ENCLOSURE 1

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

REPORT NO.: 50-59/OL-92-01

FACILITY DOCKET NO.: 50-59

FACILITY LICENSE NO.: R-23

FACILITY: Texas A&M University (AGN-211)

EXAMINATION DATES: January 13-16, 1992

EXAMINER: Brian Hughes, Chief Examiner

SUBMITTED BY: Warren Easton for 2/4/92
Brian Hughes, Chief Examiner Date

APPROVED BY: Warren Easton for 2/4/92
James L. Caldwell, Chief Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Licensee Performance
and Quality Evaluation, NRR

SUMMARY:

Two initial reactor operator (RO) examinations were administered. Both applicants passed the written exam, one applicant passed the operating portion of the examination, and one applicant failed the operating examination.

REPORT DETAILS

1. Examiner:

Brian Hughes, Chief Examiner

2. Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	Total (Pass/Fail)
NRC Grading:	1/1	N/A	1/1

3. Written Examination:

All applicants passed the written examination. There were no written facility comments and no questions deleted on this examination. The NRC review discovered a typographical error on the answer key, Section A, question number 13, the correct answer is changed to A. Both applicants answered the question correctly.

4. Operating Examinations:

One RO passed the operating examination, one RO failed the operating examination.

5. Exit Meeting:

The following attended the exit meeting held at the facility:

Mr. Robert Berry, Reactor Supervisor Texas A&M
Mr. Brian Hughes, Chief Examiner NRC

Operating Exam Review - concerns discussed included:

1. Definitions of a high radiation area.
2. Weakness in the concepts and integration of ALARA.

ENCLOSURE 2

Nuclear Regulatory Commission
Operator Licensing
Examination

This document is removed from
Official Use Only category on
date of examination.

NRC Official Use Only

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. The amount of blank space on an examination question page is NOT an indication of the depth of answer required.

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% in each category.

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.

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

FACILITY: Texas A&M

REACTOR TYPE: AGN-201

DATE ADMINISTERED: 92/01/13

REGION: 4

CANDIDATE: _____

LICENSE APPLIED FOR: _____

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers one side ONLY. Attach any answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each 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
19.00	33.33			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
19.00	33.33			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
19.00	33.33			C. PLANT AND RADIATION MONITORING SYSTEMS
57.00				TOTALS
		FINAL GRADE	%	

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

_____
Candidate's Signature

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	___

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

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	___

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

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

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

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	___

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

QUESTION: 001 (1.00)

What is the current power level authorized by the reactor's operating license for steady state power operation?

a) 5 watts
b) 10 watts
c) 50 watts
d) 100 watts

QUESTION: 002 (1.00)

If the Texas A&M AGN reactor was configured to a Keff value of .90, what is the value of it's reactivity in delta K/K ?

a) 11.1%
b) 10.0%
c) -10.0%
d) -11.1%

QUESTION: 003 (1.00)

Which ONE of the following is the dominant factor 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: 004 (1.00)

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

a) The fuel temperature feedback adding positive reactivity.
b) U-235 fission by source neutrons.
c) The negative reactivity added on a scram being more than k excess.
d) The decay constant of the longest lived group of delayed neutron precursors.

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

QUESTION: 005 (1.00)

It takes one minute to raise the reactor power from 10 watts to 100 watts. What period is associated with this power increase?

a) 26.1 sec
b) 28.0 sec
c) 30.2 sec
d) 80.0 sec

QUESTION: 006 (1.00)

Which choice describes the characteristics of buckling in the Texas A&M AGN-201 reactor?

a) Changes only with the flux node loading
b) Increases as the rods are withdrawn
c) Moves the flux shape inward when power increases
d) Decreases as the rods are withdrawn

QUESTION: 007 (1.00)

Neutrons are classified by energy levels. A fast neutron in the Texas AGN would typically have an energy level of_____ MEV.

a) .001 MEV
b) .01 MEV
c) 1.0 MEV
d) 100 MEV

QUESTION: 008 (1.00)

Positive reactivity is inserted into a reactor operating at 2.5 watts. The resulting startup rate is .81 DPM. How much positive reactivity was added? (Beff= .70)

a) 32.2 PCM
b) 19.5 X 10E-4 delta K/K
c) 26.06 percent delta K/K
d) 1.95 PCM

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

QUESTION: 009 (1.00)

How much reactivity has been added to a subcritical AGN with a Keff of .95 to change the count rate from 100 cps to 150 cps?

a) 1.5%
b) 1.6%
c) 1.7%
d) 1.8%

QUESTION: 010 (1.00)

4E-4 delta K/K worth of negative reactivity was inserted into the Texas A&M AGN-201 when it was just critical. What temperature change is required to restore Keff back to a value of 1 ?

a) + 5.0 degrees
b) + 1.33 degrees
c) - 1.33 degrees
d) - 5.0 degrees

QUESTION: 011 (1.00)

What is the technical specification minimum shield water temperature?

a) 15 degrees C
b) 15 degrees F
c) 18 degrees F
d) 18 degrees C

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

QUESTION: 012 (1.00)

Match the factors which contribute to the Keff of a reactor in column I with their definitions in column II.

1. Resonance escape probability	a. Neutrons that reach thermal energy divided by fast neutrons that start to slow down
2. Thermal utilization factor	b. Thermal neutrons that cause fission divided by thermal neutrons absorbed in fission
3. Thermal nonleakage probability	c. Fast neutrons produced by thermal fission divided by thermal neutrons absorbed in fuel
4. Reproduction factor	d. Thermal neutrons absorbed in fuel divided by thermal neutrons absorbed in fuel and core materials
	e. Thermal neutrons absorbed in fuel and core materials divided by neutrons that reached thermal energy

a) a-d-e-c
b) a-d-c-b
c) b-c-d-e
d) a-b-c-d

QUESTION: 013 (1.00)

Which one of the following correctly describes the relationship between differential rod worth (DRW) and integral rod worth (IRW) ?

a) DRW is the slope of the IRW curve at a given location
b) DRW is the area under the IRW curve at a given location
c) DRW is the square root of the IRW curve at a given location
d) there is no relationship between DRW and IRW

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

QUESTION: 014 (1.00)

If the power level of the AGN-201 is increased from 2 watts to 4 watts in 40 seconds, what is the reactor period?

a) 17.3 seconds
b) 40 seconds
c) 58 seconds
d) 80 seconds

QUESTION: 015 (1.00)

An experiment at a test facility requires power to be increased from 15 watts to 50 KW on a 30 second period. How long does it take to reach 50KW at this ramp?

a) 117 seconds
b) 208 seconds
c) 243 seconds
d) 327 seconds

QUESTION: 016 (1.00)

Which ONE of the following describes the MAJOR contributions to the production and depletion of xenon in a reactor?

a) produced from radioactive decay of iodine, and depletes by radioactive decay and neutron absorption.
b) produced from radioactive decay of iodine, and depletes by neutron absorption only.
c) produced directly from fission, and depletes by neutron absorption only.
d) produced directly from fission only, and depletes by radioactive decay and neutron absorption.

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

QUESTION: 017 (1.00)

What is the approximate energy released by a single fission?

a) 50 mev
b) 100 mev
c) 150 mev
d) 200 mev

QUESTION: 018 (1.00)

Which ONE of the following describes the difference between a reflector and a moderator?

a) Reflectors slow down neutrons; while moderators decrease core leakage.
b) Reflectors decrease core leakage; while moderators thermalize neutrons.
c) Reflectors shield against neutrons; while moderators decrease plutonium production.
d) Reflectors shield against neutrons; while moderators decrease core leakage.

QUESTION: 019 (1.00)

Fuel, including fueled experiments and fuel devices not in the reactor, shall be stored in an array such that Keff is no greater than ____ for all conditions.

a) 0.6
b) 0.7
c) 0.8
d) 0.9

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

QUESTION: 001 (1.00)

Why is there a limit on shield water temperature prior to start up?

a) to ensure no freeze damage to the tank.
b) to ensure adequate shielding properties.
c) to limit temperature reactivity effects.
d) to limit resonance escape probability

QUESTION: 002 (1.00)

A cobalt-60 source has been dropped in the reactor laboratory. Thirty (30) feet from the source a radiation reading of 100 mrem/hr has been detected. Which ONE of the following is the curie content of the source? (Assume a 1.2 and a 1.3 Mev gamma emission)

a) 90 curies
b) 30 curies
c) 6 curies
d) 2.5 curies

QUESTION: 003 (1.00)

An experiment has been removed from the reactor. A reactor reading of 1Rem/hr was recorded at 3 feet when the experiment was removed. Fifteen (15) minutes later a reading of 750 mrem/hr was recorded at the same distance (3) feet).

Which ONE of the following is the length of time (AFTER REMOVAL FROM THE REACTOR) that will be required for the radiation level to decrease to 10 mrem/hr at one (1) foot?

a) 3 hours
b) 6 hours
c) 9 hours
d) 12 hours

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

QUESTION: 004 (1.00)

The thermal column tank is normally filled with _____ to provide biological shielding.

a) graphite
b) lead
c) poly
d) water

QUESTION: 005 (1.00)

What is the dose rate from a 10 curie cobalt source at a distance of 5 feet? (Co-60 emits two gammas of 1.33 and 1.17 mev)

a) 0.6 REM/hr
b) 3.192 REM/hr
c) 6.0 REM/hr
d) 10.0 REM/hr

QUESTION: 006 (1.00)

10CFR20 exposure limits for extremities are:

a) 5(n-18) REM/qtr
b) 7.5 REM/qtr
c) 18.75 REM/qtr
d) 1250 Mrem/qtr

QUESTION: 007 (1.00)

An area has been roped off five feet from an experiment producing 2500 mRem/hr at 18 inches. How should this boundary be posted?

a) CAUTION - RADIOACTIVE MATERIALS
b) DANGER - RADIATION AREA
c) CAUTION - HIGH RADIATION AREA
D) DANGER - EXCLUSION AREA

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

QUESTION: 008 (1.00)

To prevent damage to the reactor or excessive release of radioactive materials in the event of an experimental failure, explosive material shall :

a) be doubly encapsulated
b) be neutralized by encapsulation and KRYLON spray
c) have its mass minimized to less than 2 grams
d) not be inserted into the reactor

QUESTION: 009 (1.00)

Work must be performed in a radiation field of 400 mRem/hr gamma and 2.0 Rem/hr fast neutron. The worker is 24 years old and has a lifetime exposure through last quarter of 28 Rem on his NRC Form 4. HOW LONG may this worker be permitted to work in this area per 10CFR20 limits? (Assume that the man has no exposure in the present quarter.)

a) 19.3 minutes
b) 50 minutes
c) 75 minutes
d) 115 minutes

QUESTION: 010 (1.00)

The primary duty of the reactor operator during either a fire in the reactor facility or a major spill of radioactive material is :

a) evacuate the area
b) sound the alarm
c) shut down the reactor
d) control the fire or spill

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

QUESTION: 011 (1.00)

Which describes how an experiment could be carried out in the glory hole with out being critical, to determine if a sample is a poison or a fuel?

a) perform a chemical analysis
b) insert a sample and monitor effect on count rate
c) insert the sample and attempt criticality
d) place the experiment next to the source

QUESTION: 012 (1.00)

Calculate the shielding thickness of water necessary to reduce a 0.75 MEV gamma point source by a factor of 20. (μ= 0.0785)

a) 2.4 cm
b) 3.8 cm
c) 38 cm
d) 19.7 cm

QUESTION: 013 (1.00)

What provides the shield for fast neutrons on the AGN-201?

a) concrete blocks
b) graphite
c) lead
d) water

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

QUESTION: 014 (1.00)

During reactor operation electrical power is temporarily interrupted. What actions must be taken once power is restored to satisfy the Technical Specifications requirements for reactor shutdown?

a) The control rods must be verified or driven down and the reactor switch must be locked in "OFF".
b) The cadmium plug must be inserted in the glory hole and all experiments must be removed .
c) The Sensitrol reset buttons must be pressed and the Channel 1 and Channel 2 control switches must be taken out of "Operate".
d) The fixed radiation monitors must be re-energized and the readings verified to be at normal shutdown values.

QUESTION: 015 (1.00)

Who by job position/title must consent to allow a reactor startup, in accordance with the manual of operation for the AGN-201M procedure?

a) The NRC project chief
b) Dept. head of nuclear engineering
c) Reactor supervisor
d) reactor operator

QUESTION: 016 (1.00)

What is the technical specification staff requirement when the reactor is NOT shutdown?

a) one licensed RO in the control room with one other person and one SRO on call.
b) one licensed SRO in the control room
c) one licensed RO in the control room with one SRO one hour away.
d) none required in the control room, just available on short notice.

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

QUESTION: 017 (1.00)

If a bomb threat is received over the phone which of the following information should be requested?

a) location of bomb
b) time of explosion
c) type of device
d) all of the above

QUESTION: 018 (1.00)

With all rods out the operator moves Safety rod # 2 in, then the coarse control rod in. This indicates:

a) the rods are operable
b) the alarm conditions are clear
c) permission to continue operations
d) the rod interlock system is inoperable

QUESTION: 019 (1.00)

Step 14 of the startup procedure directs the operator to move the selector switch on channel # 3 through its full range of travel. The basis for this action is:

a) to ensure the mechanical limits are functional
b) to protect against noise spikes
c) to verify low level alarm functions
d) to null the meter

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

QUESTION: 001 (1.00)

What type of DETECTOR is used by channel THREE of the nuclear instrumentation?

a) BF3 proportional counter
b) ionization chamber
c) GM tube
d) scintillation

QUESTION: 002 (1.00)

The safety system is a "FAIL SAFE" design in that the scram signal ____.

a) accelerates both gravity and spring loading
b) deenergizes the holding magnets
c) oper the holding magnets
d) opens the holding magnets for 120 milliseconds

QUESTION: 003 (1.00)

Why is emergency power NOT required on the Texas A&M AGN-201?

a) the core when critical is self sustaining
b) the installed batteries are an adequate backup
c) the reactor will scram
d) the core fuse will melt

QUESTION: 004 (1.00)

The shield water tank temperature interlock is set to prevent startup and scram the reactor if water temperature falls below:

a) 69 °F.
b) 59 °F.
c) 35 °F.
d) 32 °F.

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

QUESTION: 005 (1.00)

The AGN-201 transfers its core heat to the water tank through which method?

a) forced convection
b) natural convection
c) radiation
d) conduction

QUESTION: 006 (1.00)

The thermal fuse is designed to melt at a temperature of ___?

a) 100 degrees C
b) 110 degrees C
c) 120 degrees C
d) 130 degrees C

QUESTION: 007 (1.00)

Motion of the coarse control rod is imparted by :

a) twin lead screws
b) a magnet moved up and down
c) a chain drive
d) a magnetic gripper assembly

QUESTION: 008 (1.00)

The active part of the AGN-201 safety rods consist of _____:

a) hafnium in polyethylene
b) cadmium in polyethylene
c) polyethylene only
d) UO2 in polyethylene

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

QUESTION: 009 (1.00)

The Texas A&M emergency plan is designed around a defined Emergency Planning Zone (EPZ). The EPZ does NOT include:

a) the electronic shop
b) graduate research lab
c) machine shop
d) out side the engineering building

QUESTION: 010 (1.00)

At 5 Watts power, a student inadvertently inserts a quantity of fissionable material into the glory hole causing a two step increase in reactivity. This will require the reactor operator to enter which of the Emergency procedures?

a) Reactor emergency
b) Reactor shutdown
c) General emergency
d) Suspected overexposure of personnel PE-4

QUESTION: 011 (1.00)

The item that describes the method utilized at Texas A&M to determine rod position indication is:

a) an output from a synchro-generator driven by a drive motor.
b) magnetic reed switches inside the drive mechanism.
c) a counter that directly counts lead screw turns.
d) an induction coil current coupled along the rod shaft.

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

QUESTION: 012 (1.00)

What is the largest diameter experiment (in inches) for the following access ports: glory hole, reflector port, thermal column.

	Glory hole	Reflector port	Thermal column	
a)	7/8	20	22	inches
b)	4	6	7/8	inches
c)	7/8	4	22	inches
d)	4	7/8	22	inches

QUESTION: 013 (1.00)

The fixed radiation monitor on the control console serves the area as a criticality alarm. This radiation monitor is a :

a) Scintillation detector
b) Compensated ion chamber
c) GM tube
d) BF3 detector

QUESTION: 014 (1.00)

During the annual control rod maintenance only one control rod may be removed and dissassembled at a time. The basis for this precaution is:

a) To ensure parts are not interchanged.
b) To prevent inadvertant criticality.
c) To maintain QA per the QA manual chapter 7.
d) To ensure radiation exposure is ALARA.

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

QUESTION: 015 (1.00)

During a reactor transient the thermal fuse should heat up about twice as fast as the rest of the core because:

a) The uranium in the fuse has twice the enrichment as the rest of the core.
b) The polystyrene of the fuse is twice as soft as the rest of the core.
c) The uranium in the fuse has twice the atom density as the rest of the core.
d) The polystyrene in the fuse has twice the insulation factor as the rest of the core.

QUESTION: 016 (1.00)

During a scram the control rods enter a dashpot area to reduce the impact on the rod. At Texas A&M the original dashpots were replaced with _____ dashpots.

a) water filled
b) silicon oil filled
c) air filled
d) polyethylene tapered

QUESTION: 017 (1.00)

When the thermal fuse activates the reactor is shut down due to:

a) Control rods drop into the core
b) The reflector and core would drop
c) The control console master relay would drop out
d) The overload bus dropping out

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

QUESTION: 018 (1.00)

Each of the access ports is lined with an aluminum tube. The ports when not used for experiments are filled. What materials (from the core outward) are placed in the tube to resemble the reactor materials displaced by the access ports.

a) graphite, lead, and wood
b) polyethelene, lead and graphite
c) lead, wood, and graphite
d) lead, graphite, and wood

QUESTION: 019 (1.00)

What can the wearer of a TLD do that will enable a TLD to differentiate different types of radiation exposure to his body?

a) wear multiple TLDs
b) use different filters on the TLD
c) change location of TLD to be closer to the source
d) TLDs can not difierentiate between different exposures

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

EQUATION SHEET

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0077$

$DR_1D_1^2 = DR_2D_2^2$

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

$SCR = S/(1-Keff)$

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

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

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

$SDM = (1-Keff)/Keff$

$Pwr = W_f\, \dot{m}$

$\ell^* = 1 \times 10^{-5}$ seconds

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

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

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

$DR = DR_0e^{-\lambda t}$

---

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5°C + 32

°C = 5/9 (°F - 32)

ANSWER: 001 (1.00)

A)

REFERENCE:

Technical Specifications
Operating License R - 23

ANSWER: 002 (1.00)

d)

REFERENCE:

rho= Keff-1/Keff .90-1/.9= -.111delta K/K

ANSWER: 003 (1.00)

d)

REFERENCE:

NRC exam Intro to nuc. eng.,Lamarsh, chap 7.

ANSWER: 004 (1.00)

d)

REFERENCE:

J.R.Lamarsh chap 7.1 pp.289

ANSWER: 005 (1.00)

a)

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

REFERENCE:

J.R. Lamarsh chap 7

P(o) = 10
P(t) = 100
t = 60 sec
T = period
P(t) = P(o) e t/T
100 = 10 e 60/T
10 = e 60/T
ln10 = 60/T
T=60/ln10 =60/2.3 = 26.1 sec

ANSWER: 006 (1.00)

d)

REFERENCE:

TA&M applied principles pp3-23

ANSWER: 007 (1.00)

c]

REFERENCE:

GLASSTONE 1.39

ANSWER: 008 (1.00)

b

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

REFERENCE:

Rho = deff/1+lambda tau

ANSWER: 009 (1.00)

d)

REFERENCE:

cr1/cr2=[1-k2]/[1-k1]
100/150=-[1-k2/c1-.95]
k2= 0.967
delta rho = (1-k1)/k1-(1-k2)/k2
= k2-k1/k2Xk1
= 1.8% per equation sheet

ANSWER: 010 (1.00)

c)

REFERENCE:

TA&M data sheet -3.0 E-4 per degree

ANSWER: 011 (1.00)

a)

REFERENCE:

TS

ANSWER: 012 (1.00)

a)

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

REFERENCE:

Intro to nuc rx ops p 3-16.

ANSWER: 013 (1.00)

B)

REFERENCE:

TA&M curves fig 1&2

ANSWER: 014 (1.00)

c)

REFERENCE:

eq sheet
p=po e t/T

ANSWER: 015 (1.00)

c)

REFERENCE:

EQ sheet

ANSWER: 016 (1.00)

a)

REFERENCE:

JR LAMARSH chap 7

ANSWER: 017 (1.00)

d)

REFERENCE:

intro to nuc chapter 3

ANSWER: 018 (1.00)

b)

REFERENCE:

Larmash 2-63

ANSWER: 019 (1.00)

c)

REFERENCE:

T.S 5.2 -

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

ANSWER: 001 (1.00)

c)

REFERENCE:

TS

ANSWER: 002 (1.00)

c

REFERENCE:

EQ sheet

ANSWER: 003 (1.00)

b

REFERENCE:

EQ sheets

ANSWER: 004 (1.00)

d)

REFERENCE:

ser 4.3.2 shielding

ANSWER: 005 (1.00)

c)

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

REFERENCE:

D = 6CE/dsquared 6(10) X (1.33+1.17)/25 = 6.0 REM

ANSWER: 006 (1.00)

c)

REFERENCE:

10CFR20.101(a)

ANSWER: 007 (1.00)

c)

REFERENCE:

IoDo2 = IfDf2
this results in 225 mRem/hr at five ft. this is a high rad area
10CFR20

ANSWER: 008 (1.00)

d)

REFERENCE:

t.s. 3.3

ANSWER: 009 (1.00)

b)

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

REFERENCE:

5(24-18)=30 Rem life time limit= 30-28= 2Rem
With NRC form 4 on file up to 3 REM/qtr is permitted not to exceed 5(n-18)
Life time limit is most restrictive
Rem=Rem no quality factor is required
0.4 Rem/hr + 2.0 Rem/hr =2.4 Rem/hr
2.0 Rem/(2.4Rem/hr) =0.83 hrs = 50mins

10CFR20

ANSWER: 010 (1.00)

c

REFERENCE:

PE-3, EA-1 page 1

ANSWER: 011 (1.00)

b

REFERENCE:

U ofNM exam

ANSWER: 012 (1.00)

c

REFERENCE:

- I=e-ux EQ sheet

ANSWER: 013 (1.00)

d)

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

REFERENCE:

design features pp5 t.s. 5.1

ANSWER: 014 (1.00)

a)

REFERENCE:

Technical Specifications, Section 1

ANSWER: 015 (1.00)

b)

REFERENCE:

3.1.2 to operate the reactor

ANSWER: 016 (1.00)

a)

REFERENCE:

t.s 6.1.9a

ANSWER: 017 (1.00)

d)

REFERENCE:

EA-2 bomb threat

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

ANSWER: 018 (1.00)

d

REFERENCE:

3.3 check out procedure

ANSWER: 019 (1.00)

b

REFERENCE:

3.3 check out procedure step 14

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

ANSWER: 001 (1.00)

b)

REFERENCE:

Texas A & M AGN Manual

ANSWER: 002 (1.00)

b)

REFERENCE:

exam bank modified

ANSWER: 003 (1.00)

c

REFERENCE:

ANSWER: 004 (1.00)

b)

REFERENCE:

s.s pp9

ANSWER: 005 (1.00)

b

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

REFERENCE:

SER sec 5

ANSWER: 006 (1.00)

c

REFERENCE:

Texas A & M sys description

ANSWER: 007 (1.00)

b

REFERENCE:

ISU exam

ANSWER: 008 (1.00)

d

REFERENCE:

ser 4.4 control rods

ANSWER: 009 (1.00)

d

REFERENCE:

fig 2 TA&M E-PLAN

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

ANSWER: 010 (1.00)

a

REFERENCE:

RE-1 power excursion greater than 10 watts

ANSWER: 011 (1.00)

a

REFERENCE:

AGN-210 notes

ANSWER: 012 (1.00)

c)

REFERENCE:

facility ques modified to multi choice

ANSWER: 013 (1.00)

c)

REFERENCE:

-

ANSWER: 014 (1.00)

a)

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

PEFERENCE:

MP-1 rev4

ANSWER: 015 (1.00)

c)

REFERENCE:

RX descrip ISU ques

ANSWER: 016 (1.00)

c)

REFERENCE:

Checked with facility, reactor supervisor

ANSWER: .017 (1.00)

b)

REFERENCE:

Thermal fuse description

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

ANSWER: 018 (1.00)

a)

REFERENCE:

sys description access ports

ANSWER: 019 (1.00)

b)

REFERENCE:

exam bank

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

ANSWER KEY

MULTIPLE CHOICE

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

ANSWER KEY

MULTIPLE CHOICE

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

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

ANSWER KEY

MULTIPLE CHOICE

001 b

002 b

003 c

004 b

005 b

006 c

007 b

008 d

009 d

010 a

011 [illegible]

012 [illegible]

013 [illegible]

014 [illegible]

015 c

016 c

017 b

018 a

019 b

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