ENCLOSURE 1

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

REPORT NO.:	50-184/OL-91-01
FACILITY DOCKET NO.:	50-184
FACILITY LICENSE NO.:	TR-5
LICENSEE:	National Institute of Standards and Technology U. S. Department of Commerce Gaithersburg, Maryland 20899
FACILITY:	National Institute of Standards and Technology Reactor
EXAMINATION DATE:	February 25, 1991
EXAMINER:	Christopher Gratton, Chief Examiner

SUBMITTED BY: Christopher Gratton, Chief Examiner — 3/13/91 Date

APPROVED BY: Theodore L. Szymanski, Chief — 3/13/91 Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Licensee Performance
and Quality Evaluation, NRR

SUMMARY:

Written and operating examinations were administered on February 25, 1991 (Report No. 50-184/OL-91-01) to two Senior Reactor Operators (instants).

REPORT DETAILS

1. Examiners:

   Christopher Gratton, Chief Examiner

2. Results:

   Two instant Senior Reactor Operators took the examinations. Both candidates passed all parts of the examination.

3. Exit Meeting:

   An exit meeting was held between Dr. Tawfik Raby (NIST) and Christopher Gratton (NRC) following the completion of the examination on February 25, 1991. There were no generic concerns raised by the NRC and Mr. Gratton expressed his gratitude to the NIST staff for their help in the preparation and administration of the examination.

   As a result of the discussion during the exit meeting and further investigation by the examiner, two written examination questions (A.13 and A.17) were deleted. NIST provided several informal comments on other written examination questions but no official comments were submitted.

ENCLOSURE 2

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Nuclear Regulatory Commission
Operator Licensing
Examination

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Official Use Only category on
date of examination.

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

FACILITY: Nat Bureau of Standards

REACTOR TYPE: NBSR

DATE ADMINISTERED: 91/02/25

REGION: 1

CANDIDATE:

LICENSE APPLIED FOR: Senior Operator

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		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. Use only the answer sheets provided. Credit will only be given for answers properly marked on these sheets. Follow the instructions for filling out the answer sheets.

7. Print your name in the upper right-hand corner of each answer sheet.

8. Partial credit will NOT be given on multiple choice questions.

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

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

11. To pass the examination, you must achieve at least 70% in each category.

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

13. 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)

Identify the neutron absorber that results in a POSITIVE reactivity effect.

a. U-235 in the center of G-4.

b. Stainless steel in the center of G-4.

c. Cadmium in the center of G-4.

d. Light water introduced into the heavy water system.

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

QUESTION: 002 (1.00)

Consider the following conditions:

-- The rods are fully inserted --> Keff = 0.5
-- The shim rods are pulled 10 degrees --> $5 worth of reactivity is added.

Select the FACTOR by which count rate will change.

a. 0.98

b. 1.00

c. 1.02

d. 1.04

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

Q"ESTION: 003 (1.00)

Reactor power increases from 10 watts to .8 kW in 250 seconds. (Assume a positive step change in reactivity.)

What is the approximate doubling time?

a. 57.0 seconds

b. 43.2 seconds

c. 39.5 seconds

d. 21.6 seconds

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

QUESTION: 004 (1.00)

Select the factor that will NOT affect the estimated shim arm critical position.

a. Moderator temperature

b. Primary system pressure

c. Time after shutdown

d. Core age

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

QUESTION: 005 (1.00)

The reactor is shutdown with one shutdown cooling pump running.

System parameters are:

Coolant flow rate through the core --> 750 gpm
Delta-T across the core --> 8 degrees F

What is the current decay heat power level of the core?

a. 972 Kw

b. 880 Kw

c. 245 Kw

d. 50 Kw

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

QUESTION: 006 (1.00)

What is the PRINCIPAL source of heat in the reactor after shutdown?

a. Cosmic radiation causing fission

b. Decay of fission products

c. Spontaneous fission within the core

d. Stored energy from the reactor and core materials

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

QUESTION: 007 (1.00)

Given the following information:

-- $3 of reactivity is added to a critical reactor
-- Neutron lifetime --> 7.0E-4 seconds
-- Beff --> 0.008
-- Teff --> 10 seconds

What is the STABLE period resulting from these conditions?

a. 0.0112 seconds

b. 0.0175 seconds

c. 0.0292 seconds

d. 0.0345 seconds

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

QUESTION: 008 (1.00)

The following plant conditions are given:

-- Primary flow	-->	8800 gpm
-- Secondary Flow through HE-1A and B	-->	9650 gpm
-- HE-1A and 1B secondary Inlet Temperature	-->	80 degrees F
-- HE-1A and 1B secondary Outlet Temperature	-->	91 degrees F
-- Thermal Power constant	-->	162 watts/gpm-F

Determine the current operating power of the reactor?

a. 78%

b. 71%

c. 65%

d. 59%

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

QUESTION: 009 (1.00)

Identify the definition of SUBCRITICAL MULTIPLICATION:

Subcritical multiplication is:

a. the time required for neutron flux (power) to change by a factor of "e" (2.718).

b. when the neutron population of one generation is greater than that of the preceding generation.

c. a calculation of the total reactivity deviation from critical.

d. the multiplication of source neutrons resulting from reactivity addition.

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

QUESTION: 010 (1.00)

With the reactor on a constant period, select the transient that will take the LONGEST time.

A reactor power change of:

a. 5% power -- going from 1% to 5% power

b. 10% power -- going from 10% to 20% power

c. 15% power -- going from 20% to 35% power

d. 20% power -- going from 40% to 60% power

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

QUESTION: 011 (1.00)

WHAT is the PRINCIPAL reason for operating with thermal neutrons instead of fast neutrons?

a. Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

b. Reactors operating primarily on fast neutrons are inherently unstable and cannot be safely controlled.

c. The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.

d. Doppler and moderator temperature coefficients become positive as neutron energy increases.

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

QUESTION: 012 (1.00)

The following plant parameters are given:

-- Primary system flow rate	--> 8800 GPM
-- Secondary system flow rate	--> 9450 GPM
-- Primary system delta-T across the heat exchanger	--> 13 degrees F
-- Secondary side heat exchanger inlet temperature	--> 77 degrees F

Determine the secondary side heat exchanger EXIT temperature.

a. 83 degrees F

b. 86 degrees F

c. 89 degrees F

d. 92 degrees F

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

QUESTION: 013 (1.00)

Given the following secondary system parameters:

-- Secondary coolant temperature at pump suction --> 80 degrees F
-- Height of water above pump suction --> 15" of water

Calculate the available Net Positive Suction Head (NPSH) for the Main Secondary Cooling Pumps.

a. 14.030 psia

b. 14.730 psia

c. 15.300 psia

d. 15.507 psia

deleted: no tables to solve it.

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

A. RX THEORY, THERMO & FAC OP CHARS

QUESTION: 014 (1.00)

What is the expected reactivity worth of PEAK XENON following a shutdown from full power operations?

a. $ 3.75

b. $ 5.00

c. $ 15.00

d. $ 18.75

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

QUESTION: 015 (1.00)

The reactor is started up following a scram from several days at high power. When the reactor is back at full power the regulating rod and shim arms are at the same positions they were at prior to the scram.

Using the curve provided, about how long has it been since the scram?

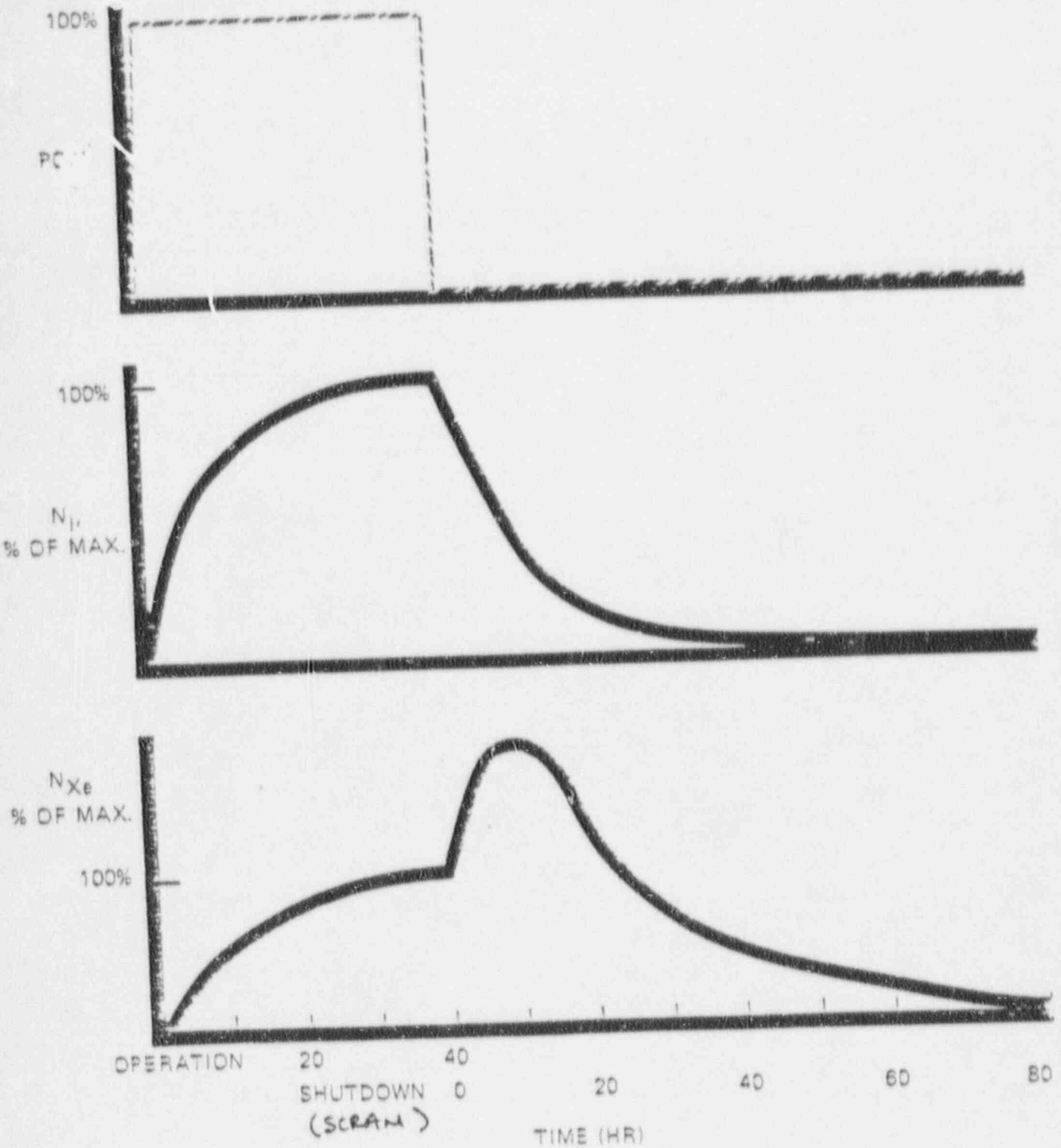
a. 10 hours

b. 18 hours

c. 22 hours

d. 30 hours

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



Transient Xenon - Startup and Shutdown

QUESTION: 016 (1.00)

Identify the definition of REACTOR PERIOD.

a. The time required for neutron flux (power) to change by a factor of e (2.718).

b. The time required for neutron flux (power) to change by a factor of 10.

c. The multiplication of source neutrons resulting from reactivity addition.

d. A measure of the reactivity which must be added to a shutdown reactor to make it exactly critical.

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

QUESTION: 017 (1.00)

Given the following conditions:

-- Reactor is shutdown
-- Shutdown margin: --> 4%
-- Source range power level: --> 100 cps
-- An installed experiment is worth: --> -$1.43
-- Xenon is decaying

Following removal of the experiment, source range power level is 196 cps. What was the approximate CHANGE in reactivity DUE to Xenon.

a. $ .98

b. $1.18

c. $2.51

d. $3.14

deleted: no correct answer
(answer is $\rho_{Xe} = 1.02$)

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

QUESTION: 018 (1.00)

Select the definition of SHUTDOWN MARGIN.

a. The multiplication of source neutrons resulting from reactivity addition.

b. A measure of the total reactivity deviation from critical.

c. Condition of the reactor in which the neutron population of one generation is greater than that of the preceding generation.

d. A measure of the reactivity which must be added to a shutdown reactor to make it exactly critical.

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

QUESTION: 019 (1.00)

What is the reactivity coefficient that will turn power when the regulating rod has been withdrawn to increase power? (Assume no other actions are taken.)

a. Pressure coefficient

b. Void coefficient

c. Moderator temperature coefficient

d. Fuel temperature coefficient

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

QUESTION: 020 (1.00)

What is the principal source of neutrons in the reactor while shutdown?

a. Spontaneous fission

b. Photo-neutron reactions

c. Alpha-neutron reactions with oxygen

d. Cosmic radiation interactions

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

QUESTION: 001 (1.00)

SELECT the excess reactivity limit established by Technical Specifications with the reactor at normal operating temperature.

a. 1.3% delta rho

b. 5.1% delta rho

c. 15.0% delta rho

d. 16.3% delta rho

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

QUESTION: 002 (1.00)

In order to deal with plant conditions and circumstances not specifically covered by the NBSR Emergency Instructions, deviations from those instructions are allowed.

Who has the PRIMARY responsibility for approving these deviations?

Deviations from the Emergency Instructions must be approved by:

a. the Nuclear Regulatory Commission (NRC)

b. the Chief, Reactor Operations Section

c. the Emergency Director

d. any licensed Senior Reactor Operator

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

QUESTION: 003 (1.00)

Upon declaration of an Alert, E.I. 3.4.2, "Emergency Response Summary (Alert)" directs the Emergency Director to notify the NRC.

Notification must be made to the NRC:

a. as soon as practicable, but no later than the next working day.

b. as soon as possible, but no later than 8 hours.

c. immediately, but no later than 4 hours.

d. when time permits, but no later than 1 hour.

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

QUESTION: 004 (1.00)

Following several days of operation at 100% power (20 MW), a D2O system rupture occurs.

What is the MINIMUM time coolant must be maintained in the core after the shutdown under these conditions?

a. 20 hours

b. 10 hours

c. 5 hours

d. 2.5 hours

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

QUESTION: 005 (1.00)

Select the person meeting the criteria allowing their QUARTERLY exposure limit to be raised from 1 1/4 rem to 3 rem.

a. Person "A" -- 24 years old
-- Has an undocumented current lifetime dose of 22.5 rem

b. Person "B" -- 19 years old
-- Has a documented current lifetime dose of 5 mrem

c. Person "C" -- 29 years old
-- Has an undocumented current lifetime dose of 48.2 rem

d. Person "D" -- 37 years old
-- Has a documented current lifetime dose of 93.7 rem

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

QUESTION: 006 (1.00)

A Radiation Work Permit (RWP) is written to perform a non-repetitive task on equipment that is potentially contaminated.

How long is this RWP allowed to remain in effect?

a. Until the job is completed.

b. 8 hours or until the end of the current shift.

c. A maximum of 24 hours.

d. Indefinitely, if reviewed daily by Health Physics.

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

QUESTION: 007 (1.00)

Select the facility staffing REQUIRED for a reactor startup as specified in O.I. 1.1, "Reactor Startup".

Prior to commencing a reactor startup:

a. the Reactor Supervisor must be present in the control room.

b. a licensed senior operator will be in the control room.

c. two (2) reactor operations personnel will be at the facility, one of which shall be licensed and in the control room.

d. a licensed senior operator will be present at the facility.

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

QUESTION: 008 (1.00)

As a MINIMUM, who may authorize a reactor restart following an unplanned scram? (Assume the cause of the scram has been found and corrected.)

a. Any Senior Reactor Operator.

b. The Reactor Supervisor on shift.

c. Deputy Chief, Reactor Operations Section

d. Chief, Reactor Operations Section

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

QUESTION: 009 (1.00)

Technical Specification 3.7, "Fuel Handling and Storage", states that fuel may not be removed from the reactor vessel unless the reactor has been shutdown for a minimum of one (1) hour for each megawatt of operating power level.

Select the BASIS for this requirement.

This time limit:

a. ensures that decay heat will have decreased to a level precluding melting should a fuel element become stuck in the fuel transfer chute.

b. coincides with the minimum forced cooling time limitations established by the Reactor Shutdown operation instructions.

c. provides a reasonable period following reactor shutdown for radiation levels to decrease prior to the start of fuel handli..g activities.

d. ensures a minimal hazard from any remaining tritium that may diffuse up through the reactor vessel 5" diameter top plug when opened.

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

QUESTION: 010 (1.00)

Select the Technical Specification absolute reactivity LIMITS for:

-- any one experiment

-- the sum of all experiments installed within the NBSR.

The reactivity limits are:

a. 0.2% delta rho
   1.3% delta rho

b. 0.5% delta rho
   1.3% delta rho

c. 0.2% delta rho
   2.6% delta rho

d. 0.5% delta rho
   2.6% delta rho

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

QUESTION: 011 (1.00)

Identify the condition REQUIRING an immediate halt to any fuel handling in progress.

a. Calculations determine shutdown margin has decreased to twenty five cents ($.25) above the most reactive shim arm.

b. The Reactor Supervisor approves a request for 2 personnel to enter the Process Room.

c. The Control Room operator notes a step change in level on NC-1 from 10 c.p.s. to 150 c.p.s. that steadies out at 90 c.p.s.

d. Nuclear Instrumentation channel NC-3 fails downscale with channels NC-1, 2 and 4 still operable.

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

QUESTION: 012 (1.00)

The Reactor Supervisor has authorized a clearance and Tag #855 to be hung on a piece of plant equipment.

Under what SPECIFIC conditions can this piece of equipment be operated once the tag is hung?

The equipment can be operated:

a. only by the person to whom the clearance was issued.

b. if someone from Reactor Operations is present.

c. if specifically authorized by the Reactor Supervisor on shift.

d. only under the specific conditions listed on the tag.

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

QUESTION: 013 (1.00)

Whose PERMISSION must be obtained prior to the insertion of any sample in the pneumatic or vertical manual irradiation facilities?

a. Any licensed Reactor Operations personnel on shift.

b. The on-shift Reactor Console Operator.

c. The Reactor Supervisor.

d. Anyone on the approved list of supervisors for the insertion and removal of samples.

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

QUESTION: 014 (1.00)

During an emergency, rescue or other essential personnel, are authorized to receive a pre-established radiation exposure WITHOUT Emergency Director approval in order to save someone's life.

Assuming rescue personnel have reached this pre-established limit, how much ADDITIONAL radiation exposure can the Emergency Director authorize for LIFESAVING ACTIONS during that same emergency?

a. 5 Rem

b. 25 Rem

c. 75 Rem

d. 100 Rem

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

QUESTION: 015 (1.00)

The plant is experiencing area radiation problems and the Reactor Supervisor has entered Emergency Instructions Manual E.I. 2.11, "Area Monitor High Radiation".

Identify the specific plant conditions that REQUIRE a Major Scram and evacuation of the Confinement Building.

a. All monitors on the first floor are alarming and are reading 15 mr/hour.

b. Monitor RD 1-1, East Wall Reactor First Floor, is reading 20 mr/hour and is increasing.

c. Monitors RD 1-4, South Wall Reactor First Floor, and RD 1-2, North Wall Reactor First Floor are both alarming.

d. All monitors on the second floor are alarming and are reading 10 mr/hour.

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

QUESTION: 016 (1.00)

Which of the following Health Physics reports would influence the Reactor Supervisor to direct the immediate evacuation of the Control Room based on the guidance in E.I. 3.2.4, "Site Area and Control Room Evacuation"?

Health Physics reports exposures in the Control Room:

a. will be 150 mrem per person over the next 8 hours.

b. have been 60 mrem/hour over the last 4 hours.

c. are currently at 250 mrem per person.

d. have been 130 mrem/hour over the last 3 hours.

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

QUESTION: 017 (1.00)

What is the MAXIMUM amount of time the reactor is allowed to operate following receipt of AN 1-43: "Emergency Refrigerator Trouble" and the Emergency Refrigerator cannot be re-started?

a. 25 minutes

b. 45 minutes

c. 60 minutes

d. 75 minutes

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

QUESTION: 018 (1.00)

While loading a spent fuel cask, what is the CLOSEST to the surface of the water a fueled section is allowed to be raised per O.I. 6.4, "NBSR Spent Fuel Cask Loading and Shipping"?

a. 52 inches

b. 48 inches

c. 40 inches

d. 36 inches

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

QUESTION: 019 (1.00)

During a D2O system rupture, under what specific conditions is the operator DIRECTED to START light water cooling?

a. When Emergency Cooling Tank water level drops below 10 inches.

b. When reactor water level decreases to 140 inches.

c. When the D2O storage tank low level annunciator alarms.

d. As soon as power is under control following a moderator dump.

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

QUESTION: 020 (1.00)

Assuming no decay heat in the core, what is the maximum power level allowed with NO forced coolant flow?

a. 1 kW

b. 10 kW

c. 1 MW

d. 10 MW

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

QUESTION: 001 (1.00)

Select the TYPE of poison segment used by the shim arms for reactor control.

The poison segment is made of:

a. cadmium clad with aluminum

b. solid aluminum

c. boron clad with stainless steel

d. solid hafnium

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

QUESTION: 002 (1.00)

What is the shim arm POSITION below which scram spring force will NOT be sufficient to overcome the shock absorber resistance and fully scram the shim?

a. 2 degrees

b. 8 degrees

c. 12 degrees

d. 15 degrees

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

QUESTION: 003 (1.00)

What is the total OPERATIONAL range of the Regulating Rod in automatic control?

a. 7 inches

b. 14 inches

c. 15 inches

d. 29 inches

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

QUESTION: 004 (1.00)

During a loss of normal coolant (D2O), the emergency cooling tank can provide a reserve source of D2O for experiment cooling.

What is the amount of D2O available in the emergency cooling tank for the REACTOR? (Assume it has already supplied the design amount to the experiments cooling system.)

a. 3000 gallons

b. 2000 gallons

c. 1000 gallons

d. 800 gallons

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

QUESTION: 005 (1.00)

Identify the METHOD for controlling the flow rate from the inner reserve cooling tank to the emergency cooling distribution pan upon decreasing reactor vessel water level?

The flow rate is controlled by:

a. throttling the "Emergency Cooling to Reserve Tank valves" (DWV-32 & 33).

b. the rate at which the operator pumps the Hot Waste Sump (#4 Sump) to the D2O Storage Tank.

c. diverting some of the emergency cooling flow to the two reactor inlet plena via DWV-34 & 35.

d. two unisolable flow restrictor nozzles in the inner reserve cooling tank wall.

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

QUESTION: 006 (1.00)

Select the TYPE of detectors used for nuclear instrumentation channels ND-6, 7 & 8.

a. Fission chamber

b. Uncompensated ionization chamber

c. B10 proportional counter

d. Compensated ionization chamber

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

QUESTION: 007 (1.00)

Identify the conditions allowing the process scram logic selector to be placed in the "2 of 2" position while the reactor is OPERATING.

The process scram logic selector may be placed in the "2 of 2" position:

a. for not longer than 8 hours to allow the checking of a channel's operability.

b. indefinitely if power is reduced below 10 MW before changing the selector's position.

c. up to a maximum of 12 hours if no experiments are inserted into the reactor.

d. while maintaining a steady power level but must be returned to the "1 of 2" position prior to a power change.

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

QUESTION: 008 (1.00)

Upon a loss of commercial power, identify the source of electricity to re-energize the Critical Power portions of the facility distribution system. (Assume the emergency power network was in the PREFERRED Critical Power Mode prior to the loss of commercial power.)

Critical power will be supplied:

a. by the inverter/diverter from the emergency battery.

b. only after the emergency diesel generators have started and re-energized MCCA-5/MCCB-6.

c. from a backup commercial power line after the breakers are manually closed.

d. by the static inverter from the emergency battery.

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

QUESTION: 009 (1.00)

What is the designed MINIMUM time the emergency battery can supply power to all of the reactor emergency equipment?

a. 1 hour

b. 3 hours

c. 4 hours

d. 8 hours

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

QUESTION: 010 (1.00)

Why is the operator directed NOT to operate the reactor in automatic control below 100Kw?

Operation in automatic control at power levels below 100 Kw:

a. will have the regulating rod at, or near, the lower end of its control range where it would automatically return to "manual".

b. may not be possible within the required 1.0% power band due to circuitry noise within the system.

c. may cause unintentional reactivity additions and power transients beyond the system's automatic compensation capability.

d. does not allow small incremental power changes due to the design of the Power Demand Potentiometer.

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

QUESTION: 011 (1.00)

Select the monitor that uses an ion chamber detector.

a. Liquid Effluent Monitor

b. Confinement Building Ventilation Tritium Monitor

c. Secondary Coolant Monitor

d. Reactor Building Filter Radiation Monitor

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

QUESTION: 012 (1.00)

In accordance with the "Reactor Startup Checklist (Shutdown > 24 hours)", what is the FIRST action required PRIOR to a startup if NC-3 and NC-4 are reading less than 2E-10 amps?

a. Ensure the Source Range Detectors (NC-1 and NC-2) are inserted.

b. Perform a channel calibration on NC-3 and NC-4.

c. Recheck the NC-3 and NC-4 period scrams to assure operability.

d. Install a neutron source to verify instrumentation operability.

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

QUESTION: 013 (1.00)

Select the condition resulting in regulating rod control swapping from "Automatic" to "Manual". (Assume no operator actions taken.)

a. Power readings on NC-6 and NC-8 are indicating a 12% difference.

b. NC-5 power is 7% above the power demand potentiometer setting.

c. Reactor water level reaches 144 inches decreasing.

d. The reactor regulating rod is at 9 inches.

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

QUESTION: 014 (1.00)

During a failure to scram transient the operator uses moderator dump to shutdown the reactor. Which action listed below DOES NOT OCCUR when the moderator dump switch is taken to "OPEN"?

a. The Main Secondary Cooling Pumps trip.

b. A reactor scram signal is initiated.

c. The Main D2O Pumps trip.

d. The reactor primary coolant drains to the D2O storage tank.

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

QUESTION: 015 (1.00)

Assuming the moderator dump works as designed, what is it's calculated MINIMUM shutdown capability?

The calculated shutdown capability is at least:

a. 1% delta rho

b. 2% delta rho

c. 4% delta rho

d. 6% delta rho

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

QUESTION: 016 (1.00)

Select the Technical Specification BASIS for monitoring primary system leakage through the primary/secondary heat exchangers?

a. Provides an early indication of any fission product releases to the secondary system.

b. Provides the means to keep track of tritium releases from the primary system.

c. Monitors the primary heat exchanger's heat transfer efficiency.

d. Determines the type of chemistry controls required for the secondary system.

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

QUESTION: 017 (1.00)

Which AUTOMATIC reactor scram will occur as reactor water level continues to INCREASE above 168 inches? (Assume no operation actions taken.)

a. High reactor D20 level.

b. High flux on NC-6, NC-7 or NC-8.

c. Low reactor D20 level.

d. High reactor delta T.

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

QUESTION: 018 (1.00)

Identify the PURPOSE of the Carbon Dioxide System.

The Carbon Dioxide system:

a. is supplied to various void areas in the plant as a fire suppression media.

b. is provided as a backup to the helium sweep system during plant shutdown periods.

c. is provided as a backup for the 150# and 90# plant service air systems.

d. is used in high neutron flux regions to remove air thus minimizing Argon activation.

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

QUESTION: 019 (1.00)

Following a containment building isolation and normal ventilation shutdown on high radiation, how is the required negative building pressure controlled? (Assume AC electrical power is available and no operator actions taken.)

Containment building pressure is controlled by the emergency exhaust system:

a. automatic fan cycling on and off to maintain a pressure of -0.25".

b. standby fan cycling on and off to maintain a pressure of -0.25".

c. automatic fan cycling on and off to maintain a pressure of -0.1".

d. standby fan cycling on and off to maintain a pressure of -0.1".

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

QUESTION: 020 (1.00)

At what point during a reactor startup is the operator directed to switch the power range scram setpoint to 125%?

a. At 2E-10 amps on NC-3 and NC-4.

b. Prior to exceeding 5 MW.

c. When NC-6, NC-7 and NC-8 are above 1%.

d. Immediately after the reactor is critical.

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

EQUATION SHEET

$f = ma$

$w = mg$

$E = mc^2$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$W = v\Delta P$

$\Delta E = 931\Delta m$

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

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

$Pwr = W_f \dot{m}$

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

$P = P_o\ e^{t/T}$

$SUR = 26.06/T$

$T = 1.44\ DT$

$SUR = 26\left(\frac{\lambda_{eff}\rho}{\bar{\beta} - \rho}\right)$

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

$T = l^*/(\rho - \bar{\beta})$

$T = (\bar{\beta} - \rho)/\lambda_{eff}\rho$

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

$\rho = [l^*/TK_{eff}] + [\bar{\beta}/(1 + \lambda_{eff}T)]$

$P = I\phi V/(3 \times 10^{10})$

$I = N\sigma$

$v = s/t$

$s = v_o t + \frac{1}{2}at^2$

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

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

$A = \lambda N \qquad A = A_o e^{-\lambda t}$

$\lambda = \ln 2/t_{\frac{1}{2}} = 0.693/t_{\frac{1}{2}}$

$t_{\frac{1}{2}}(eff) = \frac{(t_{\frac{1}{2}})(t_{\frac{1}{2}})}{(t_{\frac{1}{2}} + t_{\frac{1}{2}})}$

$I = I_o e^{-Ix}$

$I = I_o e^{-\mu x}$

$I = I_o\ 10^{-x/TVL}$

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

$SCR = S/(1 - K_{eff})$

$CR_x = S/(1 - K_{effx})$

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$M = (1 - K_{eff})_0/(1 - K_{eff})_1$

$SDM = (1 - K_{eff})/K_{eff}$

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

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

$I_1 d_1 = I_2 d_2$

$I_1 d_1^2 = I_2 d_2^2$

$R/hr = (0.5\ CE)/d^2$(meters)

$R/hr = 6\ CE/d^2$(feet)

CONSTANTS AND CONVERSIONS

WATER

1 gal (H_2O) = 8.34 lb
1 gal (D_2O) = 9.20 lb
1 ft^3 = 7.48 gal
Density (H_2O) = 62.40 lb/ft^3 = 1.000 g/cm^3
Density (D_2O) = 68.95 lb/ft^3 = 1.105 g/cm^3
1 gal = 3.78 liters

C_p (H_2O and D_2O) = 1.0 cal/g °C = 1.0 BTU/lb °F

---

1 Watt = 1 Joule/sec = 3.413 Btu/hr
1 Calorie = 4.183 Joules
1 Btu = 1054 Joules
1 Btu = 778 ft-lbf
1 HP = 2.54×10^3 Btu/hr
1 Mw = 3.41×10^6 Btu/hr

°F = 9/5(°C) + 32
°C = 5/9 (°F - 32)

Heat of vaporization = 970 Btu/lbm
Heat of fusion = 144 Btu/lbm

1 Atm = 14.7 psi = 29.92 in. Hg.
1 ft. H_2O = 0.4335 lbf/in^2
1 kg = 2.21 lbm
1 inch = 2.54 cm

1 Curie = 3.7×10^{10} dps

$\ell^* = 7 \times 10^{-4}$ sec

$\beta = .0064$

$\beta_{eff} = .008$

$\bar{\tau} = 10$ sec

$\bar{\lambda} = 0.1\ sec^{-1}$

Equilibrium Xenon	≈3%	$3.75
Equilibrium Samarium	≈1%	$1.25
Peak Xenon (above equilibrium)	≈12%	$15
Upper Reflector Worth (rods in)	≈4%	$5
Upper Reflector Worth (rods out)	≈10%	$12.50

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)

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

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

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.

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 **********)

TEST CROSS REFERENCE

QUESTION	VALUE	REFERENCE
001	1.00	9000001
002	1.00	9000002
003	1.00	9000003
004	1.00	9000004
005	1.00	9000005
006	1.00	9000006
007	1.00	9000007
008	1.00	9000008
009	1.00	9000009
010	1.00	9000010
011	1.00	9000011
012	1.00	9000012
013	1.00	9000013
014	1.00	9000014
015	1.00	9000015
016	1.00	9000016
017	1.00	9000017
018	1.00	9000018
019	1.00	9000019
020	1.00	9000020
	20.00	
001	1.00	9000021
002	1.00	9000022
003	1.00	9000023
004	1.00	9000024
005	1.00	9000025
006	1.00	9000026
007	1.00	9000027
008	1.00	9000028
009	1.00	9000029
010	1.00	9000030
011	1.00	9000031
012	1.00	9000032
013	1.00	9000033
014	1.00	9000034
015	1.00	9000035
016	1.00	9000036
017	1.00	9000037
018	1.00	9000038
019	1.00	9000039
020	1.00	9000040
	20.00	
001	1.00	9000041
002	1.00	9000042
003	1.00	9000043
004	1.00	9000044
005	1.00	9000045
006	1.00	9000046
007	1.00	9000047
008	1.00	9000048

TEST CROSS REFERENCE

QUESTION	VALUE	REFERENCE
009	1.00	9000049
010	1.00	9000050
011	1.00	9000051
012	1.00	9000052
013	1.00	9000053
014	1.00	9000054
015	1.00	9000055
016	1.00	9000056
017	1.00	9000057
018	1.00	9000058
019	1.00	9000059
020	1.00	9000060
	20.00	
	60.00	

ANSWER: 001 (1.00)

a.

REFERENCE:

NBSR Requal Exam Feb 1990

ANSWER: 002 (1.00)

c.

REFERENCE:

LaMarsh, "Introduction to Nuclear Engineering", page 252

NUS Corporation, NET, Module 3, pages 6.1-3, 12.1-3

ANSWER: 003 (1.00)

c.

REFERENCE:

NUS, Nuclear Energy Training, Module 3, page 6.3-1

ANSWER: 004 (1.00)

b.

REFERENCE:

NUS, Nuclear Energy Training, Module 3, pages 9.5-1, 9.5-2

ANSWER: 005 (1.00)

a.

REFERENCE:

General Electric, Heat Transfer and Fluid Flow Chapter 8

NBS FSAR Section 5.2

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

ANSWER: 006 (1.00)

b.

REFERENCE:

LaMarsh, pages 318-320

ANSWER: 007 (1.00)

c.

REFERENCE:

NBSR requalification Exam Feb. 1990 Question 5.

ANSWER: 008 (1.00)

a.

REFERENCE:

NBSR Requalification Exam Feb. 1990 Question 9.

ANSWER: 009 (1.00)

d.

REFERENCE:

Nuclear Energy Training, Module 3, 1.5-2 and 2.6-1.

ANSWER: 010 (1.00)

a.

REFERENCE:

Nuclear Energy Training, Module 3, Reactor Operation, 14.2-5.

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

ANSWER: 011 (1.00)

c.

REFERENCE:

Nuclear Energy Training, Module 3, 1.5-2 and 2.6-1.

ANSWER: 012 (1.00)

c.

REFERENCE:

General Electric, Heat Transfer and Fluid Flow Chapter 7

ANSWER: 013 (1.00)

b.

REFERENCE:

Nuclear Energy Training, Module 4, Plant Performance Section 6

ANSWER: 014 (1.00)

d.

REFERENCE:

NBS Reactivity Values Sheet

Nuclear Energy Training, Module 3, Section 10.3

ANSWER: 015 (1.00)

c.

REFERENCE:

Nuclear Energy Training, Module 3, Section 10.3, Page 10.3-2

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

ANSWER: 016 (1.00)

a.

REFERENCE:

Nuclear Energy Training, Module 3, 1.5-2 and 2.6-1.

ANSWER: 017 (1.00)

b.

REFERENCE:

Nuclear Energy Training, Module 3, Section 10.2

ANSWER: 018 (1.00)

d.

REFERENCE:

Nuclear Energy Training, Module 3, 1.5-2 and 2.6-1.

ANSWER: 019 (1.00)

c.

REFERENCE:

Nuclear Energy Training, Module 3, Section 8.1

ANSWER: 020 (1.00)

b.

REFERENCE:

Nuclear Energy Training, Module 3, Section 10.2

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

ANSWER: 001 (1.00)

c.

REFERENCE:

NBSR Technical Specifications, Section 3.3, Page 7 of 17

ANSWER: 002 (1.00)

c.

REFERENCE:

Emergency Instruction Manual, E. I. Introduction, Page 1 of 1

ANSWER: 003 (1.00)

b.

REFERENCE:

Emergency Instructions Manual, E.I. 3.4.2, "Emergency Response Summary (Alert), Page 1 of 1

ANSWER: 004 (1.00)

d.

REFERENCE:

Emergency Instructions Manual, E.I. 2.4, "D2O System Rupture", Page 1 of 1

ANSWER: 005 (1.00)

b.

REFERENCE:

Health Physics Procedures, H.P. 2.1, "Radiation Exposure Limits", Page 2 of 3

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

ANSWER: 006 (1.00)

a.

REFERENCE:

Health Physics Procedures, H.P. 2.4, "Radiation Work Permit (RWP), Page 1 of 2

ANSWER: 007 (1.00)

d.

REFERENCE:

Operation Instructions Manual, O.I. 1.1, "Reactor Startup", Page 4 of 7

ANSWER: 008 (1.00)

b.

REFERENCE:

Operation Instructions Manual, O.I. 1.1, "Reactor Startup Check List - Following an Unplanned Scram", Page 1 of 2

ANSWER: 009 (1.00)

a.

REFERENCE:

Technical Specifications, T.S. 3.7, "Fuel Handling and Storage", Page 12 of 17

ANSWER: 010 (1.00)

d.

REFERENCE:

Technical Specifications, T.S. 4.0, "Experiments", Page 1 of 3

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

ANSWER: 011 (1.00)

c.

REFERENCE:

Operation Instructions Manual, O.I. 6.2, "Operation of the Fuel Transfer System", Page 3 of 9

ANSWER: 012 (1.00)

c.

REFERENCE:

Administrative Rules, A.R. 11.0, "Tagging and Clearance of Equipment For Work", Page 4 of 4

ANSWER: 013 (1.00)

b.

REFERENCE:

Administrative Rules, A.R. 14.0, "Use of Pneumatic and Vertical Manual Irradiation Facilities", Page 1 of 1

ANSWER: 014 (1.00)

c.

REFERENCE:

Emergency Instructions Manual, E.I. 1.5, "General Information", Page 5 of 5

ANSWER: 015 (1.00)

a.

REFERENCE:

Emergency Instructions Manual, E.I. 2.11, "Area Monitor High Radiation", Page 2 of 2

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

ANSWER: 016 (1.00)

d.

REFERENCE:

Emergency Instructions Manual, E.I. 3.2.4, "Site Area and Control Room Evacuation, Page 1 of 1

ANSWER: 017 (1.00)

b.

REFERENCE:

Annunciator Procedures, A.P. 1.43, "Emergency Refrigerator Trouble", Page 2 of 2

ANSWER: 018 (1.00)

b.

REFERENCE:

Operation Instructions Manual, O.I. 6.4, "NBSR Spent Fuel Cask Loading and Shipping". Page 1 of 3

ANSWER: 019 (1.00)

a.

REFERENCE:

Annunciator Procedures, A.P. 0.1, "D2O System Rupture", Page 1 of 2

ANSWER: 020 (1.00)

b.

REFERENCE:

NBSR Technical Specifications, T.S. 2.1, Safety Limits, Page 1 of 4

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

ANSWER: 001 (1.00)

a.

REFERENCE:

NBSR Training Guide, Section 1.1.5, "Reactor Control", Page 6

ANSWER: 002 (1.00)

c.

REFERENCE:

NBSR Training Guide, Section 1.3.5, "Drive Package Design", Page 9

ANSWER: 003 (1.00)

c.

REFERENCE:

NBSR Training Guide, Section 1.4.2, "Drive Package", Page 10

Annunciator Procedures, A.P. 4.30, "AN 4-30: Regulating Rod Control Limit", Page 1 of 1

ANSWER: 004 (1.00)

b.

REFERENCE:

NBSR Training Guide, Section 4.1.2, "Components Description", Page 23

ANSWER: 005 (1.00)

d.

REFERENCE:

NBSR Training Guide, Section 4.1.3, "Design Considerations", Page 24

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

ANSWER: 006 (1.00)

b.

REFERENCE:

NBSR Training Guide, Section 6.2.4, "Uncompensated Ionization Chambers", Page 50

ANSWER: 007 (1.00)

a.

REFERENCE:

Operation Instructions Manual, O.I. 5.7. "Operation of the Process Instrumentation Safety System", Page 2 of 3

ANSWER: 008 (1.00)

d.

REFERENCE:

Operation Instructions Manual, O.I. 5.1, "Emergency Power Testing Procedure - Reactor Building", Page 2 of 11

NBSR Training Guide, Section 5.3.2, "Reactor Distribution", Page 45

ANSWER: 009 (1.00)

c.

REFERENCE:

NBSR Training Guide, Section 5.2 "Emergency Distribution", Page 45

ANSWER: 010 (1.00)

b.

REFERENCE:

Operation Instructions Manual, O.I. 5.4, "Operation of the Nuclear Instrumentation System", Page 6 of 6

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

ANSWER: 011 (1.00)

b.

REFERENCE:

NBSR Training Guide, Section 6.4.7, "Ventilation Tritium Monitor", Page 56

ANSWER: 012 (1.00)

a.

REFERENCE:

Operation Instructions Manual, O.I. 1.1, "Reactor Startup Checklist (Shutdown > 24 hours)", Page 3 of 10

ANSWER: 013 (1.00)

c.

REFERENCE:

Annunciator Procedures, A.P. 4.28, "AN 4-28: Reactor On Manual", Page 1 of 2

Annunciator Procedures, A.P. 6.2, "AN 6-2: Rundown", Page 1 of 2

ANSWER: 014 (1.00)

a.

REFERENCE:

Annunciator Procedures, A.P. 4.2, "AN 4-2: Moderator Dump", Page 1 of 2

ANSWER: 015 (1.00)

c.

REFERENCE:

Technical Specifications, T.S. 3.4, "Reactor Control and Safety Systems", Page 10 of 17

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

ANSWER: 016 (1.00)

b.

REFERENCE:

Technical Specifications, T.S. 3.6, "Secondary Cooling System", Page 11 of 17

ANSWER: 017 (1.00)

c.

REFERENCE:

Annunciator Procedures, A.P. 3.1, "AN 3-1: HI Reactor D2O level", Page 1 of 1

ANSWER: 018 (1.00)

d.

REFERENCE:

NBSR Training Guide, Section 4.8.1, "Carbon Dioxide System General", Page 31

ANSWER: 019 (1.00)

a.

REFERENCE:

NBSR Training Guide, Section 4.10.3, "Ventilation System Under Accident Conditions", Page 35

ANSWER: 020 (1.00)

c.

REFERENCE:

Operation Instructions Manual, O.I. 1.1, "Reactor Startup", Page 6 of 7

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

A N S W E R K E Y

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

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

A N S W E R K E Y

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

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

A N S W E R K E Y

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

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