

d. Implement only after Reactor Safety Committee and/or the Radiation Safety Committee approval.

*QUESTION (B.15) [1.0]

Which one of the following is the MINIMUM number of personnel required to perform a fuel element inspection per SOP-40?

a. 2 to handle fuel plus an RO and an SRO in the control room.

b. 2 to handle fuel. An RO, who must not be directly involved in fuel handling, at the reactor console.

c. 4 to handle fuel and an RO at the reactor console.

d. 4 to handle fuel. An RO must be at the reactor console and an SRO must be present in the facility.

*QUESTION (B.16) [1.0]

A prerequisite which must be met prior to performing SOP 44, Power Calibration, is that the reactor must not be operated for 2 days prior to the calibration. Which one of the following is the reason for this prerequisite?

a. Minimizes xenon biasing.

b. Allows the pool temperature to stabilize.

c. Maintains thermocouple calibration valid.

d. Allows pool conductivity to stabilize.

*QUESTION (B.17) [1.0]

In accordance with Emergency Implementation Procedures, Appendix C, Evacuation of the Facility, the first staff person using the exit corridor shall take the grab bag.

Which ONE of the following has the ultimate responsibility to insure the bag has been taken?

a. Emergency Coordinator.

b. The Operator.

c. Senior Member of ENCL.

d. The first RRF management to arrive on site.

*QUESTION (B.18) [1.0]

Given the following conditions:

- A 21 year old radiation worker.
- A current NRC Form 5 on file for the worker.
- The worker has received 47.0 rem Committed Dose Equivalent (CDE) for the year.
- The worker's current Annual Deep Dose Equivalent (DDE) dose is zero.

In accordance with 10 CFR 20.1201, what is the MAXIMUM amount of Deep Dose Equivalent (DDE) that the worker can receive for the remainder of the year?

a. 2.5 rem

b. 3.0 rem

c. 5.0 rem

d. 15.0 rem

*QUESTION (B.19) [1.0]

Reed's Technical Specifications and operating procedures require the reactor to be shutdown if the reactor pool temperature exceeds a specified limit.

Which one of the following is the LOWEST temperature that EXCEEDS the Tech. Spec. limit?

a. 50 degrees F

b. 45 degrees C

c. 50 degrees C

d. 120 degrees F

*QUESTION (B.20) [1.0]

A point source of GAMMA radiation measures 50 roentgen/hr [R/hr] gamma, at a distance of 2 feet.

Assuming 100% detector efficiency, which one of the following is the exposure rate [R/hr] from the GAMMA source at a distance of 16 feet?

a. 48

b. 7.8

c. 4.8

d. .78

(*** End of Section B ***)

*QUESTION (C.1) [1.0]

All power is lost to the facility and the emergency battery lights are on as required. The reactor is safely shutdown with no imminent emergency apparent. Which of the following is the MAXIMUM length of time that the emergency lights are able to produce light?

a. 1 hour.

b. 3 hours.

c. 6 hours.

d. 12 hours.

*QUESTION (C.2) [1.0]

Which one of the following describes the regulating rod drive motor and speed?

	Motor	Speed
a.	Variable Speed	24 in/min.
b.	Non-Synchronous	24 in/min.
c.	Single-Phase	19 in/min.
d.	Servomotor	19 in/min.

*QUESTION (C.3) [1.0]

Which ONE of the following interlocks will stop withdrawal of control rods?

a. Automatic control selected following two watts on the log-n channel.

b. Less than two counts per second on the startup channel.

c. A period less than 2 seconds.

d. Loss of one out of three signals to automatic reactor control.

*QUESTION (C.4) [1.0]

Using the drawing of the heating and ventilation systems provided, determine which of the following describes the condition of the ventilation fans in the event of air contamination is sensed greater than the allowable setpoint?

	Unit A	Unit B	Unit C
a.	Stopped	Running	Running
b.	Running	Running	Running
c.	Stopped	Stopped	Running
d.	Running	Stopped	Stopped

*QUESTION (C.5) [1.0]

Which ONE of the following statements is correct for the Linear Power Range Channel?

a. Covers the entire power spectrum without switching.

b. Uses an uncompensated ion chamber.

c. Provides input to the automatic reactor control circuit.

d. Produces a voltage signal proportional to the logarithm of neutron flux.

*QUESTION (C.6) [1.0]

A release has occurred in the facility. A check of the Gaseous Stack Monitor reveals a red jewelled light on the front of the monitor readout is illuminated. Which of the following is the significance of this red light?

a. The air confinement system is activated.

b. The detector has failed.

c. The failsafe is activated.

d. The air confinement system is shutdown.

*QUESTION (C.7) [1.0]

Which ONE of the following occurs when the CAM reaches the "failsafe" setpoint?

a. Amber light on.

b. Amber light off.

c. Amber light on and bell sounds.

d. Amber light off and bell sounds.

*QUESTION (C.8) [1.0]

The rotary specimen rack contains 40 tubular aluminum containers. Of these 40, 1 tube has a hole in the bottom. Which one of the following describes the reason for this hole.

a. To equalize pressure between the rack and tubes.

b. To detect moisture in the bottom of the rack.

c. To allow moisture buildup in the tubes to drain away.

d. To allow dry air flow to flow through the rack bottom.

*QUESTION (C.9) [1.0]

Which one of the following describes the minimum flowrate for the Reactor Water System demineralizers?

a. 10 gpm through at least one demineralizer.

b. 10 gpm through each demineralizer.

c. 20 gpm through at least one demineralizer.

d. 5 gpm through each demineralizer.

*QUESTION (C.10) [1.0]

Reactor pool level has decreased 8 inches over the last 4 hours.

Which ONE of the following is the approximate leakrate out of the reactor pool?

a. .25 gallons per minute.

b. 2.5 gallons per minute.

c. 25 gallons per HOUR.

d. 250 gallons per HOUR.

*QUESTION (C.11) [1.0] DELETED

Each fuel-moderator element has a colored spacer at the top. Which one of the following describes the fuel loading of a particular element when the spacer is RED?

a. Fully loaded.

b. 3/4 of full load.

c. 1/2 of full load.

d. Graphite Dummy.

*QUESTION (C.12) [1.0]

During an inspection of the top area of the reactor two wires running out of the top of an instrumented fuel-moderator element are observed to be disconnected. One wire is yellow and the other one is red. Which one of the following describes what these leads are from?

The wires lead from:

a. a fission chamber.

b. a ion chamber.

c. a self powered neutron detector (SPND).

d. a thermocouple.

*QUESTION (C.13) [1.0]

Referring to the attached Figure 1-6, Operating Ranges of Reactor Neutron Detector, which one of the following is represented by the range indicated by the "X"?

a. Compensated Ion Chamber Linear Recorder.

b. Compensated Ion Chamber Log n Recorder.

c. Uncompensated Ion Chamber Percent Power.

d. Fission Counter Count-Rate Channel.

*QUESTION (C.14) [1.0]

Which one of the following does not provide any protective interlocks or actions?

a. Linear Power Channel.

b. Log Power (Log-N Channel).

c. Percent Power Channel.

d. Count Rate Channel.

*QUESTION (C.15) [1.0]

Which one of the following is the reason conductivity of the pool water must be maintained at or below 2 micro-mhos/cm?

a. To maintain pool water pH 6.5 - 7.0.

b. To maintain clarity of the water.

c. To enhance the operation of the demineralizers.

d. To decrease corrosion.

*QUESTION (C.16) [1.0]

When a compensated ion chamber is used for neutron detection, how is the gamma flux accounted for?

a. Pulse height discrimination is used to cancel the gamma flux.

b. The gamma flux is proportional to neutron flux and is counted with the neutrons.

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

d. The gamma flux passes through the detector with no interaction because of detector design.

*QUESTION (C.17) [1.0] b + C

Which one of the following describes the radiation to which the Ion Chamber, Model RO-2 is sensitive?

a. Beta only.

b. Beta and Gamma only.

c. Beta, Gamma and X-ray only.

d. Beta, Gamma, X-ray and Alpha only.

*QUESTION (C.18) [1.0]

When calibrating the Gaseous Stack Monitor, the supervisor can authorize a change to the alarm setpoint values. Which one of the following describes the rules that govern the changing of the setpoint values?

The setpoint values may be changed providing:

a. the Failsafe setpoint is less than the Alarm setpoint AND the Alarm setpoint is less than 1000 cpm.

b. the Failsafe setpoint is less than the Alarm setpoint OR the Alarm setpoint is less than 1000 cpm.

c. the Failsafe setpoint is greater than the Alarm setpoint AND the Alarm setpoint is less than 1000 cpm.

d. the Failsafe setpoint is greater than the Alarm setpoint OR the Alarm setpoint is less than 1000 cpm.

*QUESTION (C.19) [1.0]

The Reed Facility License grants permission for possession of 2 specific sources. Which one of the following describes these sources?

a. A 2 mg Ra-226 and a 1.64 curie plutonium-beryllium source.

b. A 1 curie americium-beryllium and a 1.64 curie plutonium-beryllium source.

c. A 1.64 curie americium-beryllium and a 1 curie plutonium-beryllium source.

d. A 2 mg Ra-226 and a 1 curie americium-beryllium source.

*QUESTION (C.20) [1.0] Comment

Which one of the following describes the performance of the Reactor Water System circulating pump as the filter in the system becomes clogged?

a. Pump discharge flow decreases and discharge pressure increases.

b. Pump amps increases and pump NPSH increases.

c. Pump discharge flow increases and discharge pressure decreases.

d. Pump amps decreases and NPSH decreases.

(*** End of Section C ***)
(**** END OF EXAMINATION ****)

*ANSWER (A.1)
a.
*REFERENCE (A.1)
RRF Training Manual, page 4-2

*ANSWER (A.2)
c.

*REFERENCE (A.2)
RRF Training Manual, page 9-7.

*ANSWER (A.3)
a
*REFERENCE (A.3)
$P_f = P_0\ e^{t/\tau}$ ∴ $t = (\ln P_f/P_0)\cdot\tau$
$\ln(6/1) > \ln(20/10) > \ln(35/20) > \ln(60/40)$

*ANSWER (A.4)
b.

*REFERENCE (A.4)
RRF Training Manual, page 9-4.
$P_f = P_0\ e^{t/T}$
$100 = 10\ e^{150/T}$
$T = 65$ seconds

*ANSWER (A.5)
d.
*REFERENCE (A.5)
RRF Training Manual, page 8-7.

*ANSWER (A.6)
d.
*REFERENCE (A.6)
RRF Training Manual, page 10-6 and 10-7.

*ANSWER (A.7)
b.
*REFERENCE (A.7)
RRF Training Manual, page 10-13 and 14

*ANSWER (A.8)
b.

*REFERENCE (A.8)
RRF Training Manual, page 10-17.

*ANSWER (A.9)
d.
*REFERENCE (A.9)
RRF Training Manual, page 10-1.

*ANSWER (A.10)
d.

*REFERENCE (A.10)
RRF Training Manual, page 7-13.

*ANSWER (A.11)
c.
*REFERENCE (A.11)
RRF Training Manual, page 8-13.
M= 1/(1-Keff)
M= 1/(1-0.99)
M= 100

*ANSWER (A.12)
a.
*REFERENCE (A.12)
RRF Training Manual, page 8-13.

*ANSWER (A.13)
b.
*REFERENCE (A.13)
RRF Training Manual, page 8-2
p= (Keff-1)/Keff
p= (0.995-1)/0.995
p= -0.005025125
p1 + p2= 0.005 + -0.005025125
p1 + p2= -0.000025125
Keff= 1/(1-p)
Keff= 1/(1- -0.000025225)
Keff= 0.99997

*ANSWER (A.14)
a.
*REFERENCE (A.14)
RRF Training Manual, page 9-13

*ANSWER (A.15) DELETED
c.
*REFERENCE (A.15)
RRF Training Manual, page 8-12 and page 9-2. The candidates knowledge of subcritical multiplication and reactivity should lead him/her to the correct answer.

*ANSWER (A.16)
d.
*REFERENCE (A.16)
RRF Training Manual, page 10-17.

*ANSWER (A.17)
b.
*REFERENCE (A.17)
RRF Tech. Specs. F.4
$2.00 x 0.0075 = 0.015 delta K/K
0.015 delta K/K / 0.0012 delta K/K/sec = 12.5 secs

*ANSWER (A.18)
c.

*REFERENCE (A.18)
RRF Training Manual, page 8-11

*ANSWER (A.19)
b.

*REFERENCE (A.19)
RRF Requal Exam 88-89 / NRC Exam 8/91

*ANSWER (A.20)
c.

*REFERENCE (A.20)
Reed Exam 1990
$CR_1/CR_2 = (1 - Keff_2)/(1 - Keff_1)$
$15/45 = (1 - Keff_2/(1 - 0.95)$
$(0.05)(0.3333) = 1 - Keff_2$
$Keff_2 = 1 - 0.016665 = 0.983$

*ANSWER (B.1)
a.
*REFERENCE (B.1)
Reed, SOP 01, Step 1.7.6.7, page 8.

*ANSWER (B.2)
b.
*REFERENCE (B.2)
Reed, SOP01, Steps 1.7.6.3.2, .3, and .4, pages 6-7.

*ANSWER (B.3)
d.
*REFERENCE (B.3)
Reed, SOP02, page 2, Step 2.7.1.10.

*ANSWER (B.4)
a.
*REFERENCE (B.4)
Reed, SOP-02, Step 2.7.2, page 3.

*ANSWER (B.5)
c.
*REFERENCE (B.5)
Reed, SOP 03, Precaution 3.5.4, page 1.

*ANSWER (B.6)
c.
*REFERENCE (B.6)
Reed, SOP 10, Section 10.7.7, page 3.

*ANSWER (B.7)
a.
*REFERENCE (B.7)
Reed, SOP 18 (Index refers to it as SOP 20), Section 18.3.

*ANSWER (B.8)
c.
*REFERENCE (B.8)
10 CFR 55.53

*ANSWER (B.9)
c.
*REFERENCE (B.9)
Facility Comments on Written Examination for Requalification Exam Administered in August 1992.

*ANSWER (B.10)
b.
*REFERENCE (B.10)
Reed EIPs, Section 2.2, page 4.

*ANSWER (B.11)
d.
*REFERENCE (B.11)
Reed Admin procedures, page 12, step 12.

*ANSWER (B.12)
b.
*REFERENCE (B.12)
Reed Emergency Plan, Section 2.0, page 7.

*ANSWER (B.13)
d.
*REFERENCE (B.13)
Reed, Administrative Procedures, Section IV.4.2 and 4.3, page 13.

*ANSWER (B.14)
d.
*REFERENCE (B.14)
Reed, Admin Procedures, Section VII.7.2 and 7.2, page 17.

*ANSWER (B.15)
d.
*REFERENCE (B.15)
Reed, SOP 40, Section 40.3, page 1.

*ANSWER (B.16)
a.
*REFERENCE (B.16'
Reed, SOP 44, Section 44.4, page 1.

*ANSWER (B.17)
b.
*REFERENCE (B.17)
Reed, EIPs, Appendix C, page 13

*ANSWER (B.18)
b.
*REFERENCE (B.18)
10CFR20.1201(ii)

*ANSWER (B.19)
c.
*REFERENCE (B.19)
Reed, Technical Specifications, D.1.

*ANSWER (B.20)
d.
*REFERENCE (B.20)
D2 = [50 R/hr] x $[2/16]^2$ = 50/64 = .78
Reed Training Manual Chapter 5, pages 18-20

(*** End of Section B ***)

*ANSWER (C.1)
c.
*REFERENCE (C.1)
Reed, EIPs, Section 2.4, page 4.

*ANSWER (C.2)
a.
*REFERENCE (C.2)
Reed, SAR page 5-11.

*ANSWER (C.3)
b.
*REFERENCE (C.3)
Reed Technical Specification, Table II, page 9

*ANSWER (C.4)
a.
*REFERENCE (C.4)
RRF SAR Section 4.4, figure 4-5, page 4-7.

*ANSWER (C.5)
c.
*REFERENCE (C.5)
Reed Instrument Maint. Manual, page 1-14.

*ANSWER (C.6)
a.
*REFERENCE (C.6)
Reed, EIPs, Section 1.2, page 2.

*ANSWER (C.7)
b.
*REFERENCE (C.7)
Reed SOP-70, Section 70.7.4.2, page 3

*ANSWER (C.8)
b.
*REFERENCE (C.8)
Reed, Maintenance and Operating Manual, page 30.

*ANSWER (C.9)
b.
*REFERENCE (C.9)
Reed, Maintenance and Operating Manual, page 83.

*ANSWER (C.10)
b.
*REFERENCE (C.10)
Reed, Maintenance and Operating Manual, para 5.113, page 81.
8 inches/4 hours = 2 inches/hour
2 inches/hour X 75 gallons/inch = 150 gallons/hour
150 gallons/hour/ 60 minutes/hour = 2.5 gpm

*ANSWER (C.11) DELETED
c.
*REFERENCE (C.11)
Reed, Mech. Maint. and Operating Manual, Page 11.

*ANSWER (C.12)
d.
*REFERENCE (C.12)
Reed, Mech. Maint. and Operating Manual, Page 13.

*ANSWER (C.13)
a.
*REFERENCE (C.13)
Reed, Instrumentation Maintenance Manual, page 1-7..

*ANSWER (C.14)
b.
*REFERENCE (C.14)
Reed, Instrumentation Maintenance Manual, page 1-13,14.

*ANSWER (C.15)
d.
*REFERENCE (C.15)
Reed, Mechanical Maintenance and Operating Manual, page 84.

*ANSWER (C.16)
c.
*REFERENCE (C.16)
RF Training Manual, page 6-12.

*ANSWER (C.17)
c., b.
*REFERENCE (C.17)
Reed, Survey Instrument Instruction Manuals, Model RO-2, page 1.

*ANSWER (C.18)
a.
*REFERENCE (C.18)
Reed SOP 33, page 4.

*ANSWER (C.19)
c.
*REFERENCE (C.19)
Reed Facility License, Section 2.

*ANSWER (C.20)
a.
*REFERENCE (C.20)
Standard pump performance theory.

(*** End of Section C ***)
(**** END OF EXAMINATION ****)

ANSWER KEY

A.1	a.	
A.2	c.	
A.3	a	
A.4	b.	
A.5	d.	
A.6	d.	
A.7	b.	
A.8	b.	
A.9	d.	
A.10	d.	
A.11	c.	
A.12	a.	
A.13	b.	
A.14	a.	
A.15	c.	DELETED
A.16	d.	
A.17	b.	
A.18	c.	
A.19	b.	
A.20	c.	

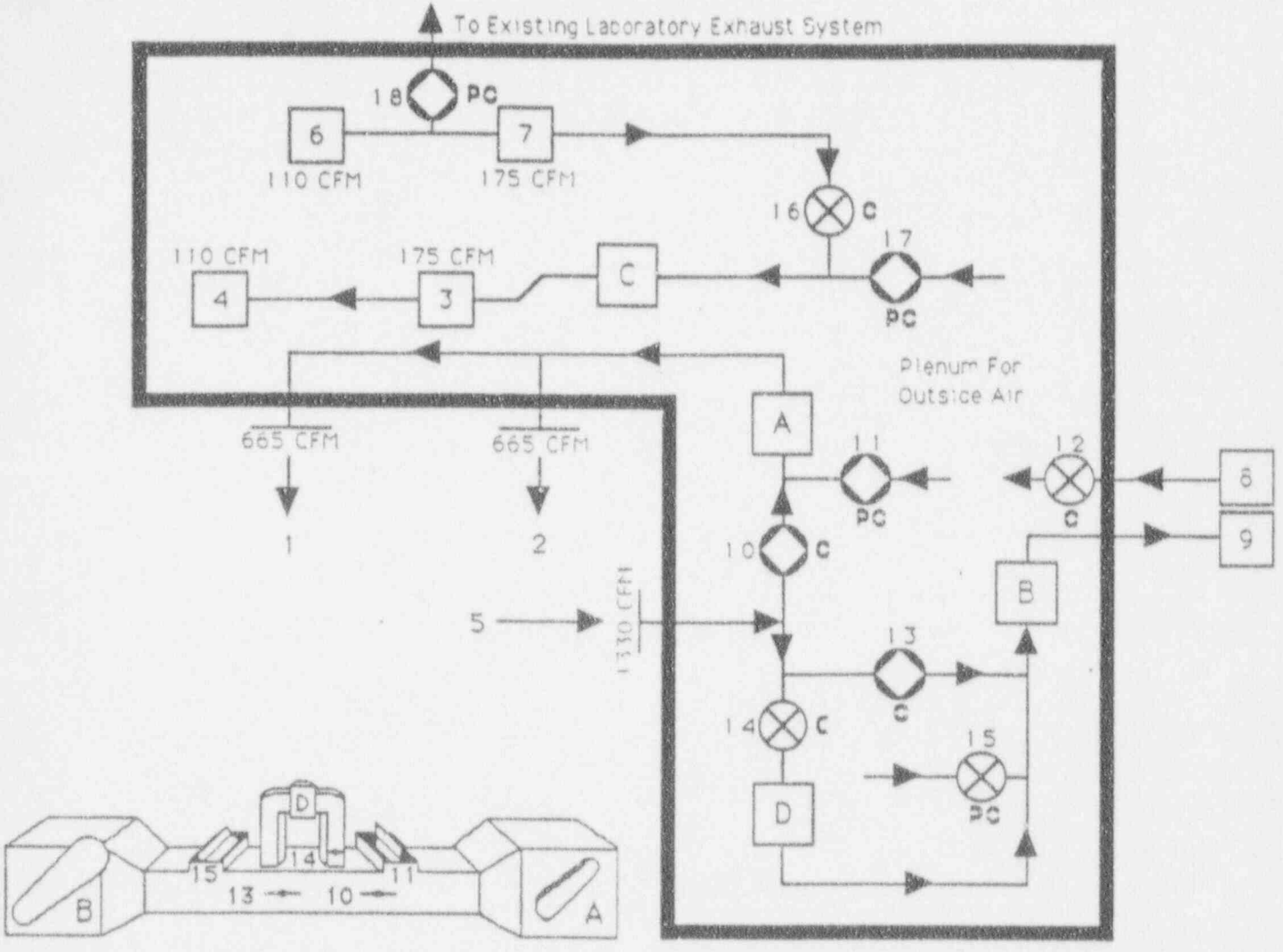
ANSWER KEY

B.1	a.
B.2	b.
B.3	d.
B.4	a.
B.5	c.
B.6	c.
B.7	a.
B.8	c.
B.9	c.
B.10	b.
B.11	d.
B.12	b.
B.13	d.
B.14	d.
B.15	d.
B.16	a.
B.17	b.
B.18	b.
B.19	c.
B.20	d.

ANSWER KEY

C.1	c.
C.2	a.
C.3	b.
C.4	a.
C.5	c.
C.6	a.
C.7	b.
C.8	b.
C.9	b.
C.10	b.
C.11	c. DELETED
C.12	d.
C.13	a.
C.14	b.
C.15	d.
C.16	c.
C.17	c. , b.
C.18	a.
C.19	c.
C.20	a.

Schematic: Air Systems
Reed Reactor

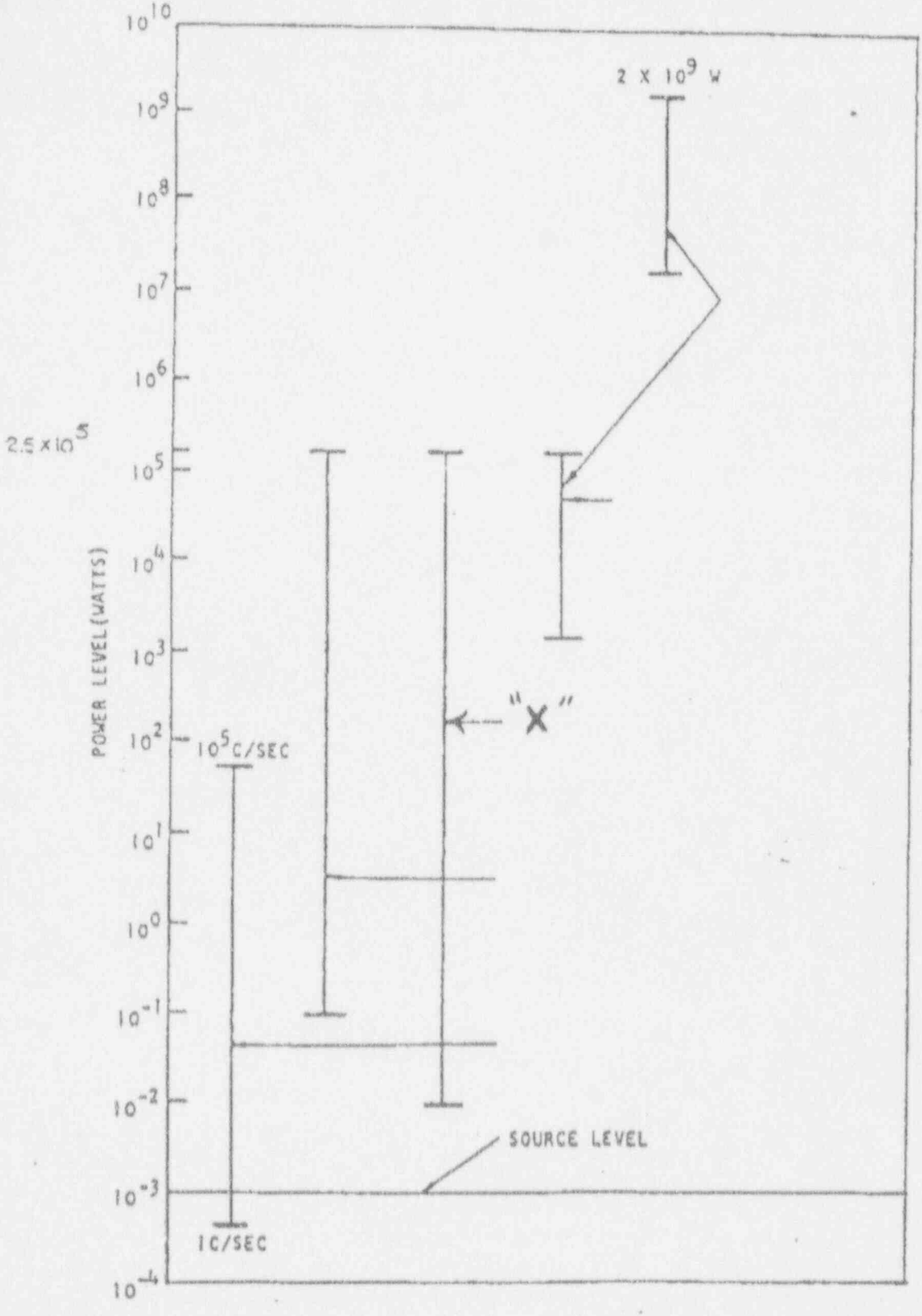


A Supply Unit Reactor Room
B Exhaust Unit Reactor Room
C Supply Unit Control & Mechanical Room
D Absolute Filter

1 Reactor Room
2 Reactor Room
3 Control Room
4 Mechanical Room
5 Reactor Room
6 Mechanical Room
7 Control Room
8 Outside Air Intake
9 Exhaust Stack

* A circle represents a damper ◇ Represents a Tight Closing Type Damper ⊗ Represents a Modulating Damper

Figure 4-4 Schematic Air Systems
(Normal Operation)



(MIII-31)

Fig. 1-6--Operating ranges of reactor neutron detector