ENCLOSURE 1

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

REPORT NO.: 50-166/OL-94-01

FACILITY DOCKET NO.: 50-166

FACILITY LICENSE NO.: R-112

FACILITY: University of Maryland

EXAMINATION DATES: March 7 - March 9, 1994

EXAMINER: Patrick J. Isaac, (Chief Examiner)

SUBMITTED BY: Patrick J. Isaac 3/22/94
Chief Examiner Date

APPROVED BY: Jose Ibarra 3/23/94
Jose Ibarra, Chief Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Reactor Controls
and Human Factors
Office of Nuclear Reactor Regulation

SUMMARY:

NRC administered written examination and operating tests to one Reactor Operator (RO) and two Senior Reactor Operator Instant (SROI) applicants. Operating tests were also administered to one Senior Reactor Operator Upgrade (SROU) Applicant. The RO applicant failed one section of the written examination. All other applicants passed all portions of the examination and have been issued the appropriate licenses.

REPORT DETAILS

1. Examiner:

Patrick J. Isaac, Chief Examiner

2. Examination Results:

RO (Pass/Fail)	SRO (Pass/Fail)	TOTAL (Pass/Fail)
0/1	3/0	3/1

3. Written Examination:

The written examination was administered on March 7, 1994 to one RO and two SROI candidates. At the conclusion of the examination, the Chief Examiner immediately secured the master examination answer key and all of the candidate answer sheets. A copy of the master "as given" examination with answer key was forwarded to the licensee's training staff for their formal review.

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

The RO candidate failed Section B of the written examination. The two SROI candidate passed all three sections of this examination.

4. Operating Tests:

Operating Tests were administered from March 7 through March 9, 1994 to 1 RO and 3 SRO candidates.

All the candidates passed this portion of the examination.

5. Exit Meeting:

Personnel attending:

Dr. Walter Chappas, Director, University of Maryland
Vince G. Adams, Associate Director
Patrick J.Isaac, NRC

The facility examination comments were discussed as noted in Enclosure 2. There were no generic concerns raised by the examiner.

NRC RESOLUTIONS - WRITTEN EXAMINATION

Question A. 008:

Following a one week shutdown, the reactor is started up to 235 kw with rod control in automatic. If the reactor remained in automatic for the next five hours what would be the change in xenon concentration be during hours two through five?

Xenon concentration would:

a. decrease due to the absorption of neutrons by xenon.

b. decrease due to the beta decay of xenon to cesium.

c. increase due to the decay of iodine to xenon.

d. increase due to the fission yield of xenon from fission.

Answer A. 008:

c.

Reference A. 008:

ENNU 320, section 9.4.

Facility Comment A. 008:

..." answers c. and d. are both correct. The cited reference is correct and gives both answers in the listed section."

NRC Resolution A. 008:

Comment accepted. The answer key has been modified to accept both c. and d. as correct.

Question B. 014:

A "Controlled Copy" of the MUTR Operating Procedures (OPs) is maintained in which one of the following locations?

a. MUTR Reactor Files

b. Reactor Director's Office

c. MUTR Training Manual

d. Reactor Emergency Box Nos. 1 & 2

Answer B. 014:

b.

Reference B. 014:

OP 100, Control And Maintenance Of Procedures, Step 2.4, pg. 1.

Facility Comment B. 014:

..." the reactor file copy is by definition a "Controlled Copy" since it is the signed original from which all other copies are made."

NRC Resolution B. 014:

Comment accepted. The answer key has been modified to accept both a. and b. as correct.

Question C. 012:

Operation of which of the following Calibrate switches will result in a scram?

a. Fuel temperature

b. Wide range log power channel

c. Multirange linear channel

d. Safety Channel I

Answer C. 012:

d.

Reference C. 012:

ENNU 320, Volume II, section 6.1.4.

Facility Comment C. 012:

..." as illustrated in OP 101 REV 10 page 6 steps 64 through 72 it is clearly illustrated that when the fuel temperature meter is removed from the "OPERATE" position the manual scram circuit enunciator is lighted and the scram circuit is activated. Therefore a. is also a valid answer for this question."

NRC Resolution C. 012:

Comment accepted. The answer key has been modified to accept both a. and d. as correct.

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

FACILITY: University of Maryland

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 1994/03/07

REGION: I

CANDIDATE: ______________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in paren-theses for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) nours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
20.0	33.3	______	______	A.	REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.0	33.3	______	______	B.	NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.0	33.3	______	______	C.	PLANT AND RADIATION MONITORING SYSTEMS
60.0		______ FINAL GRADE	______%		TOTALS

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

____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

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

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

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

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

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

6. Fill in the date on the cover sheet of the examination (if necessary).

7. Print your name in the upper right-hand corner of the first page of each section of your answer sheets.

8. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

9. The point value for each question is indicated in parentheses after the question.

10. Partial credit will NOT be given.

11. If the intent of a question is unclear, ask question :f the examiner only.

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.

A N S W E R   S H E E T

Multiple Choice (Circle or X your choice)

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

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

019 a b c d ___

(***** END OF CATEGORY 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 u ___

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 **********)

QUESTION: 001 (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.

QUESTION: 002 (1.00)

A control rod is withdrawn from the core.

Which of the following explains the reactivity addition from the rod?

a. Reactivity added will be equal for each inch of withdrawal.

b. Reactivity addition per inch will be greatest from 40% to 60% withdrawn.

c. Reactivity addition per inch will be greatest in the bottom fourth of the core.

d. Reactivity addition per inch will be greatest in the top fourth of the core.

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

QUESTION: 003 (1.00)

The reactor is operating at 100 KW. The reactor operator withdraws the Regulating Rod allowing power to increase. The operator then inserts the same rod to its original position, decreasing power.

In comparison to the rod withdrawal, the rod insertion will result in:

a. a slower period due to long lived delayed neutron precursors.

b. a faster period due to long lived delayed neutron precursors.

c. the same period due to equal amounts of reactivity being added.

d. the same period due to equal reactivity rates from the rod.

QUESTION: 004 (2.00)

The reactor is shutdown with a keff of 0.965. Initial power on the linear recorder is 300 mW. The operator withdraws the first rod, Shim I, to its required position; thereby adding 220 cents of reactivity.

DETERMINE the new power level.

a. 400 mW

b. 525 mW

c. 750 mW

d. 900 mW

(***** CATEGORY A CONTINUED ON NEXT

QUESTION: 005 (1.00)

Positive reactivity has been added to the reactor. Which of the following conditions concerning delayed neutrons causes the reactor to be controllable?

a. Delayed neutrons are born at lower energy levels than prompt neutrons.

b. The slowing down time for delayed neutrons is less than that of prompt neutrons.

c. The diffusion time for delayed neutrons is less than that of prompt neutrons.

d. The fission release time for delayed neutrons is longer for delayed neutrons than for prompt neutrons.

QUESTION: 006 (1.00)

A reactor startup is in progress by withdrawing a control rod and then waiting until count rate stabilizes. The reactor is not critical. Assume that the control rod is being withdrawn in equal amounts each time and each control rod withdrawal adds equivalent amounts of reactivity.

Compare two consecutive control rod withdrawals.

a. Time for power to stabilize will be equal for both withdrawals and the power increase will be the same for both withdrawals.

b. The power increase will be the same for both withdrawals but the time for power to stablize will be less for the second withdrawal.

c. The power increase will be the same for both withdrawals but time for power to stabilize will be longer for the second withdrawal.

d. The power increase will be larger for the second withdrawal and the time for power to stabilize will be longer for the second withdrawal.

(***** CATEGORY A CONTINUED ON NEXT

QUESTION: 007 (1.00)

Which of the following is the MAJOR cause for negative reactivity insertion upon an increase in fuel temperature?

An increase in fuel temperature will increase the probability that:

a. thermal neutrons will gain energy from hydrogen atoms in the fuel.

b. fast neutrons will gain energy from hydrogen atoms in the fuel.

c. thermal neutrons will be absorbed by zirconium.

d. neutrons will be resonantly absorbed in the fuel.

QUESTION: 008 (1.00)

Following a one week shutdown, the reactor is started up to 235 kw with rod control in automatic. If the reactor remained in automatic for the next five hours what would be the change in xenon concentration be during hours two through five?

Xenon concentration would:

a. decrease due to the absorption of neutrons by xenon.

b. decrease due to the beta decay of xenon to cesium.

c. increase due to the decay of iodine to xenon.

d. increase due to the fission yield of xenon from fission.

QUESTION: 009 (1.00)

Withdrawal of a control rod predominantly affects Keff by changing the:

a. fast fission factor.

b. thermal utilization factor.

c. neutron reproduction factor.

d. resonance escape probability.

(***** CATEGORY A CONTINUED ON NEXT

QUESTION: 010 (1.00)

A reactor startup is being performed. The reactor is supercritical and power is being raised to 200 kw. The period meter indicates 80 seconds.

Select the expected time that it would take for power to double.

a. 30 seconds

b. 55 seconds

c. 80 seconds

d. 95 seconds

QUESTION: 011 (1.00)

The MUTR startup neutron source produces neutrons by which of the following methods?

a. Spontaneous Fission

b. Gamma Ray Absorption

c. Photofission

d. Alpha Particle Absorption

QUESTION: 012 (1.00)

Which of the following would result in a decrease in excess reactivity?

a. Replacing four fuel bundles with new fuel.

b. Replacing the shim rod with a new rod.

c. Burnout of xenon.

d. Placement of an experiment containing graphite in the beam tube.

(***** CATEGORY A CONTINUED ON NEXT

QUESTION: 013 (1.00)

The reactor has been operating at 240 kw using manual rod control for approximately one hour when the operator inserts the control rod in order to maintain power constant.

The rod must be inserted to compensate for which of the following conditions?

a. Increase in moderator temperature.

b. Increase in fuel temperature.

c. Increase in xenon.

d. Decrease in fuel concentration.

QUESTION: 014 (1.00)

During performance of reactor power calibration which of the following conditions would not result in calculated core power being greater than actual core power?

a. Pool lights are left on during the calibration.

b. The diffuser pump is left on during the calibration.

c. The primary pump is left on during the calibration.

d. Pool water level is increased during the calibration.

QUESTION: 015 (1.00)

Which of the following heat transfer mechanisms provides cooling for the core?

a. Forced convection.

b. Natural convection.

c. Conduction.

d. Mixed convection.

(***** CATEGORY A CONTINUED ON NEXT

QUESTION: 016 (1.00)

Reactor power is being raised from 100 milliwatts to 225 kW using manual reactor control. A positive reactor period was established at 100 milliwatts. Select the power at which fuel temperature coefficient will begin to be apparent.

a. 500 watts

b. 2 kW

c. 10 kw

d. 50 kw

QUESTION: 017 (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: 018 (1.00)

Doppler broadening provides what percentage of the effect of the prompt negative temperature coefficient?

a. 5 %

b. 10 %

c. 25 %

d. 45 %

QUESTION: 019 (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.

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

QUESTION: 001 (1.00)

Which of the following experiment configurations would be allowed?

a. A single non-secured experiment having a reactivity worth of 1.50 dollars.

b. Two in-core experiments, one having a reactivity worth of 1.50 dollars and the other having a reactivity worth of .50 dollars.

c. Three non-secured experiments having a reactivity worth of .75 dollars each.

d. Four in-core experiments, two having a reactivity worth of .90 dollars each and the other two having a reactivity worth of .75 dollars each.

QUESTION: 002 (1.00)

A safety limit is established on fuel element temperature to prevent a loss of fuel element cladding integrity which could arise from:

a. excessive pressure between cladding and fuel.

b. exceeding the melting point for cladding.

c. exceeding the melting point for fuel.

d. excessive swelling of the fuel.

QUESTION: 003 (1.00)

The total reactivity worth of in-core experiments is 1.50 dollars.

What is the maximum excess reactivity allowed relative to cold critical conditions?

a. 3.50 dollars

b. 2.00 dollars

c. 1.50 dollars

d. 0.50 dollars

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 004 (1.00)

Experiments containing materials corrosive to reactor components shall:

a. only be irradiated in experimental facilities not in the reactor.

b. not be irradiated in the reactor or experimental facilities.

c. be encapsulated prior to being placed in the reactor.

d. be doubly encapsulated prior to being placed in the reactor.

QUESTION: 005 (1.00)

Which of the following conditions COMPLETELY satisfies the technical specification definition of "Reactor Secured?"

a. When the reactor contains insufficient fissile material or moderator present in the reactor and adjacent experiments to attain criticality under optimum available conditions of moderation and reflection.

b. When all scrammable rods have been fully inserted and verified down and the console key has been removed from the console.

c. When no work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods and no experiments are in the reactor.

d. When sufficient control rods are inserted to assure that the reactor is subcritical by at least 1.00 dollar of reactivity, with the fuel and moderator at ambient temperature.

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 006 (1.00)

An area where there is posted a "Caution - Radioactive Materials" sign is by definition a:

a. Radioactive Material Storage Area.

b. Potentially Contaminated Area.

c. High Radiation Area.

d. Radiation Area.

QUESTION: 007 (1.00)

When responding to a dry spill, the spill should be:

a. covered with dry rags and then plastic.

b. cleaned up using a filtered vacuum cleaner.

c. carefully swept up and placed in a sealed plastic bag.

d. dampened with water and confined with absorbent material.

QUESTION: 008 (1.00)

A radioactive sample which initially was reading 50 R/hr has decayed over 8 hours to 25 R/hr. What will the sample read in another 4 hours?

a. 12.5 R/hr

b. 17.7 R/hr

c. 18.7 R/hr

d. 22.9 R/hr

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 009 (1.00)

Which of the following types of radiation has the largest quality factor?

a. Neutron

b. X-ray

c. Gamma

d. Alpha

QUESTION: 010 (1.00)

The annual limit for total effective dose equivalent per 10CFR20 is:

a. .5 rem

b. 1.25 rem

c. 3 rem

d. 5 rem

QUESTION: 011 (1.00)

During routine performance of the reactor room air sample gamma ray analysis, which of the following would be indicative of possible cladding failure?

a. Krypton

b. Argon

c. Nitrogen

d. Radon

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 012 (1.00)

Which of the following individuals assumes the role of Acting Emergency Director during an emergency?

a. Reactor Director

b. Director of the Nuclear Engineering Program

c. Senior Reactor Operator

d. Director of the Environmental Safety Department

QUESTION: 013 (1.00)

Following evacuation of the reactor building, who must authorize reentry into the Reactor Building?

a. Emergency Director

b. Radiation Safety Office

c. Emergency Coordinator

d. Reactor Support Coordinator

QUESTION: 014 (1.00)

A "Controlled Copy" of the MUTR Operating Procedures (OPs) is maintained in which one of the following locations?

a. MUTR Reactor Files

b. Reactor Director's Office

c. MUTR Training Manual

d. Reactor Emergency Box Nos. 1 & 2

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 015 (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.

QUESTION: 016 (1.00)

Which one of the following evolutions could be performed without being supervised by a senior reactor operator?

a. Resumption of operation following an unscheduled shutdown due to interruption of electrical power to the plant.

b. Resumption of operation following an unscheduled shutdown due to incorrect action by a student.

c. Experiments being manipulated in the core that have an estimated reactivity worth of 0.90 dollars.

d. Removal of control rods.

QUESTION: 017 (1.00)

To determine the Primary Coolant ion exchanger inlet conductivity, the:

a. Primary Coolant pump is used and the conductivity is measured from local sample.

b. Diffuser Pump is used and the conductivity is measured from local sample.

c. Primary Coolant Pump is used and the resistivity is read on the reactor console.

d. Diffuser Pump is used and the resistivity is read on the reactor console.

QUESTION: 018 (1.00)

A REACTOR RUN is to be conducted after the initial reactor startup of the same day.

This run can be considered part of the initial run if the reactor is being started up following:

a. a valid reactor scram for which the cause has been corrected.

b. an interruption of operation for training purposes.

c. an interruption of operation for minor maintenance.

d. a reactor scram which occurred inadvertently.

QUESTION: 019 (1.00)

Upon completion of fuel movement, the fuel handling tool is secured and locked:

a. inside the water room.

b. to a wall bracket on the balcony level.

c. inside the hot room.

d. to the reactor bridge rail.

(***** CATEGORY B CONTINUED ON NEXT

QUESTION: 020 (1.00)

The reactor is operating with the following power indications:

- Safety Channel I = 75 %
- Safety Channel II = 80 %
- Linear Power Chart Recorder (Red Pen) = 63% with range switch on 30KW
- Log-Power Channel = 83 %

Which one of the indications should be used as true power level?

a. Safety Channel I

b. Safety Channel II

c. Linear Power Chart Recorder

d. Log-Power Channel

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

QUESTION: 001 (1.00)

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

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

b. the maximum voltage on the demand potentiometer.

c. the speed of the rod drive motor.

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

QUESTION: 002 (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. directly into the water handling room sump through the floor drain gratings around the base of the reactor.

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

(***** CATEGORY C CONTINUED ON NEXT

QUESTION: 003 (1.00)

A break has occurred in the reactor coolant system on the pool inlet line to the pool. The break is outside of the pool.

Select the level that the pool will drain to and why?

a. The top of the core because all reactor coolant piping external to the core is above the top of the core.

b. Two feet above the top of the core because this is the discharge point of the pool inlet line.

c. Present height of water because the pool inlet line is equipped with a siphon break.

d. Two feet below the top of the reactor pool due to the siphon break located on the pool water outlet pipe.

QUESTION: 004 (1.00)

Select the component where differential pressure is measured in order to determine flow through the primary water system.

a. Primary Coolant Pump.

b. 200 Kw Heat Exchanger.

c. Restricting orifice.

d. 40 Kw Heat Exchanger.

QUESTION: 005 (1.00)

The regulating rod is operating in automatic. Select the response if the operator attempts to withdraw Shim I while the Regulating Rod is being withdrawn by the servoamplifier.

a. The Regulating Rod will withdraw but Shim I will be interlocked to prevent movement.

b. The Shim I rod will withdraw but the Regulating Rod will be shifted to manual mode.

c. The Shim I rod will withdraw but the Regulating Rod will be interlocked to prevent further withdrawal.

d. Both rods will withdraw simultaneously.

QUESTION: 006 (1.00)

Which one of the following channels of power monitoring is supplied by a compensated ion chamber?

a. Multirange Linear Channel

b. Wide Range Log Power Channel

c. Safety Channel I

d. Safety Channel II

QUESTION: 007 (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.

(***** CATEGORY C CONTINUED ON NEXT

QUESTION: 008 (1.00)

What is achieved by use of the diffuser above the core during operation?

a. Better distribution of heat throughout the pool.

b. Better heat transfer across all fuel elements in the core.

c. Reduced dose rate at the pool surface from N16.

d. Consistent water chemistry in the core.

QUESTION: 009 (1.00)

The driving force for the pneumatic transfer system is pressurized carbon dioxide. Carbon dioxide is used to minimize the production of:

a. moisture.

b. hydrogen.

c. argon-41.

d. nitrogen-16.

QUESTION: 010 (1.00)

In addition to the control room, where can the exhaust fan radiation level be read?

a. Left hand side of the entrance to the west balcony laboratories from reactor bridge.

b. Opposite the door into the west balcony, from the outside hallway.

c. Opposite the door into the reception room, from the outside hallway.

d. In the Nuclear Engineering Program office.

(***** CATEGORY C CONTINUED ON NEXT

QUESTION: 011 (1.00)

If an operator were to continuously withdraw a shim rod from the core approximately how long would it take for the rod to go from the bottom to the top of the core?

a. 30 seconds.

b. 45 seconds.

c. 75 seconds.

d. 120 seconds.

QUESTION: 012 (1.00)

Operation of which of the following Calibrate switches will result in a scram?

a. Fuel temperature

b. Wide range log power channel

c. Multirange linear channel

d. Safety Channel I

QUESTION: 013 (1.00)

Select the location where the ventilation system can be secured.

a. Entrance to the west balcony from the hallway.

b. Inside the water room.

c. Pneumatic transfer system laboratory.

d. West wall of the ground level.

(***** CATEGORY C CONTINUED ON NEXT

QUESTION: 014 (1.00)

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

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 is never below scale.

c. A low level source is attached to 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.

(***** CATEGORY C CONTINUED ON NEXT

QUESTION: 015 (1.00)

Select the setpoint for the high radiation scram that is initiated by the bridge radiation monitor.

a. 10 mrem/hr

b. 20 mrem/hr

c. 50 mrem/hr

d. 70 mrem/hr

QUESTION: 016 (1.00)

It is desired to raise power to 30 kW in automatic. Which of the following would be the correct setting for the %-Demand control and reactor power range switch?

a. 100 with the range switch in 30 kw position.

b. 30 with the range switch in 30 kw position.

c. 30 with the range switch in 10 kw position.

d. 33 with the range switch in the 10 kw position.

QUESTION: 017 (1.00)

When is the replaceable demineralizer cartridge in the primary system required to be replaced?

a. When the signal light in the water room is illuminated during primary system operation.

b. When the differential pressure across the orifice indicates a flow rate of less than 10 gpm.

c. When differential pressure across the filter exceeds 5 psid.

d. When conductivity on the outlet exceeds 1 x 10 -6 mhos/cm.

QUESTION: 018 (1.00)

A control rod interlock is applied when the trip test switch for Safety Channel I is placed on.

This control rod interlock is required because the:

a. period scram signal is bypassed.

b. minimum source count rate interlock can be bypassed.

c. gain of the instrument is affected by operation of the trip test knob.

d. the input signal to the automatic-servo is affected by the trip test knob.

QUESTION: 019 (1.00)

The instrumented fuel rod will measure core temperature that is:

a. equal to the average of all fuel rod temperatures.

b. the highest fuel rod temperature during normal conditions.

c. at least 50% of the temperature of the hottest fuel rod during accident conditions.

d. the highest fuel rod temperature during accident conditions.

QUESTION: 020 (1.00)

As part of an approved experiment the reactor is operated without the plexiglass cover on the Through Tube. Which of the following would increase?

a. Argon 41.

b. Nitrogen 16.

c. Beta Radiation.

d. Alpha Radiation.

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

ANSWER: 001 (1.00)

c.

REFERENCE:

ENNU 320, Vol.1, Sect. 9.1.1
Outline(A.4)

ANSWER: 002 (1.00)

b.

REFERENCE:

ENNU 320, section 7.4.1.
ENNU 320, volume 2, figure 3-15 and 3-16.
FSAR section 3.3.3.
Outline (A.16)

ANSWER: 003 (1.00)

a.

REFERENCE:

ENNU 320, section 9.1.1.
Outline (A.11 and A.10)

ANSWER: 004 (2.00)

b.

REFERENCE:

ENNU 320, section 7.4; 8.2
Outline(A.14)
1. delta k/k = (keff - 1)/keff = (.965 -1) / .965 = - .0363
2. delta k/k [shim I] = $ * Beta = (220 cents) (.0070) = .0154
3. delta k/k [new] = delta k/k [initial] + delta k/k [shim I]
   = - .0363 + .0154 = - .0209
4. keff [new] = 1 / 1 - delta k/k [new] = 1 / 1 - (- .0209) = .980
5. (1 - keff [initial]) (CR [initial] = (1 - keff [new]) (CR [new])
   (1 - .965) (300 mW) = (1 - .980) (CR [new])
   525 = CR [new]

ANSWER: 005 (1.00)

d.

REFERENCE:

ENNU 320, section 7.2 and figures 7-1 and 7-2.
Outline(A.4)

ANSWER: 006 (1.00)

d.

REFERENCE:

ENNU 320, section 8.3.
Outline (A.14)

ANSWER: 007 (1.00)

a.

REFERENCE:

FSAR section 3.3.2.
Outline(A.11)

ANSWER: 008 (1.00)

c. , d.

REFERENCE:

ENNU 320, section 9.4.
Outline (A.18)

(***** CATEGORY A CONTINUED ON NEXT

ANSWER: 009 (1.00)

b.

REFERENCE:

ENNU 320, Section 9.2.
Outline (A.5)

ANSWER: 010 (1.00)

b.

REFERENCE:

ENNU 320, section 9.1.1
Outline (A.8)
Final Power=Initial Power * e E (time/period)
Final Power/Initial Power = e E (time/period)
2 (Power Doubles) = e E (time/period)
ln 2 = time/80 seconds
(.693)(80)= time
55 seconds= time

ANSWER: 011 (1.00)

d.

REFERENCE:

ENNU 320, section 6.3.1.
Outline (A.9)

ANSWER: 012 (1.00)

b.

REFERENCE:

ENNU 320, Section 7.5.
Outline (A.15)

(***** CATEGORY A CONTINUED ON NEXT

ANSWER: 013 (1.00)

a.

REFERENCE:

ENNU 320 section 9.3.2.
Outline (A.17)

ANSWER: 014 (1.00)

d.

REFERENCE:

SP 202, Reactor Power Calibration.
Outline (A.19)

ANSWER: 015 (1.00)

b.

REFERENCE:

FSAR section 3.3.
Outline (Not specified)

ANSWER: 016 (1.00)

c.

REFERENCE:

ENNU 320, Section 9.3.1.
OP 104, step 4.4.
Outline (A.17)

(***** CATEGORY A CONTINUED ON NEXT

ANSWER: 017 (1.00)

d.

REFERENCE:

ENNU 320, Sect. 9.4

ANSWER: 018 (1.00)

b.

REFERENCE:

FSAR section 3.3.2.

ANSWER: 019 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 1, Sect 9.3.3
Outline(A.17)

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

ANSWER: 001 (1.00)

c.

REFERENCE:

Technical Specification 3.5, pg. 13.

ANSWER: 002 (1.00)

a.

REFERENCE:

Technical Specification 2.1 Basis, pg. 5.

ANSWER: 003 (1.00)

a.

REFERENCE:

Technical Specification 3.1, pg. 7.

ANSWER: 004 (1.00)

d.

REFERENCE:

Technical Specification 3.5, pg. 13.

ANSWER: 005 (1.00)

a.

REFERENCE:

Technical Specification Definition 1.20, pg. 3.

(***** CATEGORY B CONTINUED ON NEXT

ANSWER: 006 (1.00)

b.

REFERENCE:

ENNU 320 Manual, Nuclear Reactor Operations, section 1.2.2, pg. 1-2.

ANSWER: 007 (1.00)

d.

REFERENCE:

EP 404, Release Of Radioactivity, Step 3.2, pg. 2.

ANSWER: 008 (1.00)

b.

REFERENCE:

A = A0 * e exp(-lambda * time)
25 = 50 * e exp(-lambda * 8 * 3600); lambda = 2.4 exp-5/sec
A = 25 * e exp(-2.4 exp-5 * 4 * 3600); A = 17.7
ENNU 320 Manual, Nuclear Reactor Operations, Section 5.1.2, pg. 5-2.

ANSWER: 009 (1.00)

d.

REFERENCE:

10CFR20.104(b)

(***** CATEGORY B CONTINUED ON NEXT

ANSWER: 010 (1.00)

d.

REFERENCE:

10CFR20.1201(a)(1)

ANSWER: 011 (1.00)

a.

REFERENCE:

SP 210, Reactor Room Air Sample Gamma Ray Analysis, Step 3.2, pg. 1.

ANSWER: 012 (1.00)

c.

REFERENCE:

Emergency Preparedness Plan, Section 3.1.2 & 3.1.5, pgs. 3-2 & 3-3.
EP 406, Responsibilities and Instructions of the MUTR Emergency Organization, Section 4.0, pg. 2.

ANSWER: 013 (1.00)

a.

REFERENCE:

EP 401, Reactor Building Evacuation, Step 2.7, pg. 1.
EP 406, Responsibilities and Instructions of the MUTR Emergency Organization, Section 3.0, 4.0, 5.0, 6.0, & 7.0, pgs. 1 through 4.

(***** CATEGORY B CONTINUED ON NEXT

ANSWER: 014 (1.00)

b. , a.

REFERENCE:

OP 100, Control And Maintenance Of Procedures, Step 2.4, pg. 1.

ANSWER: 015 (1.00)

c.

REFERENCE:

MP-303, Sect. 2.1

ANSWER: 016 (1.00)

a.

REFERENCE:

Technical Specification 6.1.3, pg. 20.

ANSWER: 017 (1.00)

c.

REFERENCE:

SP 206, Pool Water Conductivity Determination, Step 4.1 & 4.7, pg. 2.

(***** CATEGORY B CONTINUED ON NEXT

ANSWER: 018 (1.00)

b.

REFERENCE:

OP 101, Reactor Startup Checkout, Definition 2.1, pg. 1.

ANSWER: 019 (1.00)

d.

REFERENCE:

MP 303, Fuel Movement, Step 4.5, pg. 3.

ANSWER: 020 (1.00)

b.

REFERENCE:

OP-104, Reactor Operations, Step 3.5.

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

ANSWER: 001 (1.00)

a.

REFERENCE:

ENNU Vol. 2 Sect. 6.2.2 pg. 6.8
FSAR section 6.3.2.
Outline (C.13.b)

ANSWER: 002 (1.00)

a.

REFERENCE:

ENNU 320, Vol.2, Sect. 8.1
Outline (A.6)

ANSWER: 003 (1.00)

c.

REFERENCE:

FSAR section 4.1.
Outline (C.2)

ANSWER: 004 (1.00)

c.

REFERENCE:

FSAR section 4.1.
Outline (C.2)

(***** CATEGORY C CONTINUED ON NEXT

ANSWER: 005 (1.00)

d.

REFERENCE:

FSAR Section 6.1.3.
Outline (C.13.b)

ANSWER: 006 (1.00)

a.

REFERENCE:

FSAR section 6.1.2.
Outline (C.9.e)

ANSWER: 007 (1.00)

d.

REFERENCE:

ENNU 320, Vol. 2, Sect. 7.3; SP-202, Step 5.15
Outline (C.9.c)

ANSWER: 008 (1.00)

c.

REFERENCE:

FSAR section 8.3
Outline (C.17)

(***** CATEGORY C CONTINUED ON NEXT

ANSWER: 009 (1.00)

c.

REFERENCE:

FSAR section 5.4.
Outline (C.16)

ANSWER: 010 (1.00)

a.

REFERENCE:

ENNU 320, Volume 2, section 6.3.
Outline (C.10)

ANSWER: 011 (1.00)

b.

REFERENCE:

ENNU 320, Volume II, Appendix A.

ANSWER: 012 (1.00)

a. , d.

REFERENCE:

ENNU 320, Volume II, section 6.1.4.
Outline (C.12)

(***** CATEGORY C CONTINUED ON NEXT

ANSWER: 013 (1.00)

d.

REFERENCE:

ENNU 320, Volume II, Figure 2.5.
Outline (A.7)

ANSWER: 014 (1.00)

c.

REFERENCE:

ENNU 320, Vol. 2, Sect. 6.3; SP-205, Sect. 5.0
Outline (C.10)

ANSWER: 015 (1.00)

c.

REFERENCE:

FSAR Table 6-1.
Outline (C.12.a)

ANSWER: 016 (1.00)

c.

REFERENCE:

MUTR OP-104 step 6.2 Caution.
Outline (C.13.b)

(***** CATEGORY C CONTINUED ON NEXT

ANSWER: 017 (1.00)

a.

REFERENCE:

FSAR section 4.1.
Outline (C.3)

ANSWER: 018 (1.00)

b.

REFERENCE:

ENNU 320, Volume 2, section 6.1.2.1.
Outline (C.13.c)

ANSWER: 019 (1.00)

c.

REFERENCE:

ENNU 320, Volume 2, section 6.1.3.2.
Outline (C.18)

ANSWER: 020 (1.00)

a.

REFERENCE:

ENNU 320, Volume II, section 8.3.
Outline (C.16)

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

ANSWER KEY

MULTIPLE CHOICE

001 c

002 b

003 a

004 b

005 d

006 d

007 a

008 c ; d

009 b

010 b

011 d

012 b

013 a

014 d

015 b

016 c

017 d

018 b

019 d

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

A N S W E R   K E Y

MULTIPLE CHOICE

001 c

002 a

003 a

004 d

005 a

006 b

007 d

008 b

009 d

010 d

011 a

012 c

013 a

014 a , b

015 c

016 a

017 c

018 b

019 d

020 b

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

C. PLANT AND RAD MONITORING SYSTEMS

ANSWER KEY

MULTIPLE CHOICE

001 a

002 a

003 c

004 c

005 d

006 a

007 d

008 c

009 c

010 a

011 b

012 a , d

013 d

014 c

015 c

016 c

017 a

018 b

019 c

020 a

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

EQUATION SHEET

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

$$\beta = 0.0075$$

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

$$SCR = \frac{S}{1-K_{eff}}$$

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

$$CR_1(1-K_{eff_1}) = CR_2(1-K_{eff_2})$$

$$SUR = 26.06\left[\frac{\lambda_{eff}\rho}{\beta - \rho}\right]$$

$$M = \frac{1-K_{eff_0}}{1-K_{eff_1}}$$

$$M = \frac{1}{1-K_{eff}} = \frac{CR_1}{CR_2}$$

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

$$SDM = \frac{(1-K_{eff})}{K_{eff}}$$

$$P = P_0 \, e^{\frac{t}{\tau}}$$

$$\tau = \frac{\ell^*}{\rho - \bar{\beta}}$$

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

$$\rho = \frac{\Delta K_{eff}}{k_{eff}}$$

$$\tau = \frac{\ell^*}{\rho} + \left[\frac{\bar{\beta} - \rho}{\lambda_{eff}\rho}\right]$$

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

$$\rho = \frac{(K_{eff}-1)}{K_{eff}}$$

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

$$DR_1 d_1^2 = DR_2 d_2^2$$

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

DR — mRem, Ci — curies,
E — Mev, R — feet

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1 Curie = 3.7×10^{10} dis/sec

1 kg = 2.21 lbm

1 Horsepower = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5 °C + 32

1 gal (H_2O) ≈ 8 lbm

°C = 5/9 (°F - 32)