April 16, 2001

Dr. B. Don Russell. Deputy Director
Texas Engineering Experiment Station
Texas A&M University
Nuclear Science Center, Bldg. 1095
College Station, TX 77843-3575

Dear Dr. Russell:

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-128/OL-01-01

During the week of March 19, 2001, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Texas A&M University Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/indesx.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Patrick Isaac at 301-415-1019 or via Internet E-mail at pxi@nrc.gov.

Sincerely,

/RA/

Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Initial Examination Report No. 50-128/OL-01-01
2. NRC Resolution - Written Examination
3. Examination and answer key (RO)

cc w/encls:
Please see next page

cc:

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Gainesville, FL 32611

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

REPORT NO.: 50-128/OL-10-01

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-129

FACILITY: Texas A&M University

EXAMINATION DATES: March 21 - 22, 2001

EXAMINER: Patrick Isaac, Chief Examiner

SUBMITTED BY: ***/RA/*** 04/05/2001
Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of March 19, 2001, NRC administered Operator Licensing Examinations to one Reactor Operator (RO) and one Senior Reactor Operator Upgrade (SROU) candidate. The RO candidate failed Section B of the written examination. The SROU candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**0/1**	**N/A**	**0/1**
Operating Tests	**1/0**	**1/0**	**2/0**
Overall	**0/1**	**1/0**	**1/1**

ENCLOSURE 1

NRC RESOLUTIONS - WRITTEN EXAMINATION

QUESTION (C.10)
During reactor operation, a leak develops in the primary to secondary heat exchanger. Which one of the following conditions correctly describes how the system will react?

a. Pool level will increase due to leakage from the secondary, the automatic level control will maintain level in the secondary.

b. Cooling tower basin level will decrease due to leakage from the secondary, pool level will increase.

c. Cooling tower level will increase due to leakage from the primary, automatic level control will maintain level in the primary.

d. Cooling tower basin level will increase due to leakage from the primary, pool level will decrease.

ANSWER: b

Facility Comment:

The correct answer for this question is "d" since the pool level is at a higher elevation than the cooling tower basin. Also, the primary pump has a higher discharge pressure than the secondary pump. Ref. SAR Figure 4-5.

NRC Resolution:

Comment Accepted. Question C.10 will be modified to accept answer "d" as correct.

QUESTION C.13 [1.0 point]
Which one of the following statements correctly describes the purpose of the synchronous transmitter in the control rod drive assembly.

a. Provides rod position indication when the electromagnet engages the connecting rod armature.

b. Provides a variable voltage to the rod drive motor for regulating control rod speed.

c. Provides potential voltage as required for resetting the electromagnet current.

d. Provides the potential voltage to relatch the connecting rod to the electromagnet.

ANSWER: a

Facility Comment:

This question does not have a correct answer since the NSCR no longer uses synchronous transmitters. The control rod drives were modified in May 1995, per modification authorization M-46, to utilize stepping motors and an encoder/decoder system.

NRC Resolution:

Comment Accepted. Question C.13 will be deleted from the examination.

QUESTION C.18 [1.0 point]
Identify each of the beam ports listed in column A with the correct type in column B. Note, items in column B may be used more than once or not at all.

	Column A	Column B	
a.	1	1.	Radial
b.	3	2.	Through Tube
c.	4	3.	Weighted extensions tubes
d.	6	4.	Bismuth Trough may be suspended from tip.

ANSWER: a, 4; b, 1; c, 4; d, 3

Facility Comment:

The problem with this question is that the Figure (Fig 6-2) and the information in paragraph VI.2 are not currently correct. The bismuth trough was removed in early 1970's and the thermal column has been modified for use as a polycarbonate film irradiator. Consequently the answers in column B of this question that address weighted extension tubes and bismuth trough are not valid for the current configuration. Also, the candidate was trained on the current setup.

NRC Resolution:

Comment Accepted. Question C.18 will be deleted from the examination.

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

FACILITY: Texas A&M

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 2001/03/19

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach all answer sheets to the examination. Point values are indicated in parentheses for each question. A 70% in each category is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
20.00	**34.5**	_____	____	**A.**	**REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS**
20.00	**34.5**	_____	____	**B.**	**NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS**
18.00	**31.0**	_____	____	**C.**	**FACILITY AND RADIATION MONITORING SYSTEMS**
58.00		_____	____%		**TOTALS**
		FINAL GRADE			

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.

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 *****)

B. NORMAL/EMERG PROCEDURES & RAD CON

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d ___

002 a ___ b ___ c ___ d ___

003 a ___ b ___ c ___ d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

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

C. PLANT AND RAD MONITORING SYSTEMS

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

~~013 a b c d ___~~ *DELETED*

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 ___~~ *DELETED*

019 a b c d ___

020 a b c d ___

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

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

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

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

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

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

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

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

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

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

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

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

QUESTION A.1 [2.0 points, 0.5 each]
Match each term in column A with the correct definition in column B.

Column A	Column B
a. Prompt Neutron	1. A neutron in equilibrium with its surroundings.
b. Fast Neutron	2. A neutron born directly from fission.
c. Thermal Neutron	3. A neutron born due to decay of a fission product.
d. Delayed Neutron	4. A neutron at an energy level greater than its surroundings.

QUESTION A.2 [1.0 point]
You enter the control room and note that all nuclear instrumentation show a steady neutron level, and no rods are in motion. Which one of the following conditions **CANNOT** be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source has been removed from the core.

QUESTION A.3 [1.0 point]
Which one of the following describes the **MAJOR** contributor to the production and depletion of Xenon respectively in a **STEADY-STATE OPERATING** reactor?

Production	Depletion
a. Radioactive decay of Iodine	Radioactive Decay
b. Radioactive decay of Iodine	Neutron Absorption
c. Directly from fission	Radioactive Decay
d. Directly from fission	Neutron Absorption

QUESTION A.4 [1.0 point]
Which factor of the Six Factor formula is most easily varied by the reactor operator?

a. Thermal Utilization Factor (f)

b. Reproduction Factor (η)

c. Fast Fission Factor (τ)

d. Fast Non-Leakage Factor (L_f)

QUESTION A.5 [1.0 point]
Which of the following does NOT affect the Effective Multiplication Factor (Keff)?

a. The moderator-to-fuel ratio.

b. The physical dimensions of the core.

c. The strength of installed neutron sources.

d. The current time in core life.

QUESTION A.6 [1.0 point]
You perform two initial startups a week apart. Each of the startups has the same starting conditions, (core burnup, pool and fuel temperature, and count rate are the same). The only difference between the two startups is that during the **SECOND** one you stop for 10 minutes to answer the phone. For the second startup compare the critical rod height and count rate to the first startup.

	Rod Height	Count Rate
a.	Higher	Same
b.	Lower	Same
c.	Same	Lower
d.	Same	Higher

QUESTION A.7 [1.0 point]
Several processes occur that may increase or decrease the available number of neutrons. SELECT from the following the six-factor formula term that describes an **INCREASE** in the number of neutrons during the cycle.

a. Thermal utilization factor (f).

b. Resonance escape probability (p).

c. Thermal non-leakage probability ($\mathcal{L}_{th}$).

d. Reproduction factor (η).

QUESTION A.8 [1.0 point]
Which one of the following atoms will cause a neutron to lose the most energy in an elastic collision?

a. $Uranium^{238}$

b. $Carbon^{12}$

c. $Hydrogen^{2}$

d. $Hydrogen^{1}$

QUESTION A.9 [1.0 point]
K_{eff} for the reactor is 0.98. If you place an experiment worth **+$1.00** into the core, what will the new K_{eff} be?

a. 0.982

b. 0.987

c. 1.013

d. 1.018

QUESTION A.10 [1.0 point]
About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5} % full power what will the power be in three minutes.

a. 5×10^{-6} % full power

b. 2×10^{-6} % full power

c. 10^{-6} % full power

d. 5×10^{-7} % full power

QUESTION A.11 [1.0 point]
Core excess reactivity changes with…

a. Fuel burnup

b. Control Rod Height

c. Neutron Level

d. Reactor Power Level

QUESTION A.12 [1.0 point]
INELASTIC SCATTERING is the process by which a neutron collides with a nucleus and …

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

b. is absorbed, with the nucleus emitting a gamma ray and a neutron with a lower kinetic energy.

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

d. recoils with a higher kinetic energy than it had prior to the collision with the nucleus emitting a gamma ray.

QUESTION A.13 [1.0 point]
For most materials the neutron microscopic cross-section for absorption σ_a generally …

a. increases as neutron energy increases

b. decreases as neutron energy increases

c. increases as target nucleus mass increases

d. decreases as target nucleus mass increases

QUESTION A.14 [1.0 point]
Which one of the following is the definition of the FAST FISSION FACTOR?

a. The ratio of the number of neutrons produced by fast fission to the number produced by thermal fission

b. The ratio of the number of neutrons produced by thermal fission to the number produced by fast fission

c. The ratio of the number of neutrons produced by fast and thermal fission to the number produced by thermal fission

d. The ratio of the number of neutrons produced by fast fission to the number produced by fast and thermal fission

QUESTION A.15 [1.0 point]
Which one of the following is the **MAJOR** source of energy released during fission?

a. Kinetic energy of the fission neutrons.

b. Kinetic energy of the fission fragments.

c. Decay of the fission fragments.

d. Prompt gamma rays.

QUESTION A.16 [1.0 point]
As primary coolant temperature increases, rod worth:

a. increases due to higher reflector efficiency.

b. decreases due to higher neutron absorption in the moderator.

c. increases due to the increase in thermal diffusion length.

d. remains the same due to constant poison cross-section of the control rods.

QUESTION A.17 [1.0 point]
The term ***PROMPT JUMP*** refers to …

a. the instantaneous change in power due to withdrawal of a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

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

d. a negative reactivity insertion which is less than τ_{eff}.

QUESTION A.18 [1.0 point]
Which one of the following factors has the **LEAST** effect on K_{eff}?

a. Fuel burnup.

b. Increase in moderator temperature.

c. Increase in fuel temperature.

d. Xenon and samarium fission products.

QUESTION A.19 [1.0 point]
Which one of the following is the correct reason that delayed neutrons enhance control of the reactor?

a. There are more delayed neutrons than prompt neutrons.

b. Delayed neutrons increase the average neutron generation time.

c. Delayed neutrons are born at higher energies than prompt neutrons and therefore have a greater effect.

d. Delayed neutrons take longer to reach thermal equilibrium.

QUESTION B.1 [1.0 point]
Which one of the following statements define the Technical Specifications term "Channel Test?"

a. The adjustment of a channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures

b. The qualitative verification of acceptable performance by observation of channel behavior

c. The introduction of a signal into a channel for verification of the operability of the channel

d. The combination of sensors, electronic circuits and output devices connected to measure and display the value of a parameter

QUESTION B.2 [2.0 points, 0.5 each]
Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

QUESTION B.3 [2.0 points, 0.5 each]
Match the radiation reading from column A with its corresponding radiation area classification (per 10 CFR 20) listed in column B.

COLUMN A	COLUMN B
a. 10 mRem/hr	1. Unrestricted Area
b. 150 mRem/hr	2. Radiation Area
c. 10 Rem/hr	3. High Radiation Area
d. 550 Rem/hr	4. Very High Radiation Area

QUESTION B.4 [1.0 point]
10CFR50.54(x) states: *"A licensee may take reasonable action that departs from a license condition or a technical specification (contained in a license issued under this part) in an emergency when this action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent.* 10CFR50.54(y) states that the minimum level of management which may authorize this action is …

a. any Reactor Operator licensed at facility

b. any Senior Reactor Operator licensed at facility

c. Facility Manager (or equivalent at facility).

d. NRC Project Manager

QUESTION B.5 [1.0 point]
A small radioactive source is to be stored in the reactor bay with no shielding. The source reads 2 R/hr at 1 foot. A "Radiation Area" barrier would have to be erected approximately ___ from the source.

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

QUESTION B.6 [1.0 point]
Which one of the following is the 10 CFR 20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)**?

a. The sum of the deep dose equivalent and the committed effective dose equivalent.

b. The dose that your whole body receives from sources outside the body.

c. The sum of the external deep dose and the organ dose.

d. The dose to a specific organ or tissue resulting from an intake of radioactive material.

QUESTION B.7 [1.0 point]
Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an **additional four** inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr

b. 50 mR/hr

c. 75 mr/hr

d. 100 mr/hr

QUESTION B.8 [1.0 point]
Your Reactor Operator license expires after _____ years.

a. 2

b. 4

c. 6

d. 8

QUESTION B.9 [1.0 point]
While performing a power calibration the difference between the indicated power and the measured power is 10%. Which one of the below statements is correct for this condition?

a. Position the detector to match indicated and measured power.

b. The adjustments will be verified by a follow-up calorimetric prior to taking the reactor to greater than 400 kW indicated power.

c. Adjustments to the power instrumentation cannot be performed under any circumstances, if the difference is greater than 5%.

d. A difference this great is suspect and may be an indication of "shadowing effect".

QUESTION B.10 [1.0 point]
Startups following unscheduled shutdowns:

a. Need to be approved by the NRC if a safety limit was exceeded.

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

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

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

QUESTION B.11 [1.0 point]
An experiment with a reactivity worth of $0.25 is to be removed from the core. Prior to performing this operation:

a. reactor power must be less than 600 kW.

b. the reactor must be subcritical.

c. the reactor must be subcritical by at least $0.25.

d. the reactor must be shutdown.

QUESTION B.12 [1.0 point]
Which one of the following is a duty of the Reactor Operator (RO) during an emergency which requires a facility evacuation?

a. Verify that rope barriers are in place in the reception room.

b. Verify all persons are accounted for.

c. Shutdown building air handling and exhaust systems.

d. Verify all doors to the reactor building are closed.

QUESTION B.13 [1.0 point]
The Emergency Planning Zone (EPZ) for the NSC is established at the ...

a. Site boundary

b. Reactor building

c. Reception room

d. NSC Radiation Protection Office

QUESTION B.14 [1.0 point]
During a pre-startup checkout in preparation for pulsing operations, the operator sets the Wide Range Monitor Module to 600 W and attempts to fire the transient rod. He hears the transient rod pneumatic system fire. Which one of the following statements describes the status of the pre-startup check?

a. The pre-startup checkouts requirements are satisfied. Audible indication of the pneumatic system operation is sufficient to verify operability of the system since actual rod motion is not yet permitted.

b. The pre-startup checkouts requirements are satisfied if the transient rod position indication confirms that the rod did, in fact, withdraw. Both audible indication and position feedback indicating withdrawal are required to satisfy the checkouts requirements.

c. The pre-startup checkouts requirements are NOT satisfied. The power level should be set higher than the interlock level. A procedural error has been made.

d. The pre-startup checkouts requirements are NOT satisfied. The pneumatic system should not have fired. A system malfunction has occurred.

QUESTION B.15 [1.0 point]
Major differences between steady state and pulsing include:

a. The diffuser pump is not required during pulse operations.

b. Keeping the reactor below 300 watts for pulsing.

c. Limiting the peak fuel temperature to 830 °F during pulsing.

d. Setting the bridge ARM higher for pulsing.

QUESTION B.16 [1.0 point]
Which one of the following does NOT require NRC approval for changes?

a. Facility License

b. Requalification plan

c. Emergency Implementation Procedures

d. Emergency Plan

QUESTION B.17 [1.0 point]
The three fuel handling tools at the NSCR TRIGA are:

a. Designed to manipulate fuel bundles either by hand or overhead crane.

b. Fitted with a locking ball-detent latching mechanisms.

c. Stored on the tool rack located at the northeast corner of the main pool.

d. Made to release their load by raising the manipulator or plunger upwards.

QUESTION B.18 [1.0 point]
Which one of the following is a requirement for all fuel movements involving the core?

a. At least one fuel element temperature measuring channel must be operable.

b. A Health Physics technician must be on call.

c. All controls rods must be installed in the core.

d. The neutron source must be installed

QUESTION C.1 [1.0 point]
Which one of the following describes the yellow light associated with the beam port water shutters?

a. An illuminated yellow light indicates that the shutter tube is evacuated and the beam is active.

b. An illuminated yellow light indicates that a shutter flood permissive has been selected by the reactor operator.

c. The yellow light tells the experimenter that the beam has been cut off.

d. The yellow light warns the experimenter of the commencement of a reactor startup.

QUESTION C.2 [1.0 point]
Which one of the following statements concerning Beam Port #4 is *False*?

a. To clear the interlock for evacuation of the water shutter, the movable shield block shall be in the closed position.

b. A 2 inch diameter pipe connects the beam port to the central exhaust system.

c. Positioning of samples for real-time radiography requires that the neutron beam be shut off.

d. With the reactor positioned within the east rail stop, a “C-2" device causes a reactor scram when the sample preparation room door is opened.

QUESTION C.3 [1.0 point]
Which one of the following statements describes the moderating properties of Zirconium Hydride?

a. The probability that a neutron will return to the fuel element before being captured elsewhere is a function of the temperature of the hydride.

b. The ratio of hydrogen atoms to zirconium atoms affects the moderating effectiveness for slow neutrons.

c. The hydride mixture is very effective in slowing down neutrons with energies below 0.025 eV.

d. Elevation of the hydride temperature increases the probability that a thermal neutron will escape the fuel-moderator element before being captured.

QUESTION C.4 [1.0 point]
Erbium is used in FLIP fuel because it:

a. acts as a moderator due to a high scattering cross section.

b. allows greater fuel loading and extends core life.

c. reduces the prompt negative temperature coefficient.

d. increases the total fission cross section of the fuel.

QUESTION C.5 [1.0 point]
In the event of a building ventilation isolation, the emergency exhaust system can be operated in a manual mode from:

a. the Emergency Operating Panel in the central mechanical chase.

b. the Air Handling Control Panel in the reception room.

c. the Radiation Release Monitoring Panel in the Health Physicist's Office.

d. the Supervisor's Console in the control room.

QUESTION C.6 [1.0 point]
Which one of the following Facility Air Monitoring System channels initiates a shutdown of the air handling system and building isolation on receipt of an alarm?

a. building gaseous monitor

b. building particulate monitor

c. stack gaseous monitor

d. stack particulate monitor

QUESTION C.7 [1.0 point]
Which one of the following areas is NOT directly monitored by a channel of the Area Radiation Monitoring System?

a. Reception area

b. Material handling area

c. Demineralizer room

d. Research Lab No. 1

QUESTION C.8 [1.0 point]
Which of the following is NOT an option provided by the Radioactive Liquid Waste Disposal System?

a. draining liquid waste to the creek

b. storing liquid waste for radioactive decay

c. evaporation and solidification of liquid waste

d. diluting liquid waste to comply with 10CRF20 limits

QUESTION C.9 [1.0 point, 0.25 each]
Which one of the following is the primary purpose of the safety plate assembly?

a. Provide additional support to the reactor grid plate for the use of highly enriched FLIP fuel elements.

b. Ensure proper alignment of the shim-safety, regulating and transient rods.

c. Retain a shim-safety rod fuel follower if it becomes detached from its mounting.

d. Retain any debris resulting from an accident which has directly involved the fuel elements.

QUESTION C.10 [1.0 point]
During reactor operation, a leak develops in the primary to secondary heat exchanger. Which one of the following conditions correctly describes how the system will react?

a. Pool level will increase due to leakage from the secondary, the automatic level control will maintain level in the secondary.

b. Cooling tower basin level will decrease due to leakage from the secondary, pool level will increase.

c. Cooling tower level will increase due to leakage from the primary, automatic level control will maintain level in the primary.

d. Cooling tower basin level will increase due to leakage from the primary, pool level will decrease.

QUESTION C.11 [1.0 point]
The reactor is at 50 watts in "SERVO" control when gamma compensating voltage for the Linear Power measuring NI channel is lost. What effect would this have on regulating rod position, and why?

a. Rod will drive in slightly, because indicated power will increase with demand remaining the same.

b. Rod will drive out slightly, because indicated power will decrease with demand remaining the same.

c. Rod will remain as is, because input to the control circuit is from the log power amplifier.

d. Rod will scram, due to a large increase in indicated power.

QUESTION C.12 [1.0 point]
Which one of the following provides a reactor scram in any mode of operation?

a. High fuel temperature.

b. Low pool level.

c. High power level.

d. Loss of supply voltage to high power level detector

QUESTION C.13 [1.0 point] *DELETED*
~~Which one of the following statements correctly describes the purpose of the synchronous transmitter in the control rod drive assembly.~~

~~a. Provides rod position indication when the electromagnet engages the connecting rod armature.~~

~~b. Provides a variable voltage to the rod drive motor for regulating control rod speed.~~

~~c. Provides potential voltage as required for resetting the electromagnet current.~~

~~d. Provides the potential voltage to relatch the connecting rod to the electromagnet.~~

QUESTION C.14 [1.0 point]
More than 95% of the facility's Ar-41 is produced:

a. in the beam ports.

b. in the pneumatic system.

c. in the reactor building atmosphere.

d. in the reactor pool.

QUESTION C.15 [1.0 point]
The FLIP fuel elements:

a. are about 20% enriched uranium with stainless steel clad and no burnable poison.

b. are about 70% enriched uranium with stainless steel clad and erbium burnable poison.

c. are about 20% enriched uranium with aluminum clad and erbium burnable poison.

d. are about 70% enriched uranium with aluminum clad and no burnable poison.

QUESTION C.16 [1.0 point]
A 1-3/4 inch diameter hole through the grid plate is located at the southwest corner of the four rod fuel assemblies. The purpose of these holes is to:

a. accommodate a fuel followed control rod.

b. provide a mounting location for in-core experiments.

c. accommodate a zirconium rod after hydriding in the fuel elements is completed.

d. provide a coolant flow path through the grid plate.

QUESTION C.17 [1.0 point]
Which one of the following is the purpose of the graphite slugs located at the top and bottom of each fuel rod?

a. To absorb neutrons, thereby reducing neutron embrittlement of the upper and lower guide plates.

b. To absorb neutrons, thereby reducing neutron leakage from the core.

c. To reflect neutrons, thereby reducing neutron leakage from the core.

d. To couple neutrons from the core to the nuclear instrumentation, thereby decreasing neutron shadowing effects.

QUESTION C.18 [1.0 point, 0.25 each] *DELETED*
~~Identify each of the beam ports listed in column A with the correct type in column B. Note, items in column B may be used more than once or not at all.~~

~~Column A~~	~~Column B~~
~~a. 1~~	~~1. Radial~~
~~b. 3~~	~~2. Through Tube~~
~~c. 4~~	~~3. Weighted extensions tubes~~
~~d. 6~~	~~4. Bismuth Trough may be suspended from tip.~~

QUESTION C.19 [1.0 point]
The pneumatic sample system has several design features including:

a. An override so the control room can return a sample from the reactor to its origin.

b. The use of dry compressed CO2 to minimize moisture in the system.

c. Control room permissive for each remote sample station.

d. Automatic return override if the samples get more exposure than expected.

QUESTION C.20 [1.0 point]

Looking at three element fuel bundles from above:

a. You should see the locking bolt oriented North.

b. The bundle identification number should be visible.

c. Individual element identification numbers are visible.

d. The bundle doesn't have any shims.

***** END OF EXAMINATION*****

A.1 a, 2; b, 4; c, 1; d, 3
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 2.5, p. 2-36.

A.2 c
REF: Standard NRC question

A.3 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1988, §§ 8.1 —8.4, pp. 8-3 — 8-14.

A.4 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2, pp. 3-13 — 3-18.

A.5 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.4, p. 3-21.

A.6 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 5.7, pp. 5-28 — 5-38.

A.7 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2, pp. 3-13 — 3-18.

A.8 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 2.5.3 p. 2-45.

A.9 b
REF: SDM = $(1-k_{eff})/k_{eff}$ = (1-0.98)/0.98 = 0.02/0.99 = 0.02041 or 0.02041/.0075 = \$2.72, or a reactivity worth (τ) of -\$2.72. Adding +\$1.00 reactivity will result in a SDM of \$2.72 - \$1.00 = \$1.72, or .0129081 τ K/K
K_{eff} = 1/(1+SDM) = 1/(1 + 0.0129081) = 0.987

A.10 c
REF: $P = P_0 e^{-T/\tau} = 10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

A.11 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 6.2 p. 6-1 — 6-4.

A.12 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 2.4.5 p. 2-28.

A.13 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 2.5.1 p. 2-36.

A.14 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.1 p. 3-16.

A.15 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2.1, p. 3-4.

A.16 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.2, p. 3-18

A.17 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, § 4.7, p. 4-21

A.18 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.3.2, p. 3-18.

A.19 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations*, © 1982, § 3.2.4, p. 3-12.

B.1 c
REF: Technical Specifications Section 1.0, Page 1

B.2 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

B.3 a, 2; b, 3; c, 3; d, 4
REF: 10 CFR 20.1003, Definitions

B.4 b
REF: 10CFR50.54(y)

B.5 c
REF: $\frac{DR_1}{X_2^2} = \frac{DR_2}{X_1^2} X_2^2 = \frac{DR_1}{DR_2} X$ $X_2^2 = \frac{2000}{5} \times 1^2 = 400 ft^2 X_2 = 20 f$

B.6
a
REF: 10 CFR 20.1003 *Definitions*

B.7 b
REF: Nuclear Power Plant Health Physics and Radiation Protection

B.8 c
REF: 10CFR55.55(a)

B.9 b
REF: SOP II-J.2.b

B.10 a
REF: SOP II, *REACTOR OPERATIONS*, C.6, and 10 CFR 50.36

B.11 a
REF: SOP II-D.6

B.12 c
REF: SOP IX-B

B.13 b
REF: Emergency Plan

B.14 c
REF: SOP II-C.2.b; NSC form 532, Sect. D

B.15 a
REF: SOP II, *REACTOR OPERATIONS*, C.4 and E.1.

B.16 c
REF: 10 CFR 50.54 (q); 10 CFR 50.59; 10 CFR 55.59

B.17 d
REF: SOP II, *REACTOR OPERATIONS*, H.3.

B.18 a
REF: SOP-II-I *Reactor Core Manipulation*

C.1 a
REF SOP IV-D.3.b.10

C.2 d
REF SOP IV-F

C.3 d
REF GA - 3886 (Rev. A) TRIGA Mark III Reactor Hazards Analysis, Feb. 1965.

C.4 b
REF SAR III.C.2

C.5 b
REF SAR V.B.3, VIII-A; Modification Authorization M-14

C.6 d
REF SAR IX-F

C.7 a
REF SAR IX-G, Fig. 9.3

C.8 c
REF: SAR IX-B.2

C.9 c
REF SAR III-B.3

C.10 d
REF SAR IV-B.2 and figure 4-6.

C.11 a
REF SAR VII figure 7-2.

C.12 a
REF: SAR, Table V pg. 100

~~C.13 a~~ *DELETED*
~~REF: SAR III.B.7~~

C.14 d
REF: SAR IX-D

C.15 b
REF: SAR III-B.4

C.16 a
REF SAR III-B.3

C.17 c
REF: SAR III-B.4

~~C.18 a, 4; b, 1; c, 4; d, 3;~~ *DELETED*
~~REF: SAR VI-A.2.~~

C.19 c

REF: SOP IV-C

C.20 d
REF: SOP II H.1 and 2.