ENCLOSURE 1

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

REPORT NO.: 50-166/OL-92-01

FACILITY DOCKET NO.: 50-166

FACILITY LICENSE NO.: R-70

FACILITY: University of Maryland

EXAMINATION DATES: 04/07 - 13/92

FXAMINER: Frank Collins, Chief Examiner

SUBMITTED BY: Joseph F. Collins, Chief Examiner — 5/4/92 Date

APPROVED BY: James L. Caldwell, Chief — 5/5/92 Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Licensee Performance
and Quality Evaluation, NRR

SUMMARY:

Initial operator licensing examinations were conducted at the Maryland University Training Reactor (MUTR) from April 7 - 13, 1992. Written and operating examinations were administered for two Senior Reactor Operator, Instant (SROI) applicants and three Reactor Operator (RO) applicants. Operating examinations were also administered for two Senior Reactor Operator, Upgrade (SROU) applicants. All applicants passed their respective examinations.

Applications for license were delivered to USNRC Headquarters on March 13, 1992.

REPORT DETAILS

1. Examiners: Frank Collins, Chief Examiner

2. Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	Total (Pass/Fail)
NRC Grading:	3/0	4/0	7/0

3. Written Examination:

The Written examination was administered on Tuesday, April 7, 1992 for the two SRO-I and three RO applicants. All applicants completed the examination within the allotted three hours. Facility management concurrently reviewed the examination and commented on two questions. The Chief Examiner agreed to reword one option of question number A3 for clarification and instructed the applicants to revise their examinations. Each applicant was queried at the completion of the examination to ensure that the revised question wording was considered in answer selection. Additionally, applicants were informed that question C9 was to be deleted from the examination because no correct answer existed in the options. Alterations have been made to the facility primary cooling system that were not reflected in the system descriptions from which the examination was developed. Examination changes were entered by hand in the master copy of the examination by the Chief Examiner.

Facility comments were received on Monday, April 20, 1990 in accordance with the provisions of Examiner Standard ES-201 and are included as an attachment to this report. Resolution of facility comments is as follows:

Facility Comment to Question A11 - "The section cited refers to thermal utilization factors not fuel utilization factors. We therefore request that, in addition to "b" as the correct answer, "d" also be accepted as a correct answer."

Resolution - Comment not accepted. The objective of the question was to determine if the applicant could predict the effects of an experiment that altered the ratio of fuel to non-fuel atoms in the core, thus changing the utilization factor. Option "d" pertains to the reproduction factor, or the ratio of neutrons produced from fission to the number of neutrons absorbed in fuel. This latter factor is a characteristic of the fuel and not a function of the fuel to non-fuel ratio. NRC appreciates that point that use of the word fuel in both options "b" and "d" are not in accordance the specific terminology used in the reference data. A review of the applicants' examinations shows that the wording used did not adversely affect any applicant's answer selection. However, the terminology of the question has been changed in the examination question bank to preclude confusion in future examinations.

Facility Comment to Question B2 - "Start-up following a power outage of the kind described does not require an intermediate start-up check (ref. TS 6.1.3.3.d). We therefore request that "b" and "d" be accepted as correct."

Resolution - Comment not accepted. The Technical Specification section referred to in the facility comment pertains to facility staff requirements for start-up, specifically, relaxation of the requirement for Senior Reactor Operator supervision of a start-up for resumption of operation following an unscheduled shutdown if the shutdown was initiated by an interruption of electrical power. The question did not concern the staff requirements; rather it addressed the procedural requirements for completion of a start-up checkout form.

Facility Comment to Question B12 - "During the last emergency drill, it was determined that communications was hampered by the heavy shielding in the linac area, resulting in the movement of the ESC to Parking Lot UU. A facility oversight failed to correct the copies in your hands and some of the copies used by the students in preparation for the test. We therefore request that in addition to "a", "b" and "c" also be accepted."

Resolution - Question Deleted. Option "b" cannot be considered to be the ESC since it, the hallway outside the Nuclear Engineering Offices, is defined in Emergency Procedure EP-401, Reactor Building Evacuation, as the primary assembly area. Option "c" cannot be considered to be the ESC since it, the surrounding area encompassing the Chemical and Nuclear Engineering Building, Patterson Hall, and the Animal Science Building, is defined as the Emergency Planning Zone (EPZ) in the Emergency Preparedness Plan. Option C, the courtyard alongside the Chemical and Nuclear Engineering Building, originally intended to be a distractor is now closest to the new answer, but not, however, precise enough to be reliably interpreted by the applicants as the equivalent of Parking Lot UU. Therefore, NRC considers that no correct answer exists. The question has been deleted from this examination and revised in the examination question bank to preclude confusion in future examinations.

Facility Comment to Question C9 - "Deleted during the exam."

Resolution - Question Deleted. Question C9 was deleted during the examination as described in the first paragraph of this section.

4. Operating Examinations:

Operating examinations were administered for all seven applicants beginning on Tuesday, April 7 and ending on Monday, April 13, 1992. SRO-I and RO applicants were given examinations that included pre-startup checkouts and reactor operations consisting of startup to criticality and power escalation in both manual and automatic modes.

SRO-U applicants were not required to demonstrate reactor operations. A facility licensed SRO was present for and supervised all reactor operations. At no time was the licensed SRO required to intervene in the operations.

The average time spent for an operating examination, including required discussions of administrative topics, tours of facility equipment, and the pre-startup and operations activities was approximately four hours per applicant, which is consistent with the guidance contained in Examiner Standard ES-304.C.3.f.

5. Exit Meeting:

The exit meeting was conducted by the Chief Examiner on April 13, 1992. The facility was represented by Dr. Gary Pertner, Director, Nuclear Engineering Programs, and Dr. Frank Munno, Director, MUTR. The Chief Examiner informed the facility as to the conduct of the written and operating examinations. The applicants' general level of preparedness was discussed and was noted to be high, although specific examination results were not yet available, pending incorporation or resolution of facility comments on the written examination and grading of the operating examinations. The examiner noted that no generic deficiencies in operator knowledge or abilities were identified during the operating examinations. The facility commented on the thoroughness of the operating examinations, noting the average time to complete the examination was three to four hours required for each applicant. The Chief Examiner explained the examination structure, correlating the examination with the requirements of the Operator Licensing Examiner Standards, Rev. 6 (NUREG -1021).

The facility agreed with the Chief Examiner that comments on the written examination must be submitted, with appropriate recommendations and rationale, by Tuesday, April 21, 1992.

Several improvements in the condition and maintenance of the facility have been made since the last operator license examinations, eleven months ago.

The examiner immediately noted a greatly improved state of order and cleanliness on the ground level, particularly in the areas around the experimental facilities.

Broken or discarded parts and obsolete experiments have been removed from the facility.

Markers and system labels have been installed throughout the facility to enhance safety and to facilitate operator interface with the equipment outside the control room.

In the control room, new instrumentation has been installed to provide easier and more reliable monitoring and maintenance of the fuel temperature Limiting Safety System Setting (LSSS).

Unused wiring from previous control system components has been removed from the console and associated electrical conduit, allowing the rear doors of the console to be re-installed where the area had previously been inaccessible.

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: Univ. of Maryland

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 92/04/07

REGION: 1

CANDIDATE:

LICENSE APPLIED FOR:

INSTRUCTIONS TO CANDIDATE:

Answers are to be written ONLY on the answer sheet provided. Attach any answer or work 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~~ 34.5			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
~~20.00~~ 19.00	~~33.33~~ 32.75			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
~~20.00~~ 19.00	~~33.33~~ 32.75			C. PLANT AND RADIATION MONITORING SYSTEMS
~~60.00~~ 58.00				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 *****)

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 ____

020 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 ___

020 a b c d ___

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

EQUATION SHEET

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

$\rho = \Delta Keff/Keff$

$\beta = 0.0077$

$DR_1D_1^2 = DR_2D_2^2$

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

$SCR = S/(1-Keff)$

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

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

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

$SDM = (1-Keff)/Keff$

$Pwr = W_f \dot{m}$

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

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

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

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

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

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)

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)

The energy required to break a fuel atom into its constituent parts is equal to the mass defect and is called the:

a. mass equivalent.

b. rest energy.

c. binding energy.

d. Q-value.

QUESTION: 002 (1.00)

Thermalization of neutrons is accomplished most efficiently when the moderator has:

a. LOW atomic mass number and HIGH scattering cross-section.

b. HIGH atomic mass number and HIGH scattering cross-section.

c. LOW neutron absorption cross-section and LOW scattering cross-section.

d. LOW neutron absorption cross-section and HIGH atomic mass number.

QUESTION: 003 (1.00)

The macroscopic cross-section differs from the microscopic cross-section in that it, (the MACROSCOPIC),:

a. never changes with energy level.

b. always is a total for all reactions.

c. considers the ~~neutron~~ NUMBER density. JPC

d. is only applicable to one type of reaction.

QUESTION: 004 (1.00)

The probability of neutron-induced fission is LARGEST with:

a. neutrons in the fast energy level since high kinetic energy is needed to overcome the binding energy of the fuel.

b. medium, or resonant, neutron energies since the natural instability of the fuel is exploited to incite fission.

c. neutrons that are in transition between high and medium energy levels since they still have enough kinetic energy to excite a target nucleus but have lost enough energy to remain in the core region.

d. low energy level neutrons since they are more easily absorbed by the fuel.

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 difference between the lifetime of a delayed neutron and a prompt neutron is that the delayed neutron ______________________ is longer.

a. fission release time

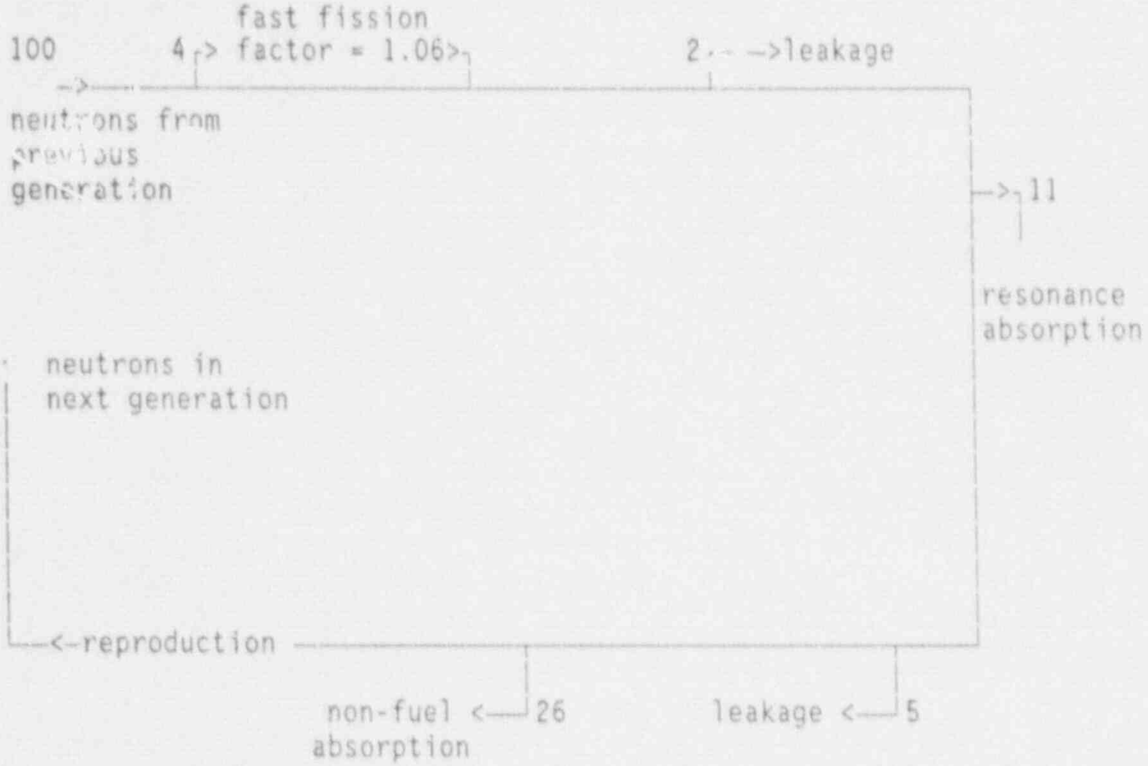
b. slowing down time

c. diffusion time

d. thermal lifetime

QUESTION: 007 (1.00)

Given the following reactor:



What is the Reproduction Factor if the reactor is exactly critical?

a. 0.62

b. 1.61

c. 1.92

d. 2.43

QUESTION: 008 (1.00)

What would be the effective multiplication factor (Keff) for the MUTR if it were prompt critical?

a. 0.997

b. 1.0

c. 1.007

d. 1.01

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.

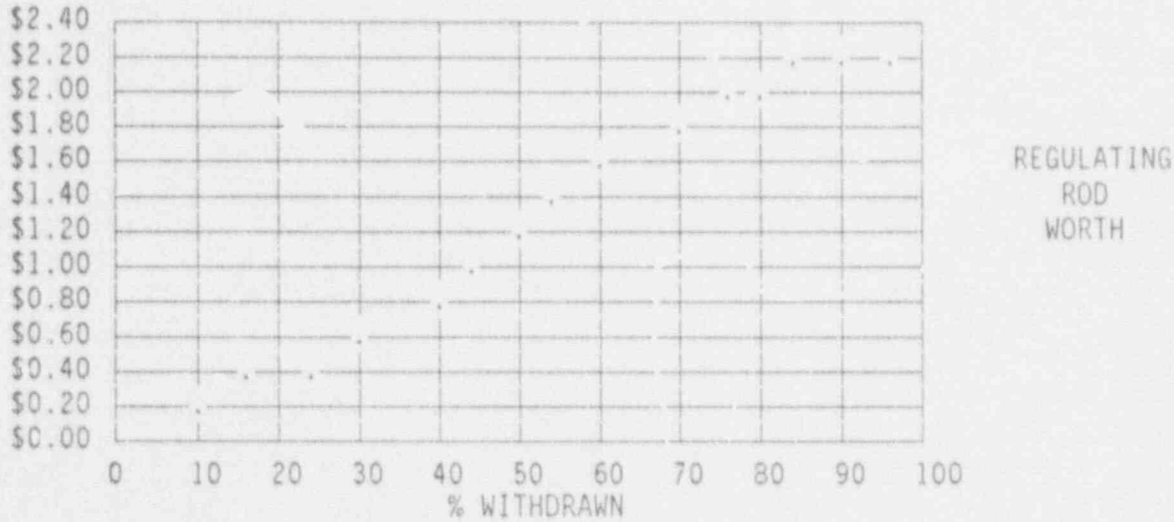
c. exactly critical.

d. subcritical.

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

QUESTION: 010 (1.00)

Given a Regulating Rod with the following characteristics in a reactor that is exactly critical:



What is the resulting Keff if the rod is withdrawn from the 30% to the 70% position?

a. 0.998

b. 1.001

c. 1.008

d. 1.019

QUESTION: 011 (1.00)

A boron thimble is placed in a rabbit and inserted into the core. Which ONE of the following reactivity factors will change?

a. fast fission factor

b. ~~fuel~~ THERMAL utilization factor PER FACILITY COMMENTS

c. resonance escape probability

d. ~~fuel~~ reproduction factor

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.

QUESTION: 013 (1.00)

As the neutron multiplication constant (k), approaches unity (1), the multiplication factor (M):

a. approaches infinity (∞).

b. approaches zero.

c. increases linearly until M=k, then remains constant.

d. increases until M=k, then decreases.

QUESTION: 014 (1.00)

During fuel loading, a reciprocal multiplication curve is plotted to:

a. determine compensating voltage for the neutron detectors.

b. estimate a new value of critical mass.

c. confirm automatic protective action.

d. properly locate detectors in the core region.

(***** 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)

Which ONE of the following statements describes the predominant fuel temperature effects on core operating characteristics?

a. Fuel temperature decrease results in Doppler Broadening of U-238 and Pu-240 resonance peaks and the decrease of resonance escape probability.

b. Fuel temperature decrease will increase neutron absorption by U-238 and Pu-240.

c. Fuel temperature increase result in Doppler Broadening of U-238 and PU-240 resonance peaks and the decrease of total neutron absorption during moderation.

d. Fuel temperature increase will increase the neutron mean free path; decreasing the resonance escape probability.

QUESTION: 017 (1.00)

The term that considers the effects of both the fuel temperature coefficient of reactivity and the moderator temperature coefficient of reactivity is the:

a. effective temperature coefficient of reactivity.

b. combined temperature coefficient of reactivity.

c. transient coefficient of reactivity.

d. power coefficient of reactivity.

QUESTION: 018 (1.00)

The end of the fuel cycle, or end of core life, for the reactor occurs when:

a. shim rods are fully withdrawn at rated power.

b. the regulating rod is fully withdrawn in automatic before reaching rated power.

c. xenon concentration reaches equilibrium.

d. the reactor cannot become critical.

QUESTION: 019 (1.00)

The equations which describe the MUTR Startup Neutron Source are:

a. Pu-239 -> alpha + U-235
Be-9 + alpha -> C-12 + neutron

b. Pu-239 -> alpha + U-235
B-10 + alpha -> N-13 + neutron

c. Pu-239 -> beta + U-235
Be-9 + beta -> Li-8 + neutron

d. Pu-239 -> beta + U-235
B-10 + beta -> Be-9 + neutron

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

QUESTION: 020 (1.00)

Following a scram, the value of the stable reactor period is:

a. approximately 50 seconds, because the rate of negative reactivity insertion rapidly approaches zero.

b. approximately -10 seconds, as determined by the rate of decay of the shortest lived delayed neutron precursors.

c. approximately -80 seconds, as determined by the rate of decay of the longest lived delayed neutron precursors.

d. infinity (∞), since neutron production has been terminated.

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

QUESTION: 001 (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 or a Senior Reactor Operator may conduct the startup if another person is accessible in the building.

d. A Reactor Operator and a Senior Reactor Operator must be present in the control room until proper component response has been verified.

QUESTION: 002 (1.00)

The reactor is to be started up to complete a scheduled instructional run that was interrupted by a facility electrical power failure at 10 AM. Which ONE of the following statements describes the required Checkout for the afternoon operation?

a. An Initial Startup Checkout will be required only for the electrical equipment that was de-energized. The remaining Checkout items are not required because they were recorded prior to the morning run.

b. No checkout will be required because the cause of the shutdown has been corrected and documented in the log. The afternoon run is considered a part of the incomplete morning run.

c. The Initial Startup Checkout must be repeated in its entirety and recorded in the log since re-energizing the equipment is equivalent to performing a first startup for the day.

d. The Intermediate Checkout is required since the cause of the shutdown has been identified and corrected and an Initial Startup Checkout was performed prior to the morning run.

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

QUESTION: 003 (1.00)

Which ONE of the following describes the relationship between the Safety Limit (SL) and the Limiting Safety System Setting (LSSS)?

a. The SL is a maximum operationally limiting value that prevents the LSSS from being reached during normal runs.

b. The SL is a parameter that ensures the integrity of the fuel cladding. The LSSS initiates protective action to preclude reaching the SL.

c. The LSSS is a parameter that ensures the integrity of the fuel adding. The SL initiates protective action to preclude reaching the LSSS.

d. The SL is a maximum setpoint for instrumentation response. The LSSS is the minimum number of channels required to be operable.

QUESTION: 004 (1.00)

During Initial Startup Checkout for a scheduled instructional run, Safety Channel 1 High Voltage scram light does NOT come on when the test trip button is pressed. The Safety 1 scram light illuminated as expected. Which ONE of the following statements applies to the requirements for startup?

a. Startup cannot be conducted until the Safety Channel passes the High Voltage Scram test since the channel is not operable.

b. Startup can proceed as scheduled since the scram light illuminated, proving scram capability by the Safety Channel.

c. The test discrepancy must be noted in the log. The startup may proceed if Safety 2 passes its test, proving backup scram capability.

d. The startup may proceed; however, power must be limited to less than 83% of the Safety Channel trip setpoint.

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

QUESTION: 005 (1.00)

Reactor power is being raised in the AUTOMATIC mode from the present power level, indicating 50% on the 10(x10) watts range, to a new % DEMAND setting, corresponding to 65% on the 30(x10) kilowatts range. Assuming the design rate of power change for the AUTOMATIC mode, how long will the power excursion take?

a. 38 seconds

b. 89 seconds

c. 102 seconds

d. 124 seconds

QUESTION: 006 (1.00)

A reactor scram occurs due to high Exhaust Area Radiation Monitor indications as a rabbit is being removed from the core. Which ONE of the following statements describes the required follow-up action?

a. Quickly remove the rabbit to the west balcony laboratory area.

b. Leave the rabbit in the transfer tube and evacuate the facility.

c. Re-calibrate the instrument and raise the setpoints to clear the alarm

d. Re-insert the rabbit in the core to decay.

QUESTION: 007 (1.00)

During a reactor power calibration run the primary pump is:

a. ON to minimize N-16 buildup over the pool.

b. OFF to minimize heat losses.

c. ON to ensure uniform temperature distribution.

d. OFF to prevent power oscillations due to temperature changes.

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

QUESTION: 008 (1.00)

During a control rod calibration the power is maintained:

a. less than 500 watts to avoid measurement inaccuracies due to temperature effects on reactivity.

b. as close to rated power as possible to avoid measurement inaccuracies due to low instrument signal-to-noise ratios.

c. above 1 kilowatt to ensure that all detectors are operating in the linear proportional region of their characteristic curves.

d. between 500 watts and 1 kilowatt so that period determination is facilitated by measuring the time for power to double.

QUESTION: 009 (1.00)

Which ONE of the following Senior Reactor Operator (SRO) and Reactor Operator (RO) staffing requirements must be satisfied before moving fuel?

a. an SRO must be in the Chemical and Nuclear Engineering Building; an RO must supervise the fuel movement from the reactor bridge.

b. an SRO must be accessible on the College Park campus; two (2) ROs must be available to move fuel - one supervising from the reactor bridge and the other monitoring from the control console.

c. an SRO must supervise the movement from the reactor bridge; an RO must monitor from the control console.

d. Two (2) SROs must be present - one supervising from the reactor bridge and the other available in the Chemical and Nuclear Engineering Building.

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

QUESTION: 010 (1.00)

Which ONE of the following precautions is required before a control rod may be removed from the core?

a. sufficient fuel must be removed so that the nuclear instruments no longer are capable of registering on scale.

b. half of the fuel, on the same side of the core as the rod, and the source must be removed from the core .

c. one third of the core, immediately surrounding the rod, must be removed from the core.

d. a minimum of four fuel bundles must be removed from the core.

QUESTION: 011 (1.00)

During fuel movement for periodic inspection, the Reactor Operator, upon being notified that the bridge is ready to lower fuel into the core is directed to monitor certain parameters. Which ONE of the following instruments is NOT specifically identified in the fuel movement procedures?

a. fuel temperature meter

b. wide range log power chart recorder

c. linear power chart recorder

d. reactor period meter

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

QUESTION: 012 (1.00)

During a Class 2, Alert, emergency the reactor is shutdown and the control room is evacuated in accordance with EP-401, Reactor Building Evacuation, the Reactor Operator might be directed to go to the Emergency Support Center (ESC). The ESC is:

a. the Electron Linear Accelerator (LINAC) Laboratory

b. the hallway outside the Nuclear Engineering offices

c. the courtyard alongside the Chemical and Nuclear Engineering Building

d. the surrounding area encompassing the Chemical and Nuclear Engineering Building, Patterson Hall, and the Animal Science Building

QUESTION: 013 (1.00)

During a Class 1, Unusual Event, emergency the reactor is shutdown and the control room is evacuated in accordance with EP-401, Reactor Building Evacuation, due to a fire within the reactor facility. Authorization for fire fighters to open the roof scuttle may be granted by:

a. the Chief, Prince George's County Fire Department

b. the Emergency Director

c. the Emergency Coordinator

d. the Reactor Support Coordinator

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

QUESTION: 014 (1.00)

For the reactor to be considered shutdown:

a. the Shutdown Checklist, Attachment OP-102-1 must be completed and approved by the licensed operator.

b. shutdown margin must be less than $0.50 of reactivity and the moderator must be cooled to ambient temperature with peak xenon concentrations in the core.

c. all rods, except the highest worth rod, must be fully inserted: all positive reactivity experiments must be removed from the core; plus, all beam and through tubes must be closed and locked.

d. sufficient control rods must be inserted to remain subcritical by at least $1.00 of reactivity with the fuel and moderator at ambient temperature.

QUESTION: 015 (1.00)

Normal rod withdrawal procedures during startup are to:

a. first, withdraw the Regulating rod fully; then, withdraw the Shim rods in 1-5% increments until criticality is achieved.

b. first, withdraw the Shim rods to approximately 80%; then, withdraw the Regulating rod until criticality is achieved.

c. first, withdraw Shim 1 rod to 80%; then, withdraw the Regulating rod to 25%; then Withdraw Shim 2 rod until criticality is achieved.

d. first, withdraw the Regulating rod in 10% increments to 80%; then, withdraw the Shim rods in 1-5% increments until criticality is achieved.

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

QUESTION: 016 (1.00)

During an instructional run on Monday morning, the Reactor Operator, noticing that he previously overlooked a step in the pre-startup procedures, starts the Primary Coolant Pump while at 238 kilowatts reactor power. A reactor scram occurs. Which ONE of the following statements describes the requirements for re start of the reactor?

a. The reactor console must be secured de-energized. The Nuclear Regulatory Commission must approve any subsequent reactor operation.

b. The reactor console must be secured. The Reactor Director must authorize and supervise any subsequent reactor start-up.

c. The reactor console must be secured. The Reactor Director must be notified. The Senior Reactor Operator must supervise any subsequent reactor start-up.

d. The reactor console must be secured and de-energized. The facility must be evacuated in accordance with EP-401. The Emergency Director must authorize and supervise any subsequent reactor operation.

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)

Work is to be performed near a source of radiation emitting a field of 2 Mev gamma measuring 500 Mrem/hr. Considering linear attenuation coefficients of 1.15 $in.^{-1}$ and 0.575$in.^{-1}$, respectively, estimate the thickness of lead and steel (separately) in inches to reduce the radiation level to 5 Mrem/hr.

	lead	steel	
a.	2	4	inches
b.	4	8	inches
c.	2	10	inches
d.	4	20	inches

QUESTION: 019 (1.00)

A two year old Co-60 source that was 10 curies when new is brought into the facility. The sample emits two gammas at 1.17 Mev and 1.33 Mev with a half life of 5.2 years. What will the dose rate from this source be today at a distance of 20 feet?

a. 2 rem/hr

b. 28 mrem/hr

c. 287 mrem/hr

d. 375 mrem/hr

QUESTION: 020 (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

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

QUESTION: 001 (1.00)

The Safety Channels use:

a. the same detector to ensure that the only scrams to occur are due to actual over-power conditions.

b. the fuel temperature sensors embedded in an instrumented fuel element to ensure that the scram will prevent over-heating of the fuel.

c. a minimum source count rate permissive signal from the safety bistables to ensure that startup cannot occur unless the Safety Channels are operating reliably.

d. signals from both the fission detector and an ion chamber detector to ensure that protection is provided over the full range of power.

QUESTION: 002 (1.00)

The instrumented fuel element:

a. is identical to the standard TRIGA fuel element in fuel construction with the exception of the instrument connections.

b. is secured at both the top and bottom of the fuel bundle to prevent instrument errors due to vibration.

c. has a higher fuel loading than a standard TRIGA fuel element so that it will always be the highest temperature experienced in the core.

d. is required to be positioned in the core location with the peak neutron flux to be a conservative indicator.

QUESTION: 003 (1.00)

Which ONE of the following conditions will result in a reactor scram?

a. reactor period = 10 seconds

b. power = 120%

c. fuel temperature = 400 deg F

d. detector high voltage = 95%

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

QUESTION: 004 (1.00)

The fission chamber output to the Safety Channel is:

a. a DC signal in the current mode of operation

b. an AC signal in the pulse mode of operation

c. a DC signal in the recombination mode of operation.

d. an AC signal in the ionizing mode of operation.

QUESTION: 005 (1.00)

Which ONE of the following features is NOT provided by the wide range log power channel?

a. reactor period signals for control and indication

b. low count rate control interlock

c. power feedback signal for automatic regulating rod control

d. gamma compensation

QUESTION: 006 (1.00)

If a central fuel element were to fail while operating at 250 Kw, which ONE of the following lists represents the gases that will be released?

a. argon, nitrogen, iodine, and xenon

b. bromine, iodine, xenon, and krypton

c. oxygen, chlorine, fluorine, and xenon

d. xenon, gallomine, hydrogen, and iodine

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

QUESTION: 007 (1.00)

The neutron source used at the MUTR is located:

a: at the core center location to maintain a symmetric neutron flux profile.

b: between the fission chamber and the instrumented fuel rod to ensure that correlation exists between the power and temperature instruments.

c: in the thermal column so that the moderating properties of the column will ensure that source neutrons are thermalized.

d: at the core periphery, across from the nuclear detectors to ensure instrument reliability.

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

QUESTION: 008 (1.00)

Consider the MUTR physical configuration shown below:

Which ONE of the following lists describes the components identified by the letters Q through Z?

a. Q - compensated ion chamber
R - fission chamber
S - uncompensated ion chamber
T - instrumented fuel rod
U - fuel storage rack
V - neutron source location
W - graphite reflector
X - shim rod #1
Y - shim rod #2
Z - regulating rod

b. Q - fission chamber
R - uncompensated ion chamber
S - neutron source location
T - rabbit hole
U - graphite reflector
V - instrumented fuel rod
W - graphite reflector
X - shim rod #2
Y - shim rod #1
Z - regulating rod

c. Q - uncompensated ion chamber
R - compensated ion chamber
S - instrumented fuel rod
T - neutron source location
U- graphite reflector
V - regulating rod
W - graphite reflector
X - shim rod #2
Y - shim rod #1
Z - rabbit hole

d. Q - uncompensated ion chamber
R - compensated ion chamber
S - rabbit hole
T - neutron source location
U - boral reflector
V - instrumented fuel rod
W - graphite reflector
X - regulating rod
Y - shim rod #1
Z - shim rod #2

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

QUESTION: 009 (1.00)

Which ONE of the following lists describes the order of components in the primary coolant system, starting at the reactor pool outlet and ending at the pool inlet?

a. filter, makeup water connection, pump, heat exchangers, flow orifice

b. flow orifice, makeup water connection, pump, filter, heat exchangers

c. makeup water connection, filter, pump, flow orifice, heat exchangers

d. filter, pump, flow orifice, heat exchangers, makeup water connection

Deleted

QUESTION: 010 (1.00)

What feature of the makeup water system prevents potential contamination of the city water supply system if activity levels of the pool water are high?

a. the radiation monitor in the system will alarm to alert the operator.

b. the makeup demineralizer and filter will remove contamination in the coolant.

c. the pressure reducer in the makeup line will lower the static head of the pool water to less than the city water pressure.

d. the makeup water line check valve will prevent backflow into the secondary coolant system.

QUESTION: 011 (1.00)

The fresh air supplies for the ventilation system are located:

a. on the ground floor level on the west side of the building.

b. at the top of the reactor room on the east side of the building.

c. on the ground floor level beneath the control room.

d. at the northwest and southeast corners of the penthouse walls.

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

QUESTION: 012 (1.00)

A Keff limit is imposed on the fuel storage facilities to ensure that:

a. new, unirradiated fuel does not come in contact with irradiated fuel.

b. a coolable geometry is maintained to keep fuel temperatures below design limits.

c. inadvertent criticality cannot occur outside of the core area.

d. physical damage to fuel elements due to improper handling is minimized.

QUESTION: 013 (1.00)

Which ONE of the following devices is installed to minimize the release of radiation from the activation of dissolved oxygen in the coolant?

a. bridge radiation area monitor

b. N-16 diffuser

c. primary coolant ion exchanger

d. coolant conductivity monitor

QUESTION: 014 (1.00)

The ion chamber power indications are correlated to the heat balance calculated thermal power by:

a. adjusting the detector high voltage.

b. adjusting the circuit comparator voltage.

c. moving the graphite reflectors to change the neutron flux near the detectors.

d. physically adjusting the height of the detectors in the support assembly.

QUESTION: 015 (1.00)

During reactor operation, a shim rod magnet disengages with the drive at its normal 80% withdrawn position. Which ONE of the following statements describes the rod status indications that are available to the operator?

a. UP light on
DOWN light off
CONT light on
PWR ON light off

b. UP light off
DOWN light off
CONT light off
PWR ON light on

c. UP light off
DOWN light on
CONT light on
PWR ON light off

d. UP light off
DOWN light on
CONT light off
PWR ON light on

QUESTION: 016 (1.00)

In the automatic power regulation mode, reactor response to a large decrease in demand is limited by:

a. a 15 second period limiter in the input to the rate error pre-amplifier.

b. a high voltage clamp on the output of the demand error linear amplifier.

c. the speed of the rod drive motor.

d. the decay constant of the longest lived delayed neutron precursor group.

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

QUESTION: 017 (1.00)

During pre-startup checkout, the reactor operator lines up the makeup water system to add water to the pool and neglects to check the level later. Overflow from the pool will go:

a. into the holdup tank in the water handling room sump through the pool overflow piping.

b. directly into the water handling room sump through the pool overflow piping.

c. into the city sewer system through the makeup water-secondary coolant system cross- connection and the secondary coolant holdup tank.

d. directly into the sewer system through the floor drain gratings around the base of the reactor.

QUESTION: 018 (1.00)

An experimenter breaks a sample vial and spills the sample on his hand. Where should he go within the facility for decontamination?

a. He should use the lavatory facilities below the east balcony on the ground level, near the experimental facilities.

b. He should go to the Nuclear Engineering Department offices.

c. He should use one of the sinks in the west balcony laboratory.

d. He should use the lavatory facilities near the Emergency Support Center.

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

QUESTION: 019 (1.00)

What feature of the area radiation monitors allows the operator to check that the channels are functional when the reactor has been shutdown for an extended period and the background radiation levels are very low?

a. The self check circuitry in the instrument channel illuminates the yellow light if readings are below the range of the indicator.

b. The self check circuit maintains an artificial input signal at a level just above the instrument minimum sensitivity so that it never falls below scale.

c. A low level source is installed in the detector to keep the instrument on scale.

d. A portable Co-60 source is provided for positioning near the detector and verifying, or adjusting, the channel linearization to within 10% of known radiation levels.

QUESTION: 020 (1.00)

Where is the remote readout for the exhaust fan area radiation monitor?

a. on the wall of the Emergency Support Center near the entrance from the reactor facility

b. on the wall opposite the door into the west balcony from the outside hallway

c. next to the entrance to the west balcony laboratories from the reactor bridge

d. on the wall next to the communications and portable radiation monitoring equipment in the Campus Radiation Safety Office

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

ANSWER: 001 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 1, Sect. 4.6

ANSWER: 002 (1.00)

a.

REFERENCE:

ENNU 320, VOL. 1, Sect 6.1.1 - 6.1.2

ANSWER: 003 (1.00)

c.

REFERENCE:

ENNU 320, VOL. 1, SECT. 6.2.1 - 6.2.2

ANSWER: 004 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 1, Sect 6.1.2

ANSWER: 005 (1.00)

b.

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

REFERENCE:

ENNU 320, Vol. 1, Sect 7.2.1
24000 neutrons in current generation * 1.01 = 24240 neutrons in next generation
24240 neutrons in next generation
<u>-24000 neutrons in current generation</u>
= 240 neutrons added
240 neutrons added - 0.7% delayed neutron fraction = 238 prompt neutrons added

ANSWER: 006 (1.00)

a.

REFERENCE:

ENNU 320, Vol. 1, Fig. 7-1 and 7-2

ANSWER: 007 (1.00)

b.

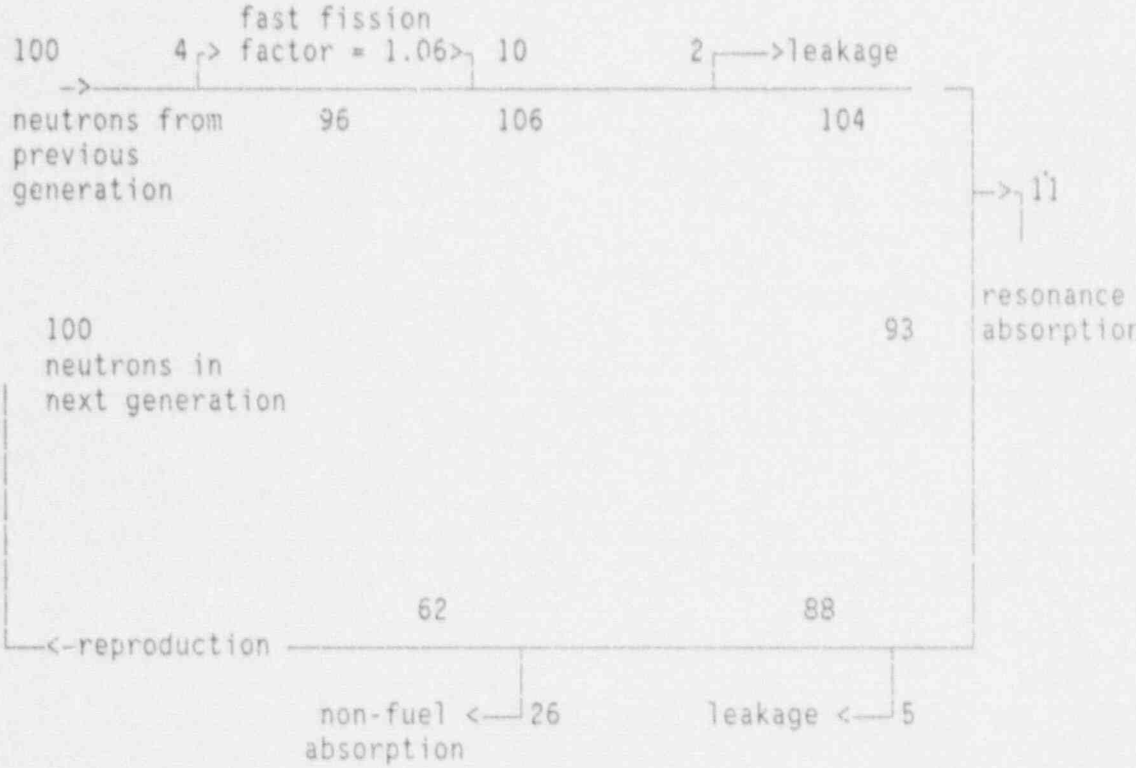
(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

REFERENCE:

ENNU 320, Vol. 1, Sect. 7.3, Fig. 7-4

if critical, neutrons next generation = neutrons previous generation = 100

$$\text{Reproduction Factor} = \frac{\text{neutrons in next generation}}{\text{neutrons absorbed in fuel}} = \frac{100}{62} = 1.61$$



ANSWER: 008 (1.00)

c.

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

REFERENCE:

ENNU 320, Vol. 1, Sect. 7.4; Equation Sheet
given at prompt critical, $\rho=\beta$ = 0.007

$$\rho = \frac{Keff-1}{Keff}$$

$$0.007 = \frac{Keff-1}{Keff}$$

0.007 Keff = Keff-1
-0.993 Keff= -1

$$Keff = \frac{-1}{-0.993} = 1.007$$

ANSWER: 009 (1.00)

b.

REFERENCE:

ENNU 320, Vol. 1, Sect. 7.1.3

ANSWER: 010 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 1, Sect 7.4

\$1.80 - \$0.60 = \$1.20
\$1.20 * 0.007 delta k/k /\$ = 0.0084 delta k/k

0.0084 delta k/k = Keff-1/Keff
0.0084Keff = Keff-1
-0.9916Keff = -1
Keff = 1.008

ANSWER: 011 (1.00)

b. ~~a.~~ d.

~~per Facility comments~~
FACILITY COMMENT NOT ACCEPTED

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

REFERENCE:

ENNU 320, Vol. 1, Sect. 7.3.5

ANSWER: 012 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 1, Sect 5 . 1

$P = P_o e^{t/T}$
$= P_o e^{120 \text{ sec}/30 \text{ sec}}$
$= 54.6 P_o$

ANSWER: 013 (1.00)

a.

REFERENCE:

ENNU 320, Vol. 1, Sect 8.1.2

ANSWER: 014 (1.00)

b.

REFERENCE:

ENNU 320, Vol. 1, Sect. 8.2

ANSWER: 015 (1.00)

a.

REFERENCE:

ENNU 320, Vol. 1, Sect. 7.4.1 and 7.4.2

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

ANSWER: 016 (1.00)

d.

REFERENCE:

ENNU 320, VOL. 2, Sect. 3.3.2

ANSWER: 017 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 1, Sect 9.3.3

ANSWER: 018 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 1, Sect. 9.4

ANSWER: 019 (1.00)

a.

REFERENCE:

ENNU 320 MANUAL VOL. 1, Sect. 6.3.1

ANSWER: 020 (1.00)

c.

REFERENCE:

ENNU 320, Vol.1, Sect. 9.1.1

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

ANSWER: 001 (1.00)

c.

REFERENCE:

10CFR55.13; Technical Specifications, 6.1.3

ANSWER: 002 (1.00)

c.

REFERENCE:

OP-101, Sect. 3.0

ANSWER: 003 (1.00)

b.

REFERENCE:

Technical Specifications, 1.25 and 1.10

ANSWER: 004 (1.00)

a.

REFERENCE:

Technical Specifications, Table 3-1a

ANSWER: 005 (1.00)

d.

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

REFERENCE:

given from OP-104, Sect 6:

- design period for power increase = 15 seconds
- P_o = 50% on 10(x10) watts range = 50 watts
- P = 65% on 30(x10) kilowatts range =195 kilowatts = 195000 watts

$P = P_o e^{t/T}$
t = ln(P/Po) * T
= ln(195000/50) * 15
= 124

ANSWER: 006 (1.00)

d.

REFERENCE:

OP-105, Sect. 5.3.10

ANSWER: 007 (1.00)

b.

REFERENCE:

SP-202, Sect. 3.1

ANSWER: 008 (1.00)

a.

REFERENCE:

SP-204, Sect. 3.2, and 5.0(Note)

ANSWER: 009 (1.00)

c.

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

REFERENCE:

MP-303, Sect. 2.1

ANSWER: 010 (1.00)

d.

REFERENCE:

MP-304, Sect. 2.1 and 4.1

ANSWER: 011 (1.00)

a.

REFERENCE:

MP-303, Sect. 3.5

ANSWER: 012 (1.00)

a.

REFERENCE:

Emergency Preparedness Plan, Section 8.1 and fig. 8.1

Deleted per FACILITY COMMENT RESOLUTION

ANSWER: 013 (1.00)

b.

REFERENCE:

Emergency Preparedness Plan, 3.1.2; EP-401, Sect. 2.7, "CAUTION"

ANSWER: 014 (1.00)

d.

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

REFERENCE:

OP-102, Sect. %.2; Technical Specifications, Sect. 1.22

ANSWER: 015 (1.00)

b.

REFERENCE:

OP-103, Sect. 2.3 - 2.8

ANSWER: 016 (1.00)

c.

REFERENCE:

OP-101-2, Step 20; OP-104, Sect. 3.5; AP-500, Sect. 3.6 and 4.4.b

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 = 50mins

10CFR20

ANSWER: 018 (1.00)

b.

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

REFERENCE:

$D = D_o e^{-\mu x}$
$\ln D/D_o = -\mu x$
$x = -4.605/ -\mu$

-or-
2 tenth thicknesses required
tenth thickness for lead is 2 inches
tenth thickness for steel is 4 inches

ANSWER: 019 (1.00)

c.

REFERENCE:

$C = C_o e^{-.693\ t/T_{1/2}}$

$= 10e^{-(.693)(2)/5.2}$

$= 7.66$ Ci

$E = 1.17$ Mev + 1.33 Mev = 2.50 Mev

Using the dose rate formula from SP-205,Sect. 3.1:
$D = 6CE/d^2$

$= 6(7.66)(2.50)/(20)^2$

$= 0.287$ rem/hr = 287 mrem/hr

ANSWER: 020 (1.00)

b.

REFERENCE:

$I_o D_o^2 = I_f D_f^2$
$(2500\ \text{mrem/hr})(182) = (I_f)((5*12)^2)$
$I_f = 225$ mrem/hr at 5 feet

225 mRem/hr > 100 mrem/hr = high rad area
10CFR20

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

ANSWER: 001 (1.00)

d.

REFERENCE:

ENNU 320, Vol 2, Sect. 6.1.1.2

ANSWER: 002 (1.00)

a.

REFERENCE:

ENNU 320, Sect. 3.1.2 and 3.1.4

ANSWER: 003 (1.00)

b.

REFERENCE:

ENNU 320, VOL. 2, Sect. Table 6.1

ANSWER: 004 (1.00)

a.

REFERENCE:

ENNU 320, Vol. 1, Sect. 10.2.1

ANSWER: 005 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.1.1.1; Fig. 6-2, Instrumentation Block Diagram

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

ANSWER: 006 (1.00)

b.

REFERENCE:

MUTR FSAR 11.2.2.1

ANSWER: 007 (1.00)

d.

REFERENCE:

ENNU Vol. 2, Fig. 3-14

ANSWER: 008 (1.00)

b.

REFERENCE:

ENNU 320, Vol. 2, Fig. 3-14

ANSWER: 009 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 2, Fig. 4-1

Deleted JR

ANSWER: 010 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 2, Sect 4.3, Figures 4-2 & 4-3

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

ANSWER: 011 (1.00)

a.

REFERENCE:

ENNU 320, VOL. 2, Sect. 2.2, Fig. 2-2

ANSWER: 012 (1.00)

c.

REFERENCE:

Technical Specifications, Sect. 5.3; ENNU 320, Vol.2, Sect. 7.1 & 7.8

ANSWER: 013 (1.00)

b.

REFERENCE:

ENNU 320, Vol. 2, Sect. 7.5

ANSWER: 014 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 2, Sect. 7.3; SP-202, Step 6.2

ANSWER: 015 (1.00)

b.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.2.1

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

ANSWER: 016 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.2.2, Fig. 6.6; ENNU 320, Vol. 1, Sect. 9.1.1

ANSWER: 017 (1.00)

a.

REFERENCE:

ENNU 320, Vol.2, Sect. 8.1

ANSWER: 018 (1.00)

c.

REFERENCE:

ENNU 320, Vol, 2, Sect. 8.1; EPP Sect. 8.3.1

ANSWER: 019 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.3; SP-205, Sect. 5.0

ANSWER: 020 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.3, Table 6-3

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

ANSWER KEY

MULTIPLE CHOICE

001 c

002 a

003 c

004 d

005 b

006 a

007 b

008 c

009 b

010 c

011 b ~~or c~~ FACILITY COMMENT NOT ACCEPTED

012 d

013 a

014 b

015 a

016 d

017 d

018 d

019 a

020 c

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

ANSWER KEY

MULTIPLE CHOICE

001 c

002 c

003 b

004 a

005 d

006 d

007 b

008 a

009 c

010 d

011 a

012 a Deleted [illegible]

013 b

014 d

015 b

016 c

017 b

018 b

019 c

020 b

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

A N S W E R   K E Y

MULTIPLE CHOICE

001 d

002 a

003 b

004 a

005 c

006 b

007 d

008 b

009 c Deleted

010 d

011 a

012 c

013 b

014 d

015 b

016 d

017 a

018 c

019 c

020 c

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