ENCLOSURE 1

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

REPORT NO.:	50-252/OL-93-01
FACILITY DOCKET NO.:	50-252
FACILITY LICENSE NO.:	R-102
FACILITY:	University of New Mexico
EXAMINATION DATES:	March 24-25, 1993
EXAMINER:	Patrick J. Isaac, (Chief Examiner)
SUBMITTED BY:	Patrick Isaac 4/2/93 Chief Examiner Date
APPROVED BY:	James L. Caldwell 4/8/93 James Caldwell, Chief Date Non-Power Reactor Section Operator Licensing Branch Division of Reactor Controls and Human Factors Office of Nuclear Reactor Regulation

SUMMARY:

Written and operating requalification examinations were administered to three Senior Reactor Operators (SRO). All three SROs passed the examinations.

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REPORT DETAILS

1. Examiner:

Patrick J. Isaac, Chie' Examiner

2. Examination Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	TOTAL (Pass/Fail)
NRC Grading:	N/A	3/0	3/0
Facility Grading:	N/A	N/A	N/A

3. Written Examination:

The written examination was administered on March 24, 1993 to three Senior Reactor Operators. All three SROs passed the written examination.

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

4. Operating Tests:

Operating Tests were administered on March 25, 1993. There were no generic deficiencies noted by the examiner. All three SROs passed the operating test.

5. Exit Meeting:

Personnel attending:

Dr. Robert Busch, Chief Reactor Supervisor
Mr. Kenneth Carpenter
Mr. James Caldwell, Chief Non-Power Reactor Section (NRC)
Patrick J.Isaac, Chief Examiner

The exit meeting was conducted on March 25, 1993. The facility examination comments were discussed as noted in Enclosure 2. There were no generic concerns raised by the examiner.

ENCLOSURE 2

NRC RESOLUTIONS - WRITTEN EXAMINATION

Question A. 018:

By how much would the AGN-201 fuel temperature increase if reactor power was to increase from 1 watt to the maximum licensed reactor power?

a. 2.7 °F

b. 3.2 °F

c. 10.5 °F

d. 35.2 °F

Answer A. 018: b

Reference A. 018:

T.S. 2.1 Basis

$4 \text{ watts} \times 0.44 \frac{°C}{\text{watt}}$

Facility Comment A. 018:

The answers are given in degrees F while our facility uses only degrees C in reading and recording temperature data. As the problem required the conversion of a delta degrees C to a delta degrees F and there were no equations given which would correctly do this conversion, we feel that the question was not appropriate to our facility. We would suggest that since answer d represents the correct degree C answer converted to an absolute F temperature that both answers b and d be accepted on this question. This also raises the philosophical question of how much material in the area on units conversion that an operator should be responsible for when the facility only uses one set of units. For our facility, we use only metric measurements and degrees C in the facility. It does not seem to be of value for our operators to be converting to degrees F or English units since these do not have application for them. We would suggest that for future examinations, this units conversion issue be considered.

NRC Resolution A. 018:

The equation for converting degrees C to degrees F was included on the equations sheet provided during the examination. The intent of the question was to examine the operator's knowledge of the rate of fuel temperature increase as related to a rise in reactor power. The fact that the question also tested the operator's ability to perform an elementary unit conversion was minor. Following the comment made by the facility regarding the lack of application of English units at the University of New Mexico AGN-201 reactor, the NRC will delete this question from the examination.

Question B 012:

In accordance with UNM Reactor Facility procedures, in the event of a fire, which ONE of the following actions should the reactor operator perform first.

a. Notify the UNM police immediately.

b. Attempt to extinguish the fire.

c. Initiate a building evacuation.

d. Notify the Reactor Supervisor.

Answer B. 012: a

Reference B. 012:

UNM Sect. V Emerg. Procedures pg. 42

Facility Comment B. 012:

Our Emergency Procedures indicate that the first two actions to be taken are to shutdown the reactor and then notify the Reactor Supervisor. However in the third set of actions it indicates that in case of fire, the UNM Police should be notified before doing anything else. After review of this set of procedures by the Reactor Operations Committee, it was concluded that the actions were not clear. We will clarify this in the emergency plan by indicating that the reactor should be shutdown first; then in case of a fire, notify the UNM Police; and then notify the Reactor Supervisor. However based on the confusion extant in the document, we believe that both answers a and d should be accepted on question B012.

NRC Resolution B. 012:

Comment accepted. The answer key will be modified to accept either a or d as correct.

Question C. 015:

Which ONE of the following conditions will NOT prevent a reactor startup?

a. Shield water temperature is 60 °F

b. Shield water level is at 0.4 ft from the top of the tank.

c. Both Safety rods upper limit switches are engaged.

d. Due to a loose connection, the seismic instrument registers an horizontal displacement of 0.21 cm.

Answer C. 015:

Reference C. 015:

UNM Reactor Control and Safety System Desc. pg. 49-50

Facility Comment C. 015:

Item b describes a condition where the water level is high enough to keep from tripping so it is the ONE condition which would not prevent a startup. However, item c describes a situation where the safety rod upper limit switches are engaged. This condition occurs in the middle of a startup and would not prevent a startup. It also represents an incredible situation for all other times than during a startup. If the situation is incredible, then it also would not prevent a startup. Based on this, we believe that both answers b and c should be accepted on question C015.

NRC Resolution C. 015:

Comment accepted. The answer key will be modified to accept either b or c as correct.

ENCLOSURE 3

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

FACILITY: University of New Mexico

REACTOR TYPE: AGN-201M

DATE ADMINISTERED: 93/03/24

REGION: 4

CANDIDATE: ____________

INSTRUCTIONS TO CANDIDATE

Answers are to be written on the answer sheet provided. Attach any answer sheets to the examination. A 70% 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
19.00	33.9			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	35.7			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
17.00	30.4			C. PLANT AND RADIATION MONITORING SYSTEMS
56.00		FINAL GRADE	%	TOTALS

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

____
Candidate's Signature

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	___
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 *****)

A N S W E R   S H E E T

Multiple Choice (Circle or X your choice)

If you ch.nge your answer, write your selection in the blank.

MULTIPLE CHOICE

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

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 ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

(***** END OF CATEGORY C *****)
(********** 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 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. The point value for each question is indicated in parentheses 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. To pass the examination, you must achieve at least 70%.

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

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.

QUESTION: A001

Which ONE of the following will insure that the AGN-201M reactor does not remain in a near-critical state following a power excursion from a 2% instantaneous increase of reactivity?
(Assume a failure of the reactor to automatically scram)

a. A manual scram initiated by the operator.

b. The negative temperature coefficient.

c. The average mean lifetime of the six groups of delayed neutrons.

d. Melting of the core thermal fuse.

QUESTION: A002

The reactor is stable during a startup. You continue the startup by inserting control rods adding 0.30% $\Delta K/K$ reactivity to the reactor. What is the resulting reactor period?

a. ≈ 60 seconds

b. ≈ 30 seconds

c. ≈ 20 seconds

d. ≈ 10 seconds

QUESTION: A003

The reactor has been run for a short time at 1 watt before being shutdown (Equilibrium Xenon conditions). An experiment worth $+2.0 \times 10^{-3}$ $\Delta K/K$ is <u>REMOVED</u> from the reactor. When the reactor is restarted ten days later core temperature is 5°C <u>COOLER</u>. What will be the difference in the worth of the rod when the reactor is returned to 1 watt (equilibrium Xe conditions)?

a. $0.25

b. $0.32

c. $0.18

d. $0.10

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

QUESTION: A004

Which ONE of the following statements describes why installed neutron sources are used in reactor cores?

a. To increase the count rate by an amount equal to the source contribution.

b. To increase the count rate by 1/M (M = Subcritical Multiplication Factor).

c. To provide neutrons to initiate the chain reaction.

d. To provide a neutron level high enough to be monitored by instrumentation.

QUESTION: A005

What is the K_{eff} for a reactor shutdown by 0.0455 $\Delta K/K$?

a. 0.957

b. 0.855

c. 0.786

d. 0.0455

QUESTION: A006

At the beginning of a reactor startup, K_{eff} is 0.90 with a count rate of 30 CPS. Power is increased to a new, steady value of 60 CPS. The new K_{eff} is:

a. 0.91

b. 0.925

c. 0.95

d. 0.975

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

QUESTION: A007

Which of the listed factors from the six-factor formula is most affected by control rod position?

a. Resonance escape probability (p)

b. Fast fission factor (ϵ)

c. Neutron reproduction factor (η)

d. Thermal utilization factor (f)

QUESTION: A008

Which ONE of the following is the reason for the -80 second period following a reactor scram?

a. The negative reactivity added during a scram is greater than ß-effective

b. The half-life of the longest-lived group of delayed neutron precursors is approximately 55 seconds

c. The fuel temperature coefficient adds positive reactivity as the fuel cools down, thus retarding the rate at which power drops

d. The amount of negative reactivity added is greater than the Shutdown Margin

QUESTION: A009

Which ONE of the following is true concerning the differences between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population

b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions

c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay process

d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period

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

QUESTION: A010

Which ONE of the following is the time period in which the maximum amount of Xe^{135} will be present in the core?

a. 7 to 11 hours after a startup to 100% power.

b. 3 to 6 hours after a power increase from 50% to 100%.

c. 3 to 6 hours after a power decrease from 100% to 50%.

d. 7 to 11 hours after a scram from 100%.

QUESTION: A011

The term "Prompt Critical" refers to:

a. the instantaneous jump in power due to a rod withdrawal

b. a reactor which is supercritical using only prompt neutrons

c. a reactor which is critical using both prompt and delayed neutrons

d. a reactivity insertion which is less than Beta-effective

QUESTION: A012

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

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

QUESTION: A013

Suppose you irradiate a 100 mg Al foil (σ_a = 0.23 barns, $T_{1/2}$ = 2.3 min., and M =26.98 amu) for 1 minute in a flux of 5 x 10^8 n/cm^2-sec. What would you expect the total activity to be 5 minutes after removal?

a. 0.16 μCi

b. 0.40 μCi

c. 1.8 μCi

d. 6.[illegible] μCi

QUESTION: A014

Which condition below describes a critical reactor?

a. K = 1; ΔK/K = 1

b. K = 1; ΔK/K = 0

c. K = 0; ΔK/K = 1

d. K = 0; ΔK/K = 0

QUESTION: A015

Which ONE of the following elements will slow down fast neutrons most quickly, i.e. produces the greatest energy loss per collision?

a. Oxygen-16

b. Uranium-238

c. Hydrogen-1

d. Boron-10

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

QUESTION: A016

In a reactor at full power, the thermal neutron flux (ϕ) is $2.5x10^{12}$ neutrons/cm^2-sec. and the macroscopic fission cross-section Σ_f is 0.1 cm^{-1}. The fission reaction rate is:

a. $2.5x10^{11}$ fissions/sec.

b. $2.5x10^{13}$ fissions/sec.

c. $2.5x10^{11}$ fissions/cm^3/sec.

d. $2.5x10^{13}$ fissions/cm^3/sec.

QUESTION: A017

How much (by what factor) would power increase in one second in a prompt critical reactor?

a. 1.00×10^2

b. 1.00×10^5

c. 7.55×10^{24}

d. 3.79×10^{65}

QUESTION: A018 *DELETED*

By how much would the AGN-201 fuel temperature increase if reactor power was to increase from 1 watt to the maximum licensed reactor power?

a. 2.7 °F

b. 3.2 °F

c. 10.5 °F

d. 35.2 °F

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

QUESTION: A019

Which one of the following factors plays the MOST important role in determining the worth of a control rod?

a. The value of the delayed neutron fraction.

b. Reactor power.

c. The rod speed.

d. The flux shape.

QUESTION: A020

The reactor is on a 30 second period at a power level of 0.1 Watt. What will the power level be after 1 minute?

a. 0.16 watts

b. 0.74 watts

c. 1.65 watts

d. 7.39 watts

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

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: B001

What pers..nel are required to be present when replacing fuel in the core?

a. Radiation Safety Officer & Chief Reactor Supervisor

b. Reactor Supervisor, Radiation Safety Officer & Operator

c. Chief Reactor Supervisor, Reactor Supervisor & Operator

d. Radiological Safety Officer & SRO

QUESTION: B002

Which ONE of the following is the definition for a CHANNEL CHECK?

a. Adjustment of the output of the channel to within specific tolerances based on a known input.

b. Qualitative comparison of multiple indications of the same parameter to verify acceptable performance of a channel.

c. Introduction of a signal into a channel to verify operability (particularly trip setpoints).

d. A visual check of a channel to insure its output is within an acceptable range.

QUESTION: B003

Which ONE of the following requires a prompt notification to the NRC?

a. An authorized operator attempts to startup the reactor without removing the cadmium rod from the glory hole.

b. During a periodic surveillance nuclear instrument channel 3 is found to be indicating outside the specified tolerances for the channel on the high side.

c. The Reactor Operator shuts down the reactor due to an electrical fire in one of the Nuclear Instrument channels.

d. While shutdown, the operator mistakenly inserts in the reactor an unplanned experiment worth 0.35% $\Delta K/K$

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

QUESTION: B004

A reactor sample has a disintegration rate of 5×10^{12} disintegrations per second. Each disintegration emits a .6 Mev gamma. What is the dose rate expected five (5) feet from the above sample (assume point source)?

a. 7 R/hr

b. 19 R/hr

c. 135 R/hr

d. 162 R/hr

QUESTION: B005

You have been assigned to decrease the dose rate being emitted by a point source. The dose rate is due to 1.5 Mev gamma. What thickness of lead will be required to decrease the dose rate by a factor of 10?

Given: Mass attenuation coefficient for lead @ 1.5 Mev = 0.051 cm^2/gram and the density of lead is 11.4 $gram/cm^3$.

a. 0.2 cm

b. 2 cm

c. 4 cm

d. 8 cm

QUESTION: B006

The Technical Specification basis for the MAXIMUM core temperature limit is to prevent:

a. melting of the core thermal fuse

b. breakdown of the graphite reflector.

c. instrument inaccuracies due to drift.

d. release of fission products.

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

QUESTION: B007

Temporary procedures which do NOT change the intent of the original procedure or involve an unreviewed safety question may be approved as a MINIMUM by the:

a. Reactor Administrator.

b. Chief Reactor Supervisor.

c. Reactor Safety Advisory Committee.

d. Dean, College of Engineering.

QUESTION: B008

The limits imposed on the reactivity worth of the control rods assure that:

a. The reactor can be brought and maintained subcritical.

b. In the event of failure of the reactor to scram, the melting of the thermal fuse will assure safe shutdown.

c. The reactor cannot become prompt critical and the shortest possible reactor period is greater than 200 milliseconds.

d. The manual scram would allow the operators sufficient time to shutdown the reactor in unsafe or abnormal contitions.

QUESTION: B009

The reactor is operating at 50% power. The reactor operator brings to your attention that the reactivity worths of the control rods was last measured on January 23, 1992. Which ONE of the following best describe your followup actions. (Today's date is 3/24/93 and you are the Reactor Supervisor.)

a. Immediately shutdown the reactor. Declare the control rods inoperable and treat this event as a reportable occurrence.

b. Shutdown the reactor. Notify the Chief Reactor Supervisor that the specified surveillance period has been exceeded.

c. Immediately scram the reactor. Confirm that the shutdown margin is within the tech. Specs limit. Inform the Chief Reactor Supervisor of the exceeded surveillance period.

d. Continue operating the reactor. Perform the required surveillance prior to the expiration date.

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

QUESTION: B010

Which ONE of the following does NOT constitute a "Reportable Occurrence"?

a. The reactor fails to scram when the reactor operator depresses the manual scram button.

b. The reactor operator initiated a manual reactor scram when he felt a "strong shock" that was caused by an unexpected earthquake

c. The reactor is operating at 50% power. All conditions are normal. The reactor shuts down when the core thermal fuse melts prematurely.

d. During an inspection, a small hole has been discovered in the core tank.

QUESTION: B011

Which ONE of the following does NOT require the notification of "UNUSUAL EVENT"?

a. The reactor fails to scram when the reactor operator depresses the manual scram button.

b. The reactor operator, fearing for the safety of the reactor, initiated a manual reactor scram when he felt a tremor that was caused by an unexpected earthquake

c. A reactor operator received a localized dose of 27 rems to his feet.

d. A radical group of Students Against Nuclear Energy (SANE) is marching toward the Reactor Facility. It appears that some are carrying weapons.

QUESTION: B012

In accordance with UNM Reactor Facility procedures, in the event of a fire, which ONE of the following actions should the reactor operator perform first.

a. Notify the UNM police immediately.

b. Attempt to extinguish the fire.

c. Initiate a building evacuation.

d. Notify the Reactor Supervisor.

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

QUESTION: B013

During routine reactor operation, a reactivity change is considered "abnormal" if:

a. Following the insertion of an experiment, the flux builds up faster than the control rods can follow it.

b. Fuel is inserted into the reactor.

c. An absorber is inserted into the reactor and this change is not followed with a control rod.

d. Channel 2 of the Neutron Flux Measuring Instruments is erratic and is considered by the operator to be inoperable.

QUESTION: B014

Which ONE of the following conditions would NOT preclude a reactor start-up per the AGN-201M operating procedures?

a. Channel 1 of the Neutron Flux Measuring Instruments is erratic and has been declared inoperable.

b. While performing the Start-Up Check-Out the operator notices that the Period scram trip light did not come on after he depressed the 10^{-8} switch on Channel 2 drawer.

c. The alarm bell does not ring when the Control Panel Power is turned on.

d. With the control and safety rods fully inserted, the excess reactivity (with no experiments in the reactor) is 0.40 $\Delta K/K$.

QUESTION: B015

Who is responsible to maintain accountability of personnel at the Hold Station following an evacuation of the Nuclear Engineering Lab. Building?

a. Reactor Operator

b. Reactor Supervisor

c. Emergengy Preparedness Coordinator (EPC)

d. Reactor Safety and Recovery Operations Coordinator (ROC)

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

QUESTION: B016

An area would be classified as a radiation area if:

a. continuous exposure will result in a dose less than 2 mRem in an hour or less than 100 mRem in 5 consecutive days.

b. a major portion of the body could receive more than 5 mRem in an hour.

c. a major portion of the body could receive 100 mRem in 7 consecutive days.

d. a major portion of the body could receive more than 100 mRem in an hour.

QUESTION: B017

Which ONE of the following represents the 10 CFR 20 exposure limits for the skin?

a. 1.25 Rem/qtr

b. 3 Rem/qtr

c. 7.5 Rem/qtr

d. 18.75 Rem/qtr

QUESTION: B018

Which ONE of the following is the correct definition for Limiting Safety System Setting at the UNM AGN-201M.

a. The lowest functional capability, setting or performance levels of equipment required for safe operation of the reactor.

b. Settings for automatic alarm related to those variables having significant safety functions.

c. Limits upon important process variables that are found to be necessary to protect against the uncontrolled release of radioactivity.

d. Settings for automatic protective actions that will correct an abnormal situations before a safety limit is exceeded.

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

B. NORMAL/EMERG PROCEDURES & RAD CON

QUESTION: B019

While performing a survey of the reactor room, the operator identifies a pool of water in the vicinity of the reactor. The RAM is alarming and radiation measurements reveal a radiation level of 35 mr/hr at the console. What actions should the reactor operator take in accordance with UNM procedures?

a. Notify the Reactor Supervisor and wait for him to arrive. Record any pertinent information in the log.

b. Sound the evacuation alarm. Leave by the nearest exit. Proceed to the Hold Station.

c. Notify the UNM police immediately. Notify the Chief Reactor Supervisor and evacuate the facility.

d. Sound the evacuation alarm. Turn on the air circulation fans and proceed to the Hold Station.

QUESTION: B020

Which ONE of the following statements applies to experiments?

a. Experiments containing explosive materials MUST be doubly encapsulated.

b. Experiments containing materials corrosive to reactor components may not be inserted into the reactor under ANY circumstances or conditions.

c. All new experiments must be reviewed and approved by the Radiological Control Commitee.

d. An experiment containing a fissionable gas MUST be doubly encapsulated.

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

QUESTION: C001

The type of detector used for Channel #1 of the Neutron Monitoring System is a:

a. Boron lined ionization chamber

b. U-235 Fission Chamber

c. GM Meter.

d. Compensated Scintillation detector.

QUESTION: C002

Which ONE of the following statements describe the control rod interlocks?

a. The fine control rod cannot be inserted until the safety rods are "FULLY INSERTED".

b. The safety rods must be fully inserted before their drive motors will operate in the "LOWER" position.

c. The fine control rod cannot be inserted unless the course control rod is "DISENGAGED".

d. The coarse control rod cannot be inserted until the safety rods are "FULLY INSERTED".

QUESTION: C003

Which ONE of the following type of instruments is best for detecting ALPHA radiation?

a. Proportional Counter

b. G-M Counter

c. Scintillation Counter fitted with a sodium iodide crystal

d. Photographic Dosimetry

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: C004

Which ONE of the following statements is TRUE?

a. A scram signal deenergizes the holding magnets allowing all the rods to be accelerated outward by gravity.

b. The fine control rod is worth less than the other rods because it contains less U-235 due to a lower enrichment value.

c. The total distance of rod travel is 23 inches, starting from a fully withdrawn position just inside the lead shield.

d. The limitation on reactivity addition rates ensures that ample time will be available for the reactor protection system and/or operator to shutdown the reactor.

QUESTION: C005

Which ONE of the following describes the Standard Loading #2 ?

a. The glory hole is empty, half of the access port fillers in port 4 are removed and a boron-lined ion chamber is fully inserted into the remaining cavity. The rest of the cavity is then filled with paraffin or polyethylene and the access port is sealed and locked. The fine control rod contains normal fuel material rod sections.

b. The glory hole is empty, all access port fillers are in their normal positions, and the fine control rod contains polyethylene rod sections.

c. Same as (b) above except that the 2Ci Pu-Be source and source drive are mounted in the north side of access port 2.

d. Same as (a) above except that the 2Ci Pu-Be source and source drive are mounted in the north side of access port 2.

QUESTION: C006

Small positive adjustments of the excess reactivity of the reactor can be made by:

a. adjusting the Bottom limit switches to decrease the amount of rod travel.

b. altering the position of the Upper limit switches to increase the amount of rod travel.

c. adjusting the rod carriages to limit the amount of travel in the full out position.

d. inserting the rods in the sequence of Safety Rod 1; Safety Rod 2; Coarse and Fine Rods separately.

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

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

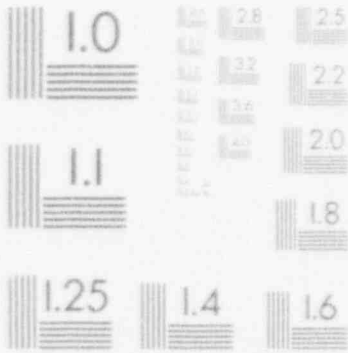
1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6"

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: C007

During a transient that causes the core to heat up, how will the thermal fuse heat up when compared to the core heatup rate?

a. The same rate as the core heats up.

b. A just discernable rate faster than core heatup.

c. Twice the rate of core heatup.

d. Three times rate of core heatup.

QUESTION: C008

The AGN-201 shield tank is designed to provide an effective biological shield from :

a. High energy beta radiation.

b. Thermal neutron radiation.

c. High energy capture gamma radiation.

d. Fast neutron radiation.

QUESTION: C009

Choose the item that describes how control rod position indication is obtained.

a. Reed switches inside the lead screw.

b. An inductor with the leadscrew extension acting as a coupler.

c. A counter that directly counts lead screw revolutions.

d. An output from a syncho-generator driven by the drive motor.

QUESTION: C010

Choose the scram signal which will directly trip the scram magnet current.

a. Shield water temperature trip.

b. Period trip.

c. Seismic sensor trip.

d. Shield water level trip.

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: C011

Which ONE of the following statements describe the design/operation of the control rod drive assemblies?

a They use dashpots which consist of a spring to reduce the impact of the rods on a scram.

b. The fine control rod does not have a dashpot.

c. The course control rod dashpot uses magnetic force to slow the rod down before impact on a scram.

d. Dashpots are only associated with the safety rods since these rods have been raised against spring tension to assist in driving these rods down on a scram.

QUESTION: C012

Each ONE of the following would be considered an advantage of using fueled control rods over poison rods, EXCEPT:

a. rods may be removed anytime.

b. larger reactor size.

c. simplification of calculations for a homogeneous reactor.

d. no critical mass assembled when shutdown.

QUESTION: C013

The purpose of the aluminum core tank is to:

a. limit doses to personnel to levels less than permitted by 10CFR20.

b. provide a fluid-tight container for the core, the reflector and the lead shielding.

c. contain fission gases that might leak from the core.

d. to separate the core from the graphite reflector.

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

C. PLANT AND RAD MONITORING SYSTEMS

QUESTION: C014

The shield tank water temperature interlock prevents from:

a. reactor operations in the event of a high temperature condition.

b. reactor operations during conditions that will produce high radiation levels.

c. reactor operations during periods of high thermal stress.

d. a reactivity addition due to a temperature decrease.

QUESTION: C015

Which ONE of the following conditions will NOT prevent a reactor startup?

a. Shield water temperature is 60 °F

b. Shield water level is at 0.4 ft from the top of the tank.

c. Both Safety rods upper limit switches are engaged.

d. Due to a loose connection, the seismic instrument registers an horizontal displacement of 0.21 cm.

QUESTION: C016

The detector used for the shield tank water level signal is a:

a. manometer.

b. float switch.

c. pressure switch.

d. differential pressure switch.

QUESTION: C017

The AGN-201 Access Ports pass through the steel tank:

a. up to the reflector.

b. then the lead shield, up to the reflector.

c. then the lead shield, the reflector and then back out again.

d. then the lead shield, reflector, and the core and then back out again.

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

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

A. RX THEORY, THERMO & FAC OP CHARS

*ANSWER A001
d
*REFERENCE
UNM SAR Appendix A pg. A-1

*ANSWER A002
c
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, §B.9

$$T = \frac{l^* + (\bar{\beta} - \Delta K)\ \tau}{\Delta K} = \frac{0.00005 + (0.00755 - 0.0030)\ 12.7}{0.003} = 19.3 \text{ sec.}$$

*ANSWER A003
d
*REFERENCE:
UNM SAR pg. 39: Temp Coefficient = $-2.5 \times 10^{-4}\ \Delta K/K/°C$
$-5°C = -2.5 \times 10^{-4}\ \Delta K/K/°C \times -5\ °C = 1.25 \times 10^{-3}\ \Delta K/K$

$\Delta\ \rho = 1.25 \times 10^{-3}\ \Delta K/K - 2.0 \times 10^{-3}\ \Delta K/K = -7.5 \times 10^{-4}\ \Delta K/K$

$-7.5 \times 10^{-4}\ \Delta K/K \times \frac{\$1}{0.00755} = -\ 10$ cents

*ANSWER A004
d
*REFERENCE:
REED ROBERT BURN, © 1982, §5.2, p. 5-1

*ANSWER A005
a
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, §D.1

$\rho = \$6.50\ (0.007) = 0.0455 = \Delta K/K$
$0.0455K = K - 1$
$1 = (1 - 0.455)K$
$K_{eff} = 1/(1-\rho) = 1/(1-(-0.0455) = 0.9565$

*ANSWER A006
c
*REFERENCE:

$(CR_2/CR_1) = (1-K_{eff1})/(1-K_{eff2})$
$(60/30) = (0.90)(1-K_{eff2})$
$K_{eff2} = 0.95$

*ANSWER A007
d
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, §B.5

*ANSWER A008
b
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, §B.9

*ANSWER A009
c
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, § C.4 & C.5

*ANSWER A010
d
*REFERENCE:
REED ROBERT BURN, © 1982, §8.4, Table 8.4.

*ANSWER A011
b
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, § C.6

*ANSWER A012
a
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, § C.2

*ANSWER A013
b
*REFERENCE:
UNM 1986 Requal Exam

*ANSWER A014
b
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, § B.3 & C.1

*ANSWER A015
c
*REFERENCE:
REED ROBERT BURN, © 1982, §2.5, Table 2.3, pp. 2-40 through 2-42.

*ANSWER A016
c
*REFERENCE:
AGN-201M Reactor Training Manual Volume II, § C.3

$R = \phi \Sigma_f = (2.5 \times 10^{12}) \times 0.1 = 2.5 \times 10^{11}$

*ANSWER A017
d
*REFERENCE
$T = l^*/\rho$
$l^* = 5 \times 10^{-5}$ seconds
$\rho \sim .00755$
$T = 5 \times 10^{-5}/.00755 = 0.00662$ sec
$P_f/Po = e^{t/T}$
$P_f/Po = e^{1/0.00662} = 3.79 \times 10^{65}$

*ANSWER A018 *DELETED*
b
*REFERENCE
T.S. 2.1 Basis
$4 \text{ watts} \times 0.44 \frac{°C}{\text{watt}}$

*ANSWER A019
d
*REFERENCE
Intro to Nuc. Engr., Lamarsh, Chapt. 7.

*ANSWER A020
b
*REFERENCE
UNM Requal Exam 1988

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

B. NORMAL/EMERG PROCEDURES & RAD CON

*ANSWER B001
b
*REFERENCE
UNM Reactor TRNG Manual Vol. II

*ANSWER B002
b
*REFERENCE
UNM T.S. Sect. VI pg. 43

*ANSWER B003
c
*REFERENCE
UNM TS 6.9.2

*ANSWER B004
b
*REFERENCE
1 Curie = 3.7×10^{10} dps ==> (5×10^{12} dps)/3.7×10^{10} dps= 135 Ci

$$DR = \frac{6Ci \cdot E \cdot (n)}{R^2}$$ ==> DR = (6 x 135 x .6)/5^2 = 19 R/hr

*ANSWER B005
c
*REFERENCE

μ = (0.051 cm^2/g) x 11.4 g/cm^3 = 0.5814 cm^{-1}

$I = I_o e^{-\mu x}$ ==> ln (0.1) = -(0.5814) χ

χ = 2.3026/0.5814 = 3.9672 ≈ 4

*ANSWER B006
d
*REFERENCE
UNM T.S. Safety Limits Basis

*ANSWER B007
b
*REFERENCE
Administrative Controls Procedures pg. 62

B. NORMAL/EMERG PROCEDURES & RAD CON

*ANSWER B008
a
*REFERENCE
UNM Bases for T.S. pgs 47-51

*ANSWER B009
d
*REFERENCE
Surveillance requirements Pg. 53
Surveillance Time definition pg. 45

*ANSWER B010
c
*REFERENCE
Reportable Occurrences pg. 64

*ANSWER B011
c
*REFERENCE
UNM Emergency Action Levels pg. 72

*ANSWER B012
a
*REFERENCE
UNM Sect. V Emerg. Procedures pg. 42

*ANSWER B013
d
*REFERENCE
Procedures During Operation at Power pg. 27

*ANSWER B014
a
*REFERENCE
Start-Up Check-Out Procedures pg. 24

*ANSWER B015
a
*REFERENCE
UNM Emergency Response pg. 74

B. NORMAL/EMERG PROCEDURES & RAD CON

*ANSWER B016
b
*REFERENCE
10CFR20.202

*ANSWER B017
c
*REFERENCE
10CFR20.101

*ANSWER B018
d
*REFERENCE
Section VI - Tech. Specs
10CFR50.36

*ANSWER B019
a
*REFERENCE
Section V - Emerg. Proc.

*ANSWER B020
d
*REFERENCE
UNM Tech. Specs. Limitations on Experiments

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

C. PLANT AND RAD MONITORING SYSTEMS

*ANSWER C001
b
*REFERENCE
Instrumentation And Safety Systems pg. 14

*ANSWER C002
d
*REFERENCE
UNM SAR pg 12

*ANSWER C003
a
*REFERENCE
AGN-201M Reactor Training Manual Vol. II

*ANSWER C004
d
*REFERENCE
UNM LCO 3.2 Basis

*ANSWER C005
a
*REFERENCE
UNM SAR (AGN Fuel Loading)

*ANSWER C006
b
*REFERENCE
UNM Reactor Control pg. 9

*ANSWER C007
c
*REFERENCE
UNM SAR pg. 3

*ANSWER C008
d.
*REFERENCE
UNM SAR pg. 9
UNM Design Features pg. 56

C. PLANT AND RAD MONITORING SYSTEMS

*ANSWER C009
d
*REFERENCE
UNM SAR Fig. 7 Control Rod Drive Mechanism

*ANSWER C010
b
*REFERENCE
UNM Safety Interlocks

*ANSWER C011
b
*REFERENCE
Control Rod Description Fig. 7

*ANSWER C012
b
*REFERENCE
AGN-201 Characteristics.

*ANSWER C013
c
*REFERENCE
UNM Design Features Sect. 5.1 pg. 56

*ANSWER C014
d
*REFERENCE
UNM Reactor Control and Safety System Desc. pg. 50

*ANSWER C015
b/c
*REFERENCE
UNM Reactor Control and Safety System Desc. pg. 49-50

*ANSWER C016
b
*REFERENCE
Section IV Maintenance and Inspections pg. 36

*ANSWER C017
c
*REFERENCE
General Information, AGN-201 Reactor, Access Ports & Glory Hole.

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

A. RX THEORY, THERMO & FAC OP CHARS

ANSWER KEY

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

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

B. NORMAL/EMERG PROCEDURES & RAD CON

A N S W E R   K E Y

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

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

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER KEY

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

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

EQUATION SHEET

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

$$T = \frac{\ell^* + (\beta-\Delta K)\overline{\tau}}{\Delta K}$$

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

$\rho = \Delta Keff/Keff$

$\overline{\beta} = 0.00755$

$DR_1 D_1^2 = DR_2 D_2^2$

$$DR = \frac{6CiE(n)}{R^2}$$

$R = \phi\ \Sigma_f$

$SCR = S/(1-Keff)$

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

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

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

$SDM = (1-Keff)/Keff$

$Pwr = W_f\ \dot{m}$

$\ell^* = 5 \times 10^{-5}$ seconds

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

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

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

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

$A = A_o\ (1-e^{-\lambda t})$

---

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

1 gal $H_2O \approx 8$ lbm

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5°C + 32

°C = 5/9 (°F - 32)