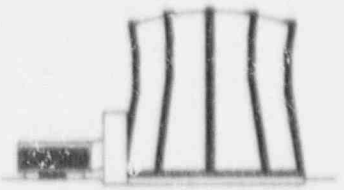
ENCLOSURE 2

TEXAS ENGINEERING EXPERIMENT STATION
TEXAS A&M UNIVERSITY
COLLEGE STATION, TEXAS 77843-3575



NUCLEAR SCIENCE CENTER
409/845-7551

92-130

22 January 1992

Mr. Frank Collins
Division of Licensee Performance
and Evaluation
U.S. Nuclear Regulatory Commission
Mail Stop 10-D-22, O.W.F.N.
Washington, D.C. 20555

Dear Mr. Collins:

After reviewing the Operator Licensing Examination, which was administered to three applicants at the Texas A&M University Nuclear Science Center, I have comments concerning the following questions.

Section B. Normal and Emergency Operating Procedures and Radiological Controls

Question:007

The keys are in the possession of the Senior Reactor Operator during reactor operations involving the irradiation cell. However, the keys will be in the possession of anyone entering the irradiation cell. The cell entry will be performed only when there is no reactor operations involving the irradiation cell.

Consequently, due to the confusion factor, I recommend that both answers a. (the Senior Reactor) and d. (Persons working in the irradiation cell) be accepted for this question.

Question:019

The air handlers are automatically shutdown if either the stack particulate monitor or fission product particulate monitor alarms. The corrective action for either alarm is to ascertain that the air handlers are shutdown. This action is outlined in SOP VII-A4.C.(2)(a) and (b).

C per telecon 1/24/92

Consequently I recommend that both answers a. (Stack particulate monitor) and ~~b.~~ (Fission product particulate monitor) be accepted for this question.

Section C. Plant and Radiation Monitoring Systems

Question:003

To reposition an experiment in the beam port cave the technician would normally do so through the shield block which is located in the top of the beam port cave (Ref, Figure IV-F-3). The movement of this shield block would cause a C-2 device alarm in the control room but not a reactor scram. To cause a reactor scram the technician would have to open the cave entry door (Ref, Figure IV-F-2). However the Senior Reactor Operator would not allow the technician to have in his possession the key necessary to open the cave entry door if the reactor was operating.

Consequently, due to the confusion caused by terminology, I recommend that both answers a. (The C-2 device alarms in the control room) and b. (The C-2 device causes a reactor scram and an alarm) be accepted for this question.

All in all this was an excellent examination. If you have any questions please contact me at (409) 845-7551.

Sincerely,

Bill F. Asher

Bill F. Asher, Manager
Reactor Operations

BFA/ym

cc: Dr. Warren D. Reece, Director, NSC
Mr. Bruce Carlisle, Assistant Director, NSC

Nuclear Regulatory Commission
Operator Licensing
Examination

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

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

FACILITY: Texas A&M

REACTOR TYPE: TRIGA

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
20.00	33.33			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	33.33			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.33			C. PLANT AND RADIATION MONITORING SYSTEMS
60.00			%	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	___
020	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	___
020	a	b	c	d	___

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

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	___
009	a	b	c	d	___
009	a	b	c	d	___
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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 C *****)
(********** END OF EXAMINATION **********)

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.

QUESTION: 001 (1.00)

Which ONE of the following characteristics is desirable in a thermal reactor fuel?

a. low concentration of fissile atoms
b. low absorption cross section
c. low mass number
d. low coefficient of expansion

QUESTION: 002 (1.00)

Which ONE of the following characteristics is NOT a desirable quality of a moderator?

a. large atomic weight
b. small atomic weight
c. large scattering cross section
d. small absorption cross section

QUESTION: 003 (1.00)

The macroscopic cross section differs from the microscopic cross section in that it:

a. never changes with energy level.
b. always is a total for all reactions.
c. considers the neutron density.
d. is only applicable to one type of reaction.

QUESTION: 004 (1.00)

The neutrons released by fission are fast neutrons because they:

a. allow accurate and quick instrumentation response.
b. are responsible for prompt criticality.
c. decay rapidly to stable levels.
d. are at high kinetic energy levels.

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

QUESTION: 005 (1.00)

A reactor with an initial population of 24000 neutrons is operating with Keff = 1.01. Of the CHANGE in population from the current generation to the next generation, how many are prompt neutrons?

a. 25
b. 238
c. 2500
d. 24240

QUESTION: 006 (1.00)

The source of delayed neutrons is:

a. delayed fission
b. decay of fission products
c. gamma interactions with structural materials
d. instrumentation dead bands and reaction times

QUESTION: 007 (1.00)

Delayed neutrons facilitate control of the reactor because they:

a. lengthen the effective neutron lifetime.
b. shorten the mean diffusion time.
c. increase the non-leakage probability.
d. decrease the fast fission factor.

QUESTION: 008 (1.00)

In order to ensure that stored fuel and sources remain subcritical, the Technical Specifications place limits on the:

a. effective multiplication factor.
b. infinite multiplication factor.
c. effective decay factor.
d. mean migration factor.

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

QUESTION: 009 (1.00)

The operator has just pulled control rods and changed the effective multiplication factor (Keff) from 0.998 to 1.002. The reactor is:

a. prompt critical.
b. supercritical.
c. exactly critical.
d. subcritical.

QUESTION: 010 (1.00)

With Keff = 0.985, how much reactivity must be added to make the reactor exactly critical?

a. 1.48% delta K/K
b. 1.50% delta K/K
c. 1.52% delta K/K
d. 1.54% delta K/K

QUESTION: 011 (1.00)

An initial count rate of 100 is doubled five time during startup. Assuming an initial Keff=0.950, what is the new Keff?

a. 0.957
b. 0.979
c. 0.988
d. 0.998

QUESTION: 012 (1.00)

While operating with the reactor critical at 1 Watt, rod motion causes a power increase at an indicated period of 30 seconds. Reactor power 2 minutes later is approximately:

a. 5 Watts
b. 10 Watts
c. 25 Watts
d. 50 Watts

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

QUESTION: 013 (1.00)

Which ONE of the following statements describes Count Rate characteristics after a control rod withdrawal with the reactor subcritical? (Assume the reactor remains subcritical.)

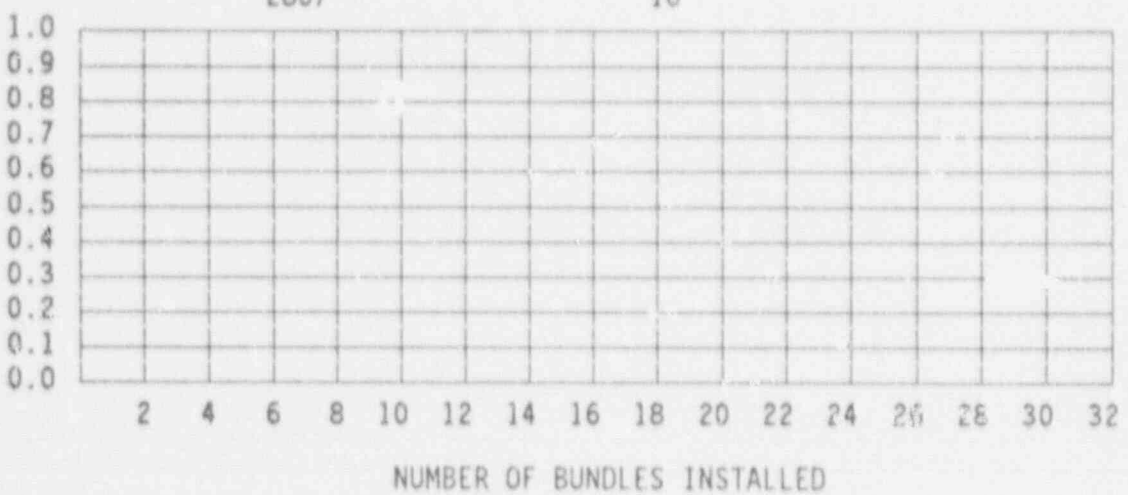
a. Count Rate will rapidly increase (prompt jump) then gradually increase to a stable value.
b. Count Rate will rapidly increase (prompt jump) then gradually decrease to the previous value.
c. Count Rate will rapidly increase (prompt jump) to a stable value.
d. There will be no change in Count Rate until criticality is achieved.

QUESTION: 014 (1.00)

A 1/M plot is used to predict criticality during fuel bundle loading. From the data and graph provided below, criticality will occur after which fuel bundle is loaded?

a. 20th bundle
b. 22nd bundle
c. 24th bundle
d. 26th bundle

Count Rate	# of Fuel Bundles
842	2
936	4
1123	7
1684	12
2807	16



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

QUESTION: 015 (1.00)

Which ONE of the following statements describes the difference between the differential and the integral rod worth curves?

a. Differential rod worth relates the worth of the rod per increment of movement to rod position. Integral rod worth relates the total reactivity added by the rod to the rod position.
b. Differential rod worth relates the total core reactivity added by the rod to the rod position. Integral rod worth is the inverse of differential rod worth.
c. Differential rod worth relates the rate of rod reactivity change to rod position. Integral rod worth relates the total reactivity in the core to the rate of rod reactivity change.
d. Differential rod worth relates the rod reactivity change to the radial rod position. Integral rod worth relates the rod reactivity change to the axial rod position.

QUESTION: 016 (1.00)

The peak power produced in a fuel element during pulsing operations is greater in FLIP fuel than it is in Standard fuel because:

a. the absolute temperature rise is smaller.
b. the burnable poison is the main factor limiting the power peak.
c. the uranium loading is greater in FLIP fuel.
d. the neutron mean free path is longer allowing more time for moderation.

QUESTION: 017 (1.00)

Which ONE of the following statements describes how fuel temperature affects the core operating characteristics?

a. Fuel temperature increase will decrease the resonance escape probability.
b. Fuel temperature decrease results in Doppler Broadening of U-238 and Pu-240 resonance peaks and the decrease of resonance escape probability.
c. Decrease in fuel temperature will increase neutron absorption by U-238 and Pu-240.
d. Fuel temperature increase results in Doppler Broadening of U-238 and PU-240 resonance peaks and the decrease of neutron absorption during moderation.

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

QUESTION: 018 (1.00)

The reactor scrams after an extended period at power. Xenon-135 concentration will:

a. decrease due to the production rate from fission stopping.
b. decrease due to the production rate from I-135 decay increasing.
c. increase due to the production rate from Pm-149 increasing.
d. increase due to the rate of I-135 decay exceeding the rate of Xe-135 decay.

QUESTION: 019 (1.00)

Neutron sources are used in new reactor cores to:

a. increase the count rate by an amount equal to the source contribution.
b. increase the count rate by 1/M (M = Subcritical Multiplication Factor).
c. provide a neutron level high enough to be monitored by source range instrumentation.
d. provide the source neutrons to initiate the chain reaction when first starting-up the reactor.

QUESTION: 020 (1.00)

Erbium is loaded in FLIP fuel to:

a. enhance fuel hydriding, physically strengthening the fuel matrix.
b. add negative reactivity, allowing excess fuel loading in the core.
c. permit reduced clad thickness in FLIP fuel as compared to standard fuel.
d. reduce the value of the prompt negative temperature coefficient of reactivity.

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

QUESTION: 001 (1.00)

The reactor is to be started up for scheduled afternoon pulsing operations following an unplanned shutdown from steady state operations due to a facility electrical power failure at 10 AM. Which ONE of the following statements describes the required Pre-startup Checks for the afternoon operation?

a. The Pre-startup Checks will not be required because they are only required once per day and were recorded prior to the morning operation.
b. The Pre-startup Checks will not be required because the cause of the shutdown has been corrected and documented in the Scram Log.
c. The Pre-Startup Checks must be repeated in their entirety and recorded since they are required for every startup.
d. The Pulse Mode Checks and a subset of marked Console Instrument Checks must be performed and recorded since the mode of operation will be different and the cause of the shutdown has been corrected.

QUESTION: 002 (1.00)

The reactor is to be started up and operated at power for routine irradiation experiments on Monday morning. Which ONE of the following parameters must be recorded in the Reactor Data Log?

a. an excess reactivity measurement at 300 watts
b. a fuel element measurement using NSC Form 558
c. a record of fuel element location using NSC Form 557
d. a summary of the previous week critical data for comparison

QUESTION: 003 (1.00)

A maintenance technician has completed an authorized modification to the control rod drive electrical system. Which ONE of the following staffing requirements applies to the subsequent startup?

a. A Senior Reactor Operator may conduct the startup alone to verify operability prior to normal operations.
b. The maintenance technician may conduct the startup to evaluate proper response under direction of a Senior Reactor Operator.
c. A Reactor Operator and a Senior Reactor Operator may conduct the startup if the Senior Health Physicist is in the facility.
d. A Reactor Operator and a trainee may conduct the startup if the Senior Reactor Operator is available in the facility.

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

QUESTION: 004 (1.00)

Which ONE of the following rod withdrawal sequences is used during a reactor startup for steady state operations?

a. transient rod to mid-travel, then
   regulating rod full out, then
   safety rods gang withdrawn until criticality
b. transient rod full out, then
   regulating rod to mid-travel, then
   shim safety rods sequentially withdrawn until criticality
c. transient rod full out, then
   regulating rod to mid-travel, then
   shim safety rods gang withdrawn until criticality
d. shim safety rods banked full out, then
   transient rod to mid-travel then
   regulating rod withdrawn until criticality

QUESTION: 005 (1.00)

What is the difference in the startup sequence between a startup for steady state operation and a startup for pulsing?

a. The regulating rod is fully withdrawn prior to pulsing operation.
b. The transient rod is not withdrawn prior to pulsing operation.
c. The shim safety rods are offset to compensate for flux changes in the pulsing mode.
d. The transient rod is withdrawn prior to pulsing operations.

QUESTION: 006 (1.00)

Which ONE of the following is NOT required by the procedure for reactor shutdown (SOP II-F)

a. All experiments are to be removed from the core.
b. All control rods are to be fully inserted.
c. All control rods are to be verified down.
d. The Regulating rod servo control system is to be placed in MANUAL.

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

QUESTION: 007 (1.00)

The following keys are attached to a single key ring.
rail stop key
reactor bridge key
irradiation cell access key
Who maintains possession of these keys during operations involving the irradiation cell?

a. the Senior Reactor Operator
b. the Reactor Operator
c. the Manager of Reactor Operations
d. the persons working in the irradiation cell

QUESTION: 008 (1.00)

During fuel unloading the instrumented fuel element is required to be operational unless insufficient fuel or moderator exists to attain criticality under optimum conditions of moderation and reflection. This requirement is considered to be met if:

a. sufficient fuel is removed so that the nuclear instruments fail to register on scale.
b. half of the fuel and the source are removed from the core.
c. one third of the core has been unloaded.
d. the core mass is reduced to minimum critical mass minus one four rod fuel bundle.

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

QUESTION: 009 (1.00)

Which ONE of the following statements describes the power and pulse calibration procedures?

a. Power calibrations compare indicated reactor power with input signals of known strength. Pulse calibrations compare pulse integrator results with radiation levels measured outside the pool.
b. Power calibrations compare indicated power with calculated heat balance data. Pulse calibrations compare pulse integrator results with irradiated foil samples.
c. Power calibrations compare indicated power with calculated heat balance data. Pulse calibrations compare heat balance data with irradiated foil samples.
d. Power calibrations compare indicated power with irradiated foil samples. Pulse calibrations compare measured heat balance data with calculated heat balance data.

QUESTION: 010 (1.00)

During a startup for steady state operation, as the shim safety rods are positioned, indications of criticality are not noted at the expected rod height. Investigation reveals that shim safety rod #1 (SS#1) is not following the rod drive. The operator must:

a. drive the SS#1 motor in the insert direction to re-latch the scram magnet then move the rod into banked position.
b. recalculate the expected critical position using the integral rod worth curve for SS#1 and proceed with the startup.
c. shutdown the reactor and obtain NSC management concurrence before starting up.
d. maintain the remaining shim safety rods in the normal position and compensate for SS#1 using the regulating rod.

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

QUESTION: 011 (1.00)

Consider the following tasks that must be performed to run experiments.
1) hold keys to the beam port gate during irradiation
2) monitoring radiation levels in the beam port area
3) authorizing surveys in beam port area
4) authorizi g beam port set-up inside the shield

Which ONE of the following lists describes the positions having primary responsibility for approvals and control of each task?

a. 1) - EXPERIMENTER
2) - HEALTH PHYSICIST
3) - SENIOR REACTOR OPERATOR
4) - NSC MANAGEMENT

b. 1) - REACTOR OPERATOR
2) - SENIOR REACTOR OPERATOR
3) - HEALTH PHYSICIST
4) - NSC MANAGEMENT

c. 1) - SENIOR REACTOR OPERATOR
2) - EXPERIMENTER
3) - HEALTH PHYSICIST
4) - SENIOR REACTOR OPERATOR

d. 1) - HEALTH PHYSICIST
2) - REACTOR OPERATOR
3) - SENIOR REACTOR OPERATOR
4) - EXPERIMENTER

QUESTION: 012 (1.00)

The D2O Moderated Rotisserie may be used if:

a. the reactor power is limited to 100 Kw.
b. pressure in the inner box is limited to 15 psig.
c. the inner box temperature is indicated on the reactor control console.
d. the D2O reactivity worth is greater than $1.0

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

QUESTION: 013 (1.00)

When directed by the Senior Reactor Operator to evacuate the facility, the Reactor Operator is required to perform all of the following actions, EXCEPT _____.

a. scram the reactor and remove the key from the console
b. survey people leaving the building for contamination
c. go to the Emergency Support Center and report to the Emergency Director
d. shutdown the building air handling and exhaust system

QUESTION: 014 (1.00)

An accident occurs within the facility resulting in contamination and injury to a worker that requires immediate medical attention. Which ONE of the following statements describes the responsibilities of the operating staff?

a. The Senior Reactor Operator will share the emergency director responsibility with the Health Physicist, the Reactor Operator must shutdown the reactor and accompany the injured worker to the hospital.
b. The Senior Reactor Operator and the Health Physicist must accompany the injured worker to the hospital, the Reactor Operator will be the emergency director and may continue reactor operations.
c. The Senior Reactor Operator will be the emergency director, the Reactor Operator will shut down the reactor as directed by the Senior Reactor Operator, the Health Physicist will accompany the injured worker to the hospital.
d. The Health Physicist will be the emergency director, the Senior Reactor Operator will assume operation responsibilities, the Reactor Operator will accompany the injured worker to the hospital.

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

QUESTION: 015 (1.00)

Following pulsing operations Channel #2 of the facility air monitor begins to alarm. Which ONE of the following statements describes the actions to be taken by the operating staff?

a. The Reactor Operator will notify the Senior Reactor Operator then increase the instrument setpoint until the alarm just clears.
b. The Reactor Operator will record the alarm in the operations log and verify that the alarm clears before further pulsing operations.
c. The Reactor Operator will notify the Senior Reactor Operator and the Health Physicist. Reactor operation will be restricted to low power until the alarm clears.
d. The Reactor Operator will notify the Senior Reactor Operator then shutdown the reactor and evacuate the facility.

QUESTION: 016 (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. DANGER - RADIATION AREA
b. CAUTION - HIGH RADIATION AREA
c. DANGER - EXCLUSION AREA
d. CAUTION - RADIOACTIVE MATERIALS

QUESTION: 017 (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

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

QUESTION: 018 (1.00)

Which ONE of the following radiation instruments should be used to monitor for Ar-41 activity?

a. stack gas monitor
b. area radiation monitors
c. reactor building particulate monitor
d. reactor building gas monitor

QUESTION: 019 (1.00)

Which one of the following alarms requires the air handlers to be shut down as part of immediate action?

a. stack particulate monitor
b. stack gas monitor
c. fission product particulate monitor
d. building particulate monitor

QUESTION: 020 (1.00)

The detectors in the area radiation monitoring system are periodically calibrated using:

a. a Cs-137 source
b. an internal check source
c. comparison readings obtained from portable instruments
d. electronic test signal generators

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

QUESTION: 001 (1.00)

Which of the following reactor safety circuits is required to be operational in BOTH the steady state and pulse modes?

a. fuel element temperature scram
b. high power level detector low voltage scram
c. high power level scram
d. log power low power interlock

QUESTION: 002 (1.00)

Placing the mode switch in the PULSE mode:

a. fires the transient rod
b. removes air from the transient rod in preparation for firing
c. disconnects the normal nuclear instrumentation channels
d. disables the transient rod cylinder drive

QUESTION: 003 (1.00)

The reactor is operating at max allowed power (per SOP IV-F) while located in the stall and positioned against the radiography reflector. A technician opens the shield floor to enter the cave to reposition an experiment. Which statement below describes the resulting indications in the control room?

a. The C-2 device alarms in the control room.
b. The C-2 device causes a reactor scram and an alarm.
c. The beam port No. 4 area radiation monitor alarms.
d. The water shutter will flood causing an alarm.

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

QUESTION: 004 (1.00)

Which ONE of the following component lists describes the safety power measuring channel?

a. fission chamber - preamp - linear amplifier - percent power meter - period meter
b. ion chamber - linear amplifier - percent power meter - bistable trips - scram circuit
c. compensated ion chamber - linear picoammeter - linear power recorder - servo amplifier
d. ion chamber - integrator - digital power display - visicorder power indication

QUESTION: 005 (1.00)

Which ONE of the following fuel element temperature selections is NOT made using the fuel element temperature selector switch?

a. instrumented fuel element temperature
b. pool temperature
c. irradiation cell temperature
d. instrumented fuel peak temperature

QUESTION: 006 (1.00)

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.

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

QUESTION: 007 (1.00)

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: 008 (1.00)

CORE VIII-A consists of:

a. 90 FLIP elements, 4 water filled elements, and 2 experimenter notches.
b. 90 Flip elements, no water filled elements, and 3 experimenter notches.
c. 91 Flip elements, 4 water filled elements, and 3 experimenter notches.
d. 87 Flip elements, no water filled elements, and 3 experimenter notches.

QUESTION: 009 (1.00)

The flow path in the Water Purification System is:

a. Pump - raw water supply - gravel filter - mixed bed demineralizer - cotton wound filter.
b. Raw water supply - pump - cotton wound filter - mixed bed demineralizer - gravel filter.
c. Raw water supply - pump - cotton wound filter - gravel filter - mixed bed demineralizer.
d. Pump - raw water supply - cotton wound filter - gravel filter - mixed bed demineralizer.

QUESTION: 010 (1.00)

The purpose of the Core Diffuser System is to:

a. maintain the pool surface clean, and free of debris.
b. improve core heat transfer by circulating water above the core.
c. maintain pool water purity and pH.
d. reduce dose-rates at the pool surface.

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

QUESTION: 011 (1.00)

The design basis for the confinement system ensures that:

a. the reactor building is maintained at a pressure lower than the atmosphere.
b. the reactor building is at a higher pressure than the atmosphere.
c. the reactor building is always equal to atmospheric pressure.
d. the reactor building and the adjacent laboratory are always at the same pressure.

QUESTION: 012 (1.00)

The confinement ventilation system divides the occupied spaces into zones of varying pressure for control of the spread of contamination. Which ONE combination listed below describes these zones in order of LEAST to GREATEST NEGATIVE PRESSURE?

a. lower research level - upper research level - control room
b. lower research level - electronics shop - upper research level
c. upper research level - lower research level - control room
d. control room - upper research level - lower research level

QUESTION: 013 (1.00)

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.

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

QUESTION: 014 (1.00)

Which ONE of the following statements describes system response if pool level drops to less than 90%?

a. One float switch shuts down the pool water recirculation pump and a different float switch energizes an alarm in the University Communications Room.
b. Two float switches actuate, each one of which shuts down the pool water recirculation pump and energizes an alarm in the University Communications Room.
c. A single float switch shuts down the pool water recirculation pump and energizes an alarm in the University Communications Room.
d. A single float switch actuates to energize an alarm in the University Communications Room, while the pool water recirculation pump continues to operate to provide cooling for the reactor.

QUESTION: 015 (1.00)

During a scram, mechanical shock to the shim safety rods is minimized by:

a. a hydraulic dashpot in the below core safety plate.
b. the armature piston at the bottom of the control rod barrel.
c. mechanical springs at the top of the control rod barrel.
d. a mechanical-hydraulic dashpot in the control rod drive motor assembly.

QUESTION: 016 (1.00)

The peak power level attained during a pulse is determined by adjusting:

a. the pressure of the air admitted to the transient rod cylinder.
b. the preset pulse timer.
c. the size of the air bleed holes above the transient rod cylinder.
d. the position of the transient rod cylinder.

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

QUESTION: 017 (1.00)

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: 018 (1.00)

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: 019 (1.00)

Which of the following areas is NOT directly monitored by a channel of the Area Radiation Monitoring System?

a. the reception area
b. the reactor bridge area
c. the demineralizer area
d. the beamport #4 area

QUESTION: 020 (1.00)

Persons assigned to the "High Risk" category are issued:

a. A pocket dosimeter and a combination badge.
b. A pocket dosimeter and a thermoluminescent dosimeter (TLD) badge.
c. A pocket dosimeter, a combination badge, and a TLD badge.
d. A combination badge and a TLD badge.

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

EQUATION SHEET

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0077$

$DR_1D_1^2 = DR_2D_2^2$

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

$SCR = S/(1-Keff)$

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

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

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

$SDM = (1-Keff)/Keff$

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

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

d.

REFERENCE:

Glasstone & Sesonske, 8.65

ANSWER: 002 (1.00)

a.

REFERENCE:

Lamarsh Sect. 3.5

ANSWER: 003 (1.00)

c.

REFERENCE:

Lamarsh, 3.2

ANSWER: 004 (1.00)

d.

REFERENCE:

Lamarsh, 5.10

ANSWER: 005 (1.00)

b.

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

REFERENCE:

24000 neutrons in current generation * 1.01 = 24240 neutrons in next generation
24240 neutrons in next generation
-24000 neutrons in current generation
240 neutrons added
240 neutrons added - 0.7% delayed neutron fraction = 238 prompt neutrons added

ANSWER: 006 (1.00)

b.

REFERENCE:

Lamarsh, 3.7

ANSWER: 007 (1.00)

a.

REFERENCE:

Lamarsh, 7.1

ANSWER: 008 (1.00)

a.

REFERENCE:

Technical Specifications, 5.5

ANSWER: 009 (1.00)

b.

REFERENCE:

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

ANSWER: 010 (1.00)

c.

REFERENCE:

ANSWER: 011 (1.00)

d.

REFERENCE:

Given - five doublings increases counts by a factor of 32.
CR1(1-Keff) = CR2(1-Keff)
100(1-0.950)=3200(1-Keff)
Keff = -3195/-3200 = 0.998

ANSWER: 012 (1.00)

d.

REFERENCE:

P=Poet/T
=Poe120 sec/30 sec
=54.6Po

ANSWER: 013 (1.00)

a.

REFERENCE:

Lamarsh, 7.1

ANSWER: 014 (1.00)

b.

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

REFERENCE:

emperical

ANSWER: 015 (1.00)

a.

REFERENCE:

Nuclear Science Center Core VIII-A Data

ANSWER: 016 (1.00)

c.

REFERENCE:

SAR, III.C.2

ANSWER: 017 (1.00)

a.

REFERENCE:

Nuclear Reactor Engineering, p.260; Glasstone & Sesonske

ANSWER: 018 (1.00)

d.

REFERENCE:

Lamarsh

ANSWER: 019 (1.00)

c.

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

REFERENCE:

ANSWER: 020 (1.00)

b .

REFERENCE:

SAR pp. 14, 18, 50

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

ANSWER: 001 (1.00)

d.

REFERENCE:

SOP II-C.2. and *notation on NSC Form 531, Pre-startup Check List.

ANSWER: 002 (1.00)

a.

REFFRENCE:

SOP II.B.7, para. 2

ANSWER: 003 (1.00)

c.

REFERENCE:

SOP II.C.1, para. 4; Tech Specs 6.1.3

ANSWER: 004 (1.00)

c.

REFERENCE:

SOP II.C.3.g through i

ANSWER: 005 (1.00)

b.

REFERENCE:

SOP II-C.4.b

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

ANSWER: 006 (1.00)

a.

REFERENCE:

SOP II-F.2.(1) through (5)

ANSWER: 007 (1.00)

d. -07 - a per facility comments JC 1/23/92

REFERENCE:

SOP IV-E.2

ANSWER: 008 (1.00)

d.

REFERENCE:

SOP II-I, Table II-I-1, Note, para 1

ANSWER: 009 (1.00)

b.

REFERENCE:

SOP II-J; SOP II-L

ANSWER: 010 (1.00)

c.

REFERENCE:

SOP II-N

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

ANSWER: 011 (1.00)

a.

REFERENCE:

SOP IV-D.3.a -.b

ANSWER: 012 (1.00)

b.

REFERENCE:

Experiment Authorization E-20, Section 4

ANSWER: 013 (1.00)

b.

REFERENCE:

Evacuation Procedure, SOP IX-C.1.e

ANSWER: 014 (1.00)

c.

REFERENCE:

SOP IX-D.3.c

ANSWER: 015 (1.00)

d.

REFERENCE:

SOP IX-E.4.a

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

ANSWER: 016 (1.00)

b.

REFERENCE:

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

ANSWER: 017 (1.00)

b.

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 = 50 min

10CFR20

ANSWER: 018 (1.00)

a.

REFERENCE:

SOP VII-B7 through VII-B11

ANSWER: 019 (1.00)

c. -or- a. per facility comments JTC 1/23/90

REFERENCE:

SOP VII-A4.c.2

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

ANSWER: 020 (1.00)

a.

REFERENCE:

SOP VII-B&.c.3.(c)

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

ANSWER: 001 (1.00)

a.

REFERENCE:

Technical Specifications, 3.2.2, Table 1

ANSWER: 002 (1.00)

c.

REFERENCE:

SAR VII.B.2

ANSWER: 003 (1.00)

b. ~~a~~ - c - 2 per facility comments GTC 1/23/92

REFERENCE:

SAR VI.F; SOP IV F.2, fig. IV-F-1

ANSWER: 004 (1.00)

b.

REFERENCE:

SAP VII; Figs. 7-1 through 7.3, Fig. 7-5

ANSWER: 005 (1.00)

d.

REFERENCE:

SAR VII.B.1, VII.B.2, Figs. 7-4 and 7-5

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

ANSWER: 006 (1.00)

d.

REFERENCE:

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

ANSWER: 007 (1.00)

b.

REFERENCE:

SAR III.C.2

ANSWER: 008 (1.00)

a.

REFERENCE:

NSC CORE VIII-A reference data book

ANSWER: 009 (1.00)

a.

REFERENCE:

SAR IV.B.2.b, Figure 4-7

ANSWER: 010 (1.00)

d.

REFERENCE:

SAR IV.B.2.d

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

ANSWER: 011 (1.00)

a.

REFERENCE:

SAR V.A

ANSWER: 012 (1.00)

d.

REFERENCE:

SAR V.B.1

ANSWER: 013 (1.00)

b.

REFERENCE:

SAR V.B.3, VIII-A; Modification Authorization M-14

ANSWER: 014 (1.00)

c.

REFERENCE:

SAR, VIII.G.1

ANSWER: 015 (1.00)

b

REFERENCE:

SAR III.B.7

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

ANSWER: 016 (1.00)

d.

REFERENCE:

SAR III.B.7; SOP II-E

ANSWER: 017 (1.00)

c.

REFERENCE:

SAR IX.B.2

ANSWER: 018 (1.00)

d.

REFERENCE:

SAR IX.F

ANSWER: 019 (1.00)

a.

REFERENCE:

SAR IX.G, Fig. 9.3

ANSWER: 020 (1.00)

a.

REFERENCE:

SOP VII-E1

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

ANSWER KEY

MULTIPLE CHOICE

001 d

002 a

003 c

004 d

005 b

006 b

007 a

008 a

009 b

010 c

011 d

012 d

013 a

014 b

015 a

016 c

017 a

018 d

019 c

020 b

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

ANSWER KEY

MULTIPLE CHOICE

001 d
002 a
003 c
004 c
005 b
006 a
007 d -OR- a per facility comments JTC 1/23/92
008 d
009 b
010 c
011 a
012 b
013 b
014 c
015 d
016 b
017 b
018 a
019 c -OR- a per facility comments JTC 1/23/92
020 a

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

ANSWER KEY

MULTIPLE CHOICE

001 a

002 c

003 b ~~or~~ a per facility comments DFC 1/03/90

004 b

005 d

006 d

007 b

008 a

009 a

010 d

011 a

012 d

013 b

014 c

015 b

016 d

017 c

018 d

019 a

020 a

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