July 17, 2013

Dr. Robert D. Busch, Director
Chief Reactor Supervisor
Chemical and Nuclear Engineering Dept, FEC 209
MSC01 1120
University of New Mexico
Albuquerque, NM 87131-0001

SUBJECT: EXAMINATION REPORT NO. 50-252/OL-13-02, UNIVERSITY OF NEW MEXICO AGN 201M REACTOR

Dear Dr. Busch:

During the week of June 17, 2013, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your University of New Mexico Reactor Facility. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Section 2.390 of Title 10 of the *Code of Federal 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 component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/

Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-252

Enclosures:
1. Examination Report No. 50-252/OL-13-02
2. Written Examination

cc without enclosures: See next page

Dr. Robert D. Busch, Director
Chief Reactor Supervisor
Chemical and Nuclear Engineering Dept, FEC 209
MSC01 1120
University of New Mexico
Albuquerque, NM 87131-0001

SUBJECT: EXAMINATION REPORT NO. 50-252/OL-13-02, UNIVERSITY OF NEW MEXICO AGN 201M REACTOR

Dear Dr. Busch:

During the week of June 17, 2013, the U.S. Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your University of New Mexico Reactor Facility. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Section 2.390 of Title 10 of the *Code of Federal 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 component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/
Gregory T. Bowman, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-252

Enclosures:
1. Examination Report No. 50-252/OL-13-02
2. Written Examination

cc without enclosures: See next page

<u>DISTRIBUTION</u> w/ encls.:
PUBLIC PROB r/f Facility File CRevelle (O-7 F-08)
ADAMS ACCESSION #: ML13192A457

OFFICE	NRR/DPR/PROB/CE	NRR/DPR/PROB/OLA	NRR/DPR/PROB/BC
NAME	PIsaac	CRevelle	GBowman
DATE	07/17/2013	07/ 17 /2013	07/17/2013

OFFICIAL RECORD COPY

cc:

City Manager
City of Albuquerque
City Hall
Albuquerque, NM 87101

Dr. Anil Prinja, Reactor Administrator
Chemical and Nuclear Engineering Department
University of New Mexico
209 Farris Engineering, MSC 01-1120
Albuquerque, NM 87131-0001

Mr. James De Zetter, Radiation Safety Officer
Safety, Health, Environmental Affairs
University of New Mexico
1801 Tucker NE, Bldg. 233MSC 07-4100
Albuquerque, NM 87131-0001

Chief, Radiation Control Bureau
Field Operations Division
Environment Department
Harold S. Runnels Bldg.
1190 St. Francis Drive, Rm S2100
Santa Fe, NM 87505-4173

Deputy Secretary, Office of the Secretary
New Mexico State Environment Dept.
1190 St. Francis Drive, Suite 4050N
Sante Fe, NM 87502-6110

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

EXAMINATION REPORT NO: 50-252/OL-13-01

FACILITY: University of New Mexico

FACILITY DOCKET NO.: 50-252

FACILITY LICENSE NO.: R-102

SUBMITTED BY: ___________**/RA/**_______ ___07/17/13____

Patrick J. Isaac, Chief Examiner — Date

SUMMARY:

During the week of June 17, 2013, the NRC administered operator licensing retake examinations to four Reactor Operator candidates. One candidate failed the examinations.

REPORT DETAILS

1. Examiner: Patrick J. Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/1	N/A	3/1
Operating Tests	N/A	N/A	N/A
Overall	3/1	N/A	3/1

3. Exit Meeting:

None.

ENCLOSURE 1

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

FACILITY: University of New Mexico AGN-201M

REACTOR TYPE: AGN-201M

DATE ADMINISTERED: 6/21/2013

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 brackets 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
10.00	33.3			A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
10.00	33.3			B. Normal and Emergency Operating Procedures and Radiological Controls
10.00	33.3			C. Facility and Radiation Monitoring Systems
Final Grade				

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

____
Candidate's Signature

ENCLOSURE 2

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have 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.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

EQUATION SHEET

$$\dot{Q} = \dot{m}c_P \Delta T = \dot{m}\Delta H = UA\Delta T$$

$$P_{max} = \frac{(\beta - \rho)^2}{(2\alpha \ell)}$$

$$\lambda_{eff} = 0.1 \sec^{-1}$$

$$P = P_0 \, e^{t/\mathrm{T}}$$

$$SCR = \frac{S}{-\rho} \cong \frac{S}{1 - K_{eff}}$$

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

$$SUR = 26.06 \left[\frac{\lambda_{eff}\rho + \dot{\rho}}{\overline{\beta} - \rho} \right]$$

$$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$

$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

$$P = \frac{\beta(1 - \rho)}{\beta - \rho} P_0$$

$$M = \frac{1}{1 - K_{eff}} = \frac{CR_2}{CR_1}$$

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

$$M = \frac{1 - K_{eff_1}}{1 - K_{eff\,2}}$$

$$SDM = \frac{1 - K_{eff}}{K_{eff}}$$

$$\mathrm{T} = \frac{\ell^*}{\rho - \overline{\beta}}$$

$$\mathrm{T} = \frac{\ell^*}{\rho} + \left[\frac{\overline{\beta} - \rho}{\lambda_{eff}\rho + \dot{\rho}} \right]$$

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

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{K_{eff_1} K_{eff_2}}$$

$$\rho = \frac{K_{eff} - 1}{K_{eff}}$$

$$DR = DR_0 \, e^{-\lambda t}$$

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

$$DR = \frac{6 \, Ci \, E(n)}{R^2}$$

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

DR – Rem, Ci – curies, E – Mev, R – feet

---

1 Curie = 3.7×10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54×10^{3} BTU/hr

1 Mw = 3.41×10^{6} BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)

c_P = 1.0 BTU/hr/lbm/°F

c_p = 1 cal/sec/gm/°C

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.1 [½ point]
Which of the following is the largest effect on the reactivity worth of a control rod?

a. Overall reactor power.

b. Speed of the control rod.

c. Axial and radial flux shape.

d. Delayed neutron fraction value.

Answer: c
Reference: NUCLEAR REACTOR THEORY; LAMARSH

Question A.2 [½ point]
Which ONE of the following describes the difference between a moderator and reflector?

a. A reflector increases the neutron production factor and a moderator increases the fast fission factor.

b. A reflector decreases the thermal utilization factor and a moderator increases the fast fission factor.

c. A reflector decreases the neutron production factor and a moderator decreases the fast non-leakage factor.

d. A reflector increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

Answer: d
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 1, Section 1.51 & 1.52

Question A.3 [½ point]
The delayed neutron fraction changes over core life primarily due to the:

a. buildup of Pu^{240} which increases the delayed neutron fraction.

b. buildup of Pu^{239} which decreases the delayed neutron fraction.

c. depletion of U^{235} which decreases the delayed neutron fraction.

d. depletion of U^{238} which increases the delayed neutron fraction.

Answer: c.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 5, Section 5.170, Chapter 2, Table 2.10.

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.4 [½ point]
Select the answer that describes the inherent **safety feature** provided by the temperature coefficient of reactivity.

a. Its negative value causes reactivity to increase as moderator temperature increases.
b. Its negative value causes reactivity to decrease as moderator temperature increases.
c. Its positive value causes reactivity to increase as moderator temperature increases.
d. Its positive value causes reactivity to decrease as moderator temperature increases.

Answer: b.
Reference: Basic Reactor Theory

Question A.5 [½ point]
The reactor is initially shut down with count rate at 8 counts per second (cps) and K_{eff} = 0.975. Control rods are inserted, changing K_{eff} to 0.995. Select the stable count rate would you expect.

a. 15 cps
b. 25 cps
c. 40 cps
d. 80 cps

Answer: c.
Reference: Basic Reactor Theory

Question A.6 [½ point]
What is the kinetic energy range of a thermal neutron?

a. > 1 MeV
b. 100 KeV – 1 MeV
c. 1 eV – 100 KeV
d. < 1 eV

Answer: d.
Reference: Standard NRC Question

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.7 [½ point]
Which ONE of the following elements will produce the greatest energy loss per collision?

a. Oxygen

b. Graphite

c. Hydrogen

d. Uranium 238

Answer: c.
Reference: Glasstone & Sesonske, Nuclear Reactor Engineering, Chapter 3, Section 3.66, Table 3.3, p 134.

Question A.8 [½ point]
Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

c. available above that which is required to keep the reactor critical.

d. available above that which is required to make the reactor subcritical.

Answer: c.
Reference: Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.172

Question A.9 [½ point]
In the AGN - 201, the largest thermal neutron microscopic cross section is:

a. Xenon-135 capture.

b. Uranium-235 fission.

c. Uranium-238 fission.

d. Graphite C-12 absorption.

Answer: a.
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 5, Section 5.62;

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.10 [½ point]
Which ONE of the following causes indicated power (count rate) to stabilize several hours after a reactor scram from full power? Assume normal system/component operation and no maintenance activity.

a. Xenon removal by decay at a constant rate.

b. Subcritical multiplication of source neutrons.

c. Decay of compensating voltage at low power levels.

d. Power level dropping below the minimum detectable level.

Answer: b.
Reference: Glasstone, Nuclear Reactor Engineering, Chapter 5, Section 5.45-5.47

Question A.11 [½ point]
At the beginning of a reactor startup, Keff is 0.90 with a count rate of 30 CPS. Power is increased to a new, steady value of 60 CPS. The new Keff is:

a. 0.91

b. 0.925

c. 0.95

d. 0.975

Answer: c.
Reference: Lamarsh, Introduction To Nuclear Engineering, 3rd Edition.
$(CR_2/CR_1) = (1-K_{eff0})/(1-K_{eff1})$ $(60/30) = (0.90)(1-K_{eff1})$ Keff1 = 0.95

Question A.12 [½ point]
Which ONE of the following samples when placed individually into the reactor experimental facilities will have a POSITIVE reactivity affect?

a. Gold wire

b. Indium foils

c. Cadmium foils

d. Polyethylene disk

Answer: d.
Reference: Experiments

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.13 [½ point]
Which ONE of the following statements explains why delayed neutrons allow control of the reactor?

a. Delayed neutrons are born at higher energies than prompt neutrons and require more collisions to reach thermal energy.

b. Delayed neutrons shorten the average time for core response to a reactivity addition.

c. Delayed neutrons increase the average generation time of the neutron population.

d. Delayed neutrons make up a higher percentage of the core's total neutron population than prompt neutrons.

Answer: c.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 334.

Question A.14 [½ point]
Inelastic scattering is the process whereby a neutron collides with a nucleus and:

a. recoils with the same kinetic energy it had prior to the collision.

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

c. is absorbed by the nucleus, with the nucleus emitting a gamma ray.

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

Answer: b.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 64.

Question A.15 [½ point]
Which ONE of the following factors is affected MOST by an increase in fission product poisoning?

a. Resonance Escape Probability

b. Fast Fission Factor

c. Thermal Utilization Factor

d. Reproduction Factor

Answer: c.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 312.

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.16 [½ point]
Which ONE of the following describes the difference between reflectors and moderators?

a. Reflectors decrease core leakage while moderators thermalize neutrons.

b. Reflectors shield against neutrons while moderators decrease core leakage.

c. Reflectors decrease thermal leakage while moderators decrease fast leakage.

d. Reflectors thermalize neutrons while moderators decrease core leakage.

Answer: a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 134. Glasstone & Sesonske, Sec. 5.175

Question A.17 [½ point]
Which ONE of the following factors in the six-factor formula can be varied by the reactor operator?

a. Fast fission factor.

b. Reproduction factor.

c. Fast non-leakage factor.

d. Thermal utilization factor.

Answer: d.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 312.

Question A.18 [½ point]
Which ONE of the following statements describes the difference between Differential (DRW) and Integral (IRW) rod worth curves?

a. DRW relates the worth of the rod per increment of movement to rod position. IRW relates the total reactivity added by the rod to the rod position.

b. DRW relates the time rate of reactivity change to rod position. IRW relates the total reactivity in the core to the time rate of reactivity change.

c. IRW relates the worth of the rod per increment of movement to rod position. DRW relates the total reactivity added by the rod to the rod position.

d. IRW is the slope of the DRW at a given rod position

Answer: a.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 361, 362.

Section A - Reactor Theory, Thermodynamics and Facility Operating Characteristics

Question A.19 [½ point]
The reactor is initially subcritical with a Keff of 0.94. Two (2) rods worth a total of 2.4% delta k/k are inserted into the core. Which ONE of the following is the new K eff?

a. 0.950

b. 0.954

c. 0.962

d. 0.971

Answer: c.
Reference: Lamarsh, Introduction to Nuclear Engineering, 3rd Edition, page 336.
Initial reactivity = (0.94 - 1)/0.94 = -0.0638 delta k/k; + .024 delta k/k added by safety rods
Final reactivity = -.0638 + .024= -0.0398 delta k/k; Keff = 1/(1 - [-0.0398])= 0.9617

Question A.20 [½ point]
Two different neutron sources are used during two reactor startups. The source used in the first startup emits ten times as many neutrons per second as the source used for the second startup. Assuming all other factors are the same, which ONE of the following states the expected result at criticality?

a. Count rate will be lower for the first startup.

b. Count rate will be higher for the first startup.

c. Rod position will be higher for the first startup (rods will be further into the core.)

d. Rod position will be lower for the first startup (rods will be further out of the core.)

Answer: b.
Reference: Count Rate is proportional to (Source Strength)/(1-K).

END OF SECTION A

Section B. - Normal & Emerg Operating Procedures & Radiological Controls

Question B.1 [1.0 point]
A radiation survey of an area reveals a general radiation reading of 1 mRem/hr. However, a small section of pipe (point source) reads 10 mRem/hr at one (1) meter. Which ONE of the following is the posting requirement for the area, in accordance with 10 CFR Part 20?

a. "CAUTION - RADIATION AREA"

b "CAUTION - HIGH RADIATION AREA"

c. "CAUTION - RADIOACTIVE MATERIAL"

d. "CAUTION - AIRBORNE RADIOACTIVITY AREA"

Answer: b.
Reference: For a point source, 10 mrem/hr at 100 cm (1 meter) = 111.1 mrem/hr at 30 cm.

Question B.2 [1.0 point]
The reactor is operating at steady-state power. Under this circumstance:

a. At least two persons must be present. One NRC-licensed operator must be present at the reactor console.

b. Two NRC-licensed operators must be present. One of the operators must be present at the reactor console.

c. One NRC-licensed operator and a Reactor Supervisor must be present at the reactor console.

d. Only one NRC-licensed operator must be present.

Answer: a.
Reference: Reactor Operation and Training Manual, Operating Procedures, General Operating Rules.

Question B.3 [1.0 point]
"A channel test of Nuclear Safety Channels #2 and #3 shall be performed prior to the first reactor startup of the day or prior to each reactor operation extending more than one day." This is an example of a(n):

a. safety limit.

b. limiting condition for operation.

c. surveillance requirement.

d. limiting safety system setting.

Answer: c.
Reference: Technical Specifications

Section B. - Normal & Emerg Operating Procedures & Radiological Controls

Question B.4 [1.0 point]
A survey instrument with a window probe is used to measure the beta-gamma dose rate from an irradiated experiment. The dose rate is 100 mR/hr with the window open and 60 mR/hr with the window closed. The gamma dose rate is:

a. 100 mR/hr.

b. 60 mR/hr.

c. 40 mR/hr.

d. 160 mR/hr.

Answer: b.
Reference: Beta radiation cannot pass through the window. With window closed, gamma dose rate = 60 mR/hr.

Question B.5 [1.0 point, ¼ point each]
Match the 10CFR Part 55 requirements listed in Column A for an actively licensed operator with the correct time period from Column B. Column B answers may be used once, more than once, or not at all.

	Column A		Column B
a.	License Expiration.	1.	1 year
b.	Medical Examination	2.	2 years
c.	Requalification Written Examination	3.	3 years
d.	Requalification Operating Test	4.	4 years
		5.	5 years
		6.	6 years

Answer: a. = 6; b. = 2; c. = 2; d. = 1
Reference: 10 CFR Part 55

Section B. - Normal & Emerg Operating Procedures & Radiological Controls

Question B.6 [1.0 point]
Which ONE of the following is the basis for the maximum core temperature safety limit?

a. Prevent separation of the core.

b. Prevent melting of the polyethylene core material.

c. Prevent operating personnel from being exposed to high temperature.

d. Prevent spontaneous ignition of the graphite reflector.

Answer: b.
Reference: Technical Specification 2.1.a.

Question B.7 [1.0 point]
Which ONE of the following is the MAXIMUM allowable excess reactivity with all control and safety rods fully inserted and including the potential reactivity worth of all experiments?

a. 0.065% delta k/k

b. 0.25% delta k/k

c. 0.65% delta k/k

d. 1.0% delta k/k

Answer: c.
Reference: Technical Specification, 3.1.a.

Question B.8 [1.0 point]
In the event of any emergency, if the radiation level at the console exceeds _______ mR/hr, the operator should sound the evacuation alarm.

a. 25.

b. 50.

c. 75.

d. 100.

Answer: d.
Reference: Reactor Operation and Training Manual, Emergency Procedures.

Section B. - Normal & Emerg Operating Procedures & Radiological Controls

Question B.9 [1.0 point]
Which ONE of the following would be classified as a Nonroutine Operation?

a. Control rod calibration.

b. Monthly inspections.

c. Excess reactivity determination with the reactor in its design configuration.

d. Control rod drive maintenance.

Answer: d.
Reference: Reactor Operation and Training Manual, Operating Procedures, Routine and Non-Routine Operations.

Question B.10 [1.0 point]
Which ONE of the following is the dose rate from a 20 curie cobalt source at 5 feet? (Assume Co-60 emits 2.5 Mev)

a. 0.6 rem/hr

b. 1.2 rem/hr

c. 6 rem/hr

d. 12 rem/hr

Answer: d.
Reference: Dose Rate = 6CiE/D2 ; Dose Rate = 6(20)(2.5)/25 ; Dose Rate = 12 rem/hr

END OF SECTION B

Section C Facility and Radiation Monitoring Systems

Question: C.1 [1.0 point]
In order to extend the operating life of the Channel 1 source-range detector:

a. the detector is partially covered by a neutron-absorbing cadmium jacket.

b. the high voltage on the detector is automatically switched off at high power.

c. the detector is moved away from the neutron flux as power increases.

d. a negative voltage is applied to the detector as power increases.

Answer: b.
Reference: Reactor Operation and Training Manual, page 18.

Question: C.2 [1.0 point]
Which ONE condition listed below will NOT cause the red light on the safety interlock indicator to illuminate.

a. Shield water low level.

b. No magnet current.

c. Shield tank temperature below 18°C.

d. Earthquake switch open.

Answer: b.
Reference: Reactor Operation and Training Manual, page 32.

Question: C.3 [1.0 point]
An aluminum baffle plate separates the fuel disks in the upper section of the core from the fuel disks in the lower section of the core. Of the total of ______ fuel disks, ______ are in the upper section and _____ are in the lower section.

a. 7; 4; 3

b. 7; 3; 4

c. 9; 6; 3

d. 9; 5; 4

Answer: c.
Reference: Reactor Operation and Training Manual, page 2.

Section C Facility and Radiation Monitoring Systems

Question: C.4 [1.0 point]
Which ONE of the following is NOT a control rod system interlock?

a. Reactor startup cannot commence unless both safety rods and the coarse control rod are fully withdrawn from the core.

b. Only one safety rod can be inserted at a time.

c. The coarse control rod cannot be inserted unless both safety rods are fully inserted.

d. At any operating power below 50x10-6 watts, only the coarse control rod can be inserted.

Answer: d.
Reference: Reactor Operation and Training Manual, page 19.

Question: C.5 [1.0 point]
Which ONE of the following identifies the type of detector used in the Channel 2 Neutron Monitoring system?

a. GM tube.

b. Fission chamber.

c. Ionization chamber.

d. Scintillation detector

Answer: c.
Reference: Reactor Operation and Training Manual, page 31.

Question: C.6 [1.0 point]
The U-235 fuel in the AGN is contained in fuel disks and control rods. Of the total fuel in the reactor, approximately how much is contained in the control rods?

a. 7%.

b. 15 %.

c. 22%

d. 30%.

Answer: a.
Reference: Reactor Operation and Training Manual, page 7.
<u>Section C Facility and Radiation Monitoring Systems</u>

Question: C.7 [1.0 point]
Which ONE of the following is designed to contain fission product gases that might leak from the core?

a. Lead shielding.

b. Water shield.

c. Steel Reactor Tank.

d. Aluminum Core Tank.

Answer: d.
Reference: Technical Specification 5.1.b.

Question: C.8 [1.0 point]
Which ONE of the following describes the design purpose of the space between the reactor core and the graphite reflector?

a. Ensures free fall of the bottom half of the core during the most severe transient.

b. Increases the fast neutron population in the vicinity of experiments placed in the access ports.

c. Allows for accumulation and venting of fission product gases created during reactor operation.

d. Prevents core damage during the design basis earthquake and 6 cm. displacements.

Answer: a or c.
Reference: Technical Specification 5.1.a. & Training Manual pg. 5

Question: C.9 [1.0 point]
All of the remote area radiation monitors (general lab, reactor top, reactor console, checkpoint three) are:

a. G-M detectors.

b. ionization chambers.

c. scintillation detectors.

d. proportional counters.

Answer: a.
Reference: Reactor Operation and Training Manual, page 15.

Question: C.10 [1.0 point]
When the reactor is in the Standard Loading #2 as Amended configuration, the Pu-Be source is located in:

a. access port 1.

b. access port 2.

c. access port 3.

d. access port 4.

Answer: b.
Reference: Reactor Operation and Training Manual, page 9.

END OF SECTION C

END OF WRITTEN EXAMINATION