Examination Report No.: 50-228/OL-90-01

Facility: Aerotest Research and Radiography Reactor

Docket No.: 50-228

Examinations administered at Aerotest Operations, San Ramon, California.

Chief Examiner: _____ 1/3/91
Gary W. Johnston, Date Signed
Operator Licensing Examiner

Accompanying Personnel: David B. Pereira, Operator Licensing Examiner
William Dean, Chief, Regional Oversight Section, OLB

Approved: _____ 1/3/91
Lewis F. Miller, Jr. Date Signed
Chief, Operations Section

Summary:

Examinations on November 28 - 29, 1990 (Report No. 50-228/OL-90-01)

Written and oral examinations were administered to three Senior Reactor Operator candidates. Two SRO Instant candidates and one SRO Upgrade candidate passed the operating examinations. One SRO Instant candidate failed the written examination.

No significant concerns were identified during the examination.

REPORT DETAILS

1. Examiners:

   G. Johnston, RV (Chief Examiner)
   D. Pereira, RV

2. Persons Attending the Exit Meeting:

   G. Johnston, RV
   H. Simens, President, Aerotest Operations, Inc.

3. Written Examination and Facility Review:

   The written examinations were administered to two SRO Instant candidates on November 28, 1990. One candidate failed the written examination.

   At the conclusion of the written exam, the facility staff was provided a copy of the examination and were requested to provide written comments. The comments made by the staff are included in attachment (1). These comments were reviewed by the Chief Examiner and appropriate changes were made to the examination key prior to the grading of the exams.

4. Operating Examinations

   The operating examinations were conducted November 28 - 29, 1990. No specific generic weaknesses or concerns were identified during the examinations.

5. Exit Meeting

   The Chief Examiner met with the facility representative denoted in Paragraph 2 on November 29, 1990. The examiner discussed the findings to that point and the examination process.

RESOLUTION OF FACILITY COMMENTS

Questions A.11 and B.04:

Facility Comment:

The facility pointed out that the answers for A.11 and B.04 were incorrect and appeared to be typographical because there were correct answers in the choices.

Resolution:

The Chief Examiner agreed and changed the indicated answers to the appropriate choices. The order of the choices was changed during the editing process and the author failed to change the answer key to reflect the changes.

Question B.09:

Facility Comment:

The facility noted that the personnel are trained not only to make a two person search, but to also take along a member of the local law enforcement agency to assist in the bomb search. The reasoning is that their personnel are not trained to recognize bombs, whereas the LLEA members are trained for that task.

Resolution:

The Chief Examiner agreed and changed the answer to item (c.) to reflect the training. The change was not contrary to the procedural requirements.

Question A.15:

Facility Comment:

The facility views the answer (b.) as ambiguous and points out that item (a.) could also be correct as it "could be read to mean the 'mean life' of the delayed neutron precursors, in which case either (a.) or (b.) could be correct."

Resolution:

The Chief Examiner agrees that answer a. could be read as the mean life of the neutron precursors and therefore would not be wrong in meeting the call of the question. Therefore the Chief Examiner will allow for either (a.) or (b.) as a correct answer.

cc w/enclosures (1), (2) and (3):
R. Cross, RV (2 copies)

cc w/enclosure (1) only:
R. Gallo, NRR/LOLB
K. Perkins, RV
J. Martin, RV
R. Zimmerman, RV
D. Kirsch, RV
L. Miller, RV
G. Johnston, RV
P. Qualls, RV
T. Michaels, NRR/PDSNP

cc w/enclosures (1) and (2):
RSB/Document Control Desk (RIDS)

RV:jk
GJohnston
01/3/91

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01/3/91

DKirsch
01/2/91

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YES / NO	YES / NO	YES / NO

SEND TO PDR
YES / NO

IE42

ES-401-1

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

Candidate: Grading Copy License Applied For: RO/SRO (Circle one)

Facility: Aerotest Operations ARRR Reactor Type: TRIGA Fueled

Date Administered: November 28, 1990 Region: V

INSTRUCTIONS TO CANDIDATE

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers on 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	Percent of Category Value	
~~15.0~~ 16.0	~~30.6~~ 32.0			A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
17.0	~~34.7~~ 34.0			B. Normal and Emergency Operating Procedures and Radiological Controls
17.0	34.0			C. Plant and Radiation Monitoring Systems
~~49.0~~ 50.0	100.0		%	TOTALS

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

Candidate's Signature

PROCEDURES FOR THE ADMINISTRATION OF WRITTEN EXAMINATIONS

1. Check identification badges.

2. Pass out examinations and all handouts. Remind applicants not to review examination until instructed to do so.

READ THE FOLLOWING INSTRUCTIONS VERBATIM:

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.

READ THE FOLLOWING INSTRUCTIONS

1. Restroom trips are to be limited and only one applicant 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.

2. Use black ink or dark pencil only to facility legible reproductions.

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

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

5. 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.

6. Use abbreviations only if they are commonly used in facility literature. Avoid using symbols such as < or > signs to avoid a simple transposition error resulting in an incorrect answer. Write it out.

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

8. Show all calculations, methods, or assumptions used to obtain an answer to any short answer question.

9. Partial credit may be given except on multiple choice questions. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK.

10. Proportional grading will be applied. Any additional wrong information that is provided may count against you. For example, if a question is worth one point and asks for four responses, each of which is worth 0.25 points, and you give five responses, each of your responses will be worth 0.20 points. If one of your five responses is incorrect, 0.20 will be deducted and your total credit for that question will be 0.80 instead of 1.00 even though you got the four correct answers.

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

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

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

14. To pass the examination, you must achieve a grade of 80% or greater.

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

16. When you are done and have turned in your examination, leave the examination area (area to be defined by Chief Examiner). If you are found in this area while the examination is still in progress, your license may be denied or revoked.

Operations Training Equation Sheet

$F = ma$

$W = mg$

$E = mc^2$

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

$PE = mgh$

$W = \nu \Delta P$

$\Delta E = 931 \Delta m$

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

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

$P_{WT} = W_f \dot{m}$

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

$P = P_o\, e^{t/\tau}$

$SUR = 26.06/\tau$

$\tau = 1.44\ DT$

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

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

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

$\tau = (\beta - \rho)/\lambda_{eff}\, \rho$

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

$\rho = [\ell^*/\tau\, k_{eff}] + [\beta/(1 + \lambda_{eff}\, \tau)]$

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

$\Sigma = N\sigma$

$v = s/t$

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

$a = (v_f - v_o)/t$

$v_f = v_o + at$

$\omega = \theta/t$

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

$\dot{Q} = UA\ (T_{AVG} - T_{STM})$

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

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

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

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

$I = I_o\, e^{-\Sigma x}$

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

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

$TVL = 1.3/\mu$

$HVL = 0.693/\mu$

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

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

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

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

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

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

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

WATER PARAMETERS	MISCELLANEOUS CONVERSIONS
1 gal = 8.345 lbm	1 Curie = 3.7×10^{10} dps
1 gal = 3.78 liters	1 kg = 2.21 lbm
1 ft^3 = 7.48 gal	1 hp = 2.54×10^3 Btu/hr
Density = 62.4 lbm/ft^3	1 MW = 3.41×10^6 Btu/hr
Density = 1 gm/cm^3	1 Btu = 778 ft-lbf
Heat of Vaporization = 970 Btu/lbm	1 inch = 2.54 cm
Heat of fusion = 144 Btu/lbm	°F = (9/5°C) + 32
1 Atm = 14.7 psi = 29.9 in. Hg.	°C = 5/9 (°F - 32)
1 ft. H_2O = 0.4335 lbf/in^2	

CATEGORY A

Reactor Theory, Thermodynamics and
Facility Operating Characteristics

QUESTION A.01 [1.0]

What are the three materials that are considered as moderators in the design of TRIGA fueled reactors?

a. Zirconium Hydride [ZrH2], Aluminum, and Graphite

b. Water, Graphite, and Zirconium Hydride [ZrH2]

c. Aluminum, Water, and Graphite

d. Graphite, Water, and Stainless Steel

ANSWER

b.

REFERENCE

ARRR Reference Material VOL 2, PG III-2

QUESTION A.02 [1.0]

Which one of the following statements correctly describes the property of a GOOD MODERATOR?

a. It slows down fast neutrons to thermal energy levels via a large number of collisions.

b. It reduces gamma radiation to thermal energy levels via a small number of collisions.

c. It slows down fast neutrons to thermal energy levels via a small number of collisions.

d. It reduces gamma radiation to thermal energy levels via a large number of collisions.

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 3 PG RT-2.7

QUESTION A.03 [1.0]

The Aerotest reactor is at a stable power of 0.01 watt. A reactivity addition of $0.25 is inserted by withdrawing a rod.

With the following information:

Delayed neutron mean lifetime = 12.3 seconds

Prompt neutron lifetime = 2 X 10^-14 seconds

Beta effective = 0.0073

What will be the resulting STABLE reactor period?

a. 48 seconds

b. 38 seconds

c. 28 seconds

d. 22 seconds

ANSWER

b.

FROM : deltaK = 0.25 X 0.0073 = 0.0018

Prompt neutron lifetime can be ignored because of stable period.

T = [Beff - deltaK] X Upsilon / deltaK

T = [0.0073 - 0.0018] X 12.3 / 0.0018

T = 0.0677 / 0.0018

T = 37.58 [38] seconds

REFERENCE

ARRR Reference Material VOL 4 PG 1-16

QUESTION A.04 [1.0]

The reactor is SUBCRITICAL with a Keff of 0.96 and there is 300 counts per second on the source range instrumentation. A fuel element is removed and the count rate drops to 100 counts per second. No other changes have occurred.

What is the Keff of the core with the current core configuration (i.e. one element removed)?

a. 0.9733

b. 0.8800

c. 0.8400

d. 0.8000

ANSWER

b.

CR1/CR2 = [1 - Keff2] / [1 - Keff1]

30/10 = [1 - Keff] / [1 - 0.96]

Keff = 0.8800

REFERENCE

ARRR Reference Material VOL QUESTION 17 TEST NO. 7

QUESTION A.05 [1.0]

When the Aerotest reactor is operating at full power steady state of 250 kW, which of the following correctly describes the heat transfer mechanism from the fuel cladding to the surrounding water?

a. Conduction

b. Film boiling

c. Convection

d. Radiation

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 4 PG 1-28 TO 1-31

QUESTION A.06 [1.0]

Which of the following statements correctly describes the influence of DELAYED NEUTRONS on the neutron life cycle?

a. Delayed neutrons increase the time required for the neutron population to change between generations.

b. Delayed neutrons decrease the time required for the neutron population to change between generations.

c. Delayed neutrons have no effect on the neutron life cycle process.

d. Delayed neutrons decrease the time required for the neutron life cycle.

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 3 PG 1-11 TO 1-13

QUESTION A.07 [1.0]

The Aerotest reactor has been shutdown for modifications for an extended period of 2 months. The operators are preparing for a reactor startup.

Which of the following statements describe why SOURCE NEUTRONS are particularly important for this operation?

a. To ensure that reactor power can be accurately monitored on the Channel 4.

b. To ensure that the reactor will go critical above the point of adding heat.

c. To ensure that the reactor will go critical when indication is indicated on Channel 3.

d. To ensure that nuclear power can be accurately monitored in the range of Channel 1.

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 PG VIII-1 TO VIII-2; VOL 4 PG 1-17

QUESTION A.08 [1.0]

Which one of the following statements defines the term "CORE EXCESS"?

a. The maximum reactivity insertion that will allow the reactor to increase power with prompt neutrons only.

b. Extra fuel that is loaded in the core to minimize the need for control rod insertion at high power levels.

c. The maximum possible reactivity that can be inserted by the rods when the reactor is at an exactly critical condition.

d. Extra fuel that is loaded into the core to extend the reactor's functional lifetime.

ANSWER

c.

REFERENCE

ARRR Reference Material VOL TS 5.1.2

This question was dropped.
The facility does not utilize the term core excess. The reference does refer to excess reactivity, but does not clearly define it as core excess.

QUESTION A.09 [1.0]

What design feature of the Aerotest reactor causes the reactor to be much more nearly LINEAR than EXPONENTIAL in it's response to reactivity changes?

a. The short delay time for transferring heat to the cooling water and the large prompt negative temperature coefficient.

b. The short delay time for transferring heat to the cooling water and the large prompt positive temperature coefficient.

c. The long delay time for transferring heat to the cooling water and the large prompt negative temperature coefficient.

d. The long delay time for transferring heat to the cooling water and the large prompt positive temperature coefficient.

ANSWER

c.

REFERENCE

ARRA Reference Material VOL 4 PG 1-24

QUESTION A.10 [1.0]

Which of the following statements describes how NEUTRON FLUX is affected by the addition of a reflector around a reactor core?

a. With a reflector in place thermal flux is higher at the edge of the core.

b. With a reflector in place thermal flux is lower at the edge of the core.

c. With a reflector in place fast flux is very high at the edge of the core.

d. With a reflector in place fast flux is lower at the edge of the core.

ANSWER

a!

REFERENCE

ARRR Reference Material VOL 4 PG 1-8

QUESTION A.11 [1.0]

In a TRIGA fueled reactor, Keff is affected by a change in water temperature. This is often called the "BATH" coefficient of reactivity.

How will Keff be affected by an INCREASE in temperature in an OVER-MODERATED reactor such as the Aerotest reactor?

a. Keff will increase due to an increase in average energy loss per collision.

b. Keff will decrease due to an increase in average energy loss per collision.

c. Keff will increase due to a decrease in moderator density.

d. Keff will decrease due to a decrease in moderator density.

ANSWER

c.d.

REFERENCE

ARRR Reference Material VOL 4 PG 1-24

QUESTION A.12 [1.0]

Which of the following factors represents the change factor, in reactor power, that would occur over any REACTOR PERIOD?

a. 1.333

b. 1.518

c. 2.333

d. 2.718

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 4 PG 1-14

QUESTION A.13 [1.0]

How long after shutdown from high power (250 kW) will it take for the maximum XENON POISON effect to occur?

a. Immediately.

b. 1 to 3 hours.

c. 5 to 7 hours.

d. 24 to 48 hours.

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 4 PG 1-26

QUESTION A.14 [1.0]

The Aerotest (ARRR) reactor is at a power of 1 watt and is at a PERIOD of 30 seconds, how long will it take for POWER to reach 1000 watts?

a. 90 seconds

b. 207 seconds

c. 309 seconds

d. 414 seconds

ANSWER

b.

$p/po = \exp[t/T]$

$1000 = \exp[t/30]$

$\ln 1000 = t/30$

$t = 6.9078 \times 30 = 207.23$

REFERENCE

ARRR Reference Material VOL 4 PG 1-14 TO 1-17

QUESTION A.15 [1.0]

A SCRAM has just occurred on the Aerotest reactor. A stable reactor period of 80 seconds can be observed on the Nuclear Instrumentation. Which statement of the following describes the reason for this period?

a. The period results from the mean half life of the delayed neutron precursors being 80 seconds.

b. The period results from the neutron precursor Bromine-87 and it's 56 second half life.

c. The stability of the period is in direct linear relationship with the power of the reactor prior to the SCRAM.

d. The period is the result of the decay of the largest delayed neutron precursor Iodine-139 (which produces 39% of the delayed neutrons.

ANSWER

b. and a.

REFERENCE

ARRR Reference Material VOL 4 PG 1-13 TO 1-17

QUESTION A.16 [1.0]

Which of the following effects contributes the most to the large prompt temperature coefficient of TRIGA fueled reactors?

a. Cell and inhomogeneities.

b. Doppler coefficient.

c. Core leakage.

d. Bath coefficient.

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 4 PG 1-22 to 1-24

End of Category A
Go To Next Category

CATEGORY B

Normal and Emergency
Operating Procedures and
Radiological Controls

QUESTION B.01 [1.0]

A point source of GAMMA radiation measures 50 roentgen per hour [R/hr] at a distance of ONE metre.

Assuming 100% efficiency by a detector:

What is the EXPOSURE RATE [R/hr] from the GAMMA source at a distance of 8 metre.

a. 48

b. 7.8

c. 4.8

d. 0.78

ANSWER

d. D2 = [50] x [1/8]^2 = 50/64 = 0.78

REFERENCE

ARRR Reference Material VOL 5 PG 17 - 18

QUESTION B.02 [1.0]

A point source of GAMMA radiation measures 50 roentgen per hour [R/hr].

What is the QUALITY FACTOR necessary to convert this value from R/hr to rem/hr?

a. 1

b. 2.3

c. 10

d. 20

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 5 PG 4

QUESTION B.03 [1.0]

What is the 10 CFR 20 QUARTERLY standard for, "Whole body; head and trunk; active blood forming organs; lens of the eyes; or gonads?"

a. 1.25 rem

b. 7.5 rem

c. 18.75 rem

d. 5[N-18], where N = age

ANSWER

a.

REFERENCE

10CFR20

QUESTION B.04 [1.0]

You are the operator at the console during a startup of the Aerotest reactor. You are informed by a worker in proximity to the reactor that the water level appears to be dropping several inches a minute.

Which of the following describes the first action that you must take IMMEDIATELY?

a. Allow the pool water level automatic SCRAM to occur then notify the Reactor Supervisor.

b. Manually SCRAM the reactor then inform the Reactor Supervisor.

c. Notify the Reactor Supervisor and cease normal activities.

d. Depress horn acknowledge button and inform the Reactor Supervisor.

ANSWER

~~a.~~ b.

REFERENCE

ARRR Reference Material VOL 1 SECTION III PG 1

QUESTION B.05 [1.0]

What is the ARRR Technical Specification requirement for MINIMUM AND MAXIMUM reactor pool temperature?

a. 50 degrees F minimum and 125 degrees F maximum.

b. 60 degrees F minimum and 125 degrees F maximum.

c. 50 degrees F minimum and 130 degrees F maximum.

d. 60 degrees F minimum and 130 degrees F maximum.

ANSWER

d.

REFERENCE

ARRR T.S. 4.1

QUESTION B.06 [1.0]

What is the MAXIMUM REACTIVITY WORTH of any individual in-core experiment not rigidly fixed per the ARRR Technical Specifications?

a. $2.00

b. $1.00

c. 2.0 delta-K/K

d. 1.0 delta-K/K

ANSWER

b.

REFERENCE

ARRR T.S. 9.4

QUESTION B.07 [1.0]

A core alteration has just been performed on the Aerotest reactor. A reactor power calibration using the REACTIVITY LOSS TO POWER MEASUREMENT is required to be performed because of the alteration. Which statement of the following describes the reason for the REQUIREMENT to conduct this reactor power calibration?

a. The reactor may produce significantly more power from the new configuration.

b. The nuclear instrumentation could be affected by the new positioning of fuel or graphite elements.

c. It is a requirement of the license and Technical Specifications.

d. The alteration may significantly disturb the convective flow characteristics of the core.

ANSWER

b.

REFERENCE

ARRR Reference Material VOL 1 SECTION IV PG 2

QUESTION B.08 [1.0]

The ARRR Technical Specifications require that a licensed operator be present at the controls during reactor operation. What are the other MANNING REQUIREMENTS of the Technical Specifications during operation of the reactor?

a. A senior reactor operator must be on call and at least two persons shall be present in the reactor building.

b. A senior reactor operator must be present and at least two persons shall be present in the reactor building.

c. At least two persons must be present in the reactor building and at least one of the persons must be a licensed operator.

d. At least two persons must be present in the reactor building and at one of the persons must be the Radiation Safety Officer.

ANSWER

c.

REFERENCE

ARRR T.S. Vol.1

QUESTION B.09 [1.0]

Which of the following describes the REQUIRED RESPONSE to a bomb threat?

a. Inspect facility for illegal entry, make decision for possible evacuation, assist Local Law Enforcement Agency (LLEA) in search of facility.

b. Phone the LLEA, inspect facility for illegal entry, make decision for possible evacuation, make two person search of facility.

c. Phone the LLEA, inspect facility for illegal entry, make decision for possible evacuation, assist LLEA in search of facility.

d. Phone the LLEA, inspect facility for illegal entry, evacuate the facility, make two person search of facility.

ANSWER

~~b.~~ c.

REFERENCE

ARRR Reference Material VOL 1 SECTION V PG 3

QUESTION B.10 [1.0]

Which of the following describes the requirements of the Radiological Safety Procedures for posting of a RADIATION AREA?

a. > 2 mrem / hr or when conditions are such that a person might have an exposure of 100 mrem / 5 days.

b. > 5 mrem / hr or when conditions are such that a person might have an exposure of 100 mrem / 5 days.

c. > 100 mrem / hr or when conditions are such that a person might have an exposure of 100 mrem / 5 days.

d. > 100 mrem / hr and when conditions are such that a person might have an exposure of 1,000 mrem / 5 days.

ANSWER

b.

REFERENCE

ARRR Reference Material VOL 1 SECTION VI PG 8

QUESTION B.[illegible]

WHich of the [illegible]amination levels would REQUIRE THE ESTABLISHMENT of [illegible]nation zone per the ARRR Radiological Safety Procedures?

a. 150 d/m/100 cm^2 smearable Beta

b. 40 d/m/100 cm^2 smearable Alpha

c. 0.03 mrad/hr Beta direct survey

d. 200 d/m/100 cm^2 Alpha direct survey

ANSWER

b.

REFERENCE

ARRR Reference Material VOL 1 SECTION VI PG 6

QUESTION B.12 [1.0]

Which one of the following activities is the ONE REQUIRED to be performed as the SEMI-ANNUAL SURVEILLANCE?

a. Heat exchanger reactor power calibration.

b. Control rod drop time testing.

c. Low flow alarm (Pool Water) calibration.

d. Control rod reactivity worth calibration.

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 1 SECTION VIII PG 4, FIGURE II

QUESTION B.13 [1.0]

Which of the following outside organizations can provide assistance to the ARRR facility for a RADIATION INCIDENT?

a. California Highway Patrol.

b. San Ramon Police Department.

c. San Ramon Fire Department.

d. Contra Costa Health Department.

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 1 SECTION III PG 4

QUESTION B.14 [1.0]

Which of the following types of radiation will cause the most damage INTERNALLY to body tissue?

a. Alpha

b. Beta

c. Gamma

d. Neutron

ANSWER

a. (Current ICRP)

REFERENCE

ARRR Reference Material VOL 5 PG 4

QUESTION B.15 [1.0]

An experiment involving an insoluble gaseous form of Iodine-135 has ruptured in the Glory Hole irradiation facility of the Aerotest reactor. A sample indicates a concentration of 3.0E-6 microcuries per milliliter was present in the locality of the reactor bridge while two persons [radiation workers] were engaged in work activity. The personnel were in the location for 20 minutes. [An applicable portion of Appendix B 10CFR20 is provided.]

What are the MPC HOURs for EACH of the two individuals who were exposed to the airborne contamination?

a. 0.40 MPC HOURs

b. 2.50 MPC HOURs

c. 2.67 MPC HOURs

d. 22.5 MPC HOURs

ANSWER

b.

From Table 1 Column 1 the MPC for insoluble Iodine 135 is 4.0E-7 mCi/ml.

MPC HOURs = [Concentration of nuclide]/[MPC] x [Time exposed in hours.]

MPC HOURs = [3.0E-6/4.0E-7] x 20/60 = 2.5 MPC HOURs

REFERENCE

10CFR20 APPENDIX B

APPENDIX B—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

[See footnotes at end of Appendix B]

Element (atomic number)	Isotope		Table I		Table II	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
	Au 198	S	3×10^{-7}	2×10^{-6}	1×10^{-6}	8×10^{-6}
	Au 199	S	2×10^{-7}	1×10^{-6}	8×10^{-7}	5×10^{-6}
Hafnium (72)	Hf 181	S	1×10^{-6}	5×10^{-6}	4×10^{-6}	2×10^{-5}
Holmium (67)	Ho 166	S	8×10^{-7}	4×10^{-6}	3×10^{-6}	2×10^{-5}
Hydrogen (1)	H3	W	4×10^{-6}	2×10^{-5}	1×10^{-5}	7×10^{-5}
		Sub	7×10^{-7}	2×10^{-5}	3×10^{-7}	7×10^{-5}
Indium (49)	In 113m	S	2×10^{-7}	9×10^{-6}	7×10^{-7}	3×10^{-5}
	In 114m	S	2×10^{-7}	9×10^{-6}	6×10^{-7}	3×10^{-5}
	In 115m	S	5×10^{-6}	1×10^{-5}	2×10^{-7}	3×10^{-5}
	In 115	S	5×10^{-6}	1×10^{-5}	2×10^{-7}	3×10^{-5}
Iodine (53)	I 125	S	2×10^{-9}		4×10^{-9}	
	I 126	S	6×10^{-8}	4×10^{-7}	3×10^{-7}	1×10^{-6}
	I 129	S	7×10^{-8}	4×10^{-7}	2×10^{-7}	1×10^{-6}
	I 131	S	1×10^{-7}	5×10^{-7}	4×10^{-7}	2×10^{-6}
	I 132	S	2×10^{-6}	5×10^{-6}	7×10^{-7}	2×10^{-6}
	I 133	S	2×10^{-6}	1×10^{-5}	8×10^{-8}	4×10^{-6}
	I 134	S	2×10^{-6}	1×10^{-5}	6×10^{-8}	4×10^{-6}
	I 135	S	2×10^{-7}	1×10^{-6}	9×10^{-8}	4×10^{-6}
Iridium (77)	Ir 190	S	3×10^{-7}	2×10^{-6}	1×10^{-6}	9×10^{-6}
	Ir 192	S	2×10^{-7}	6×10^{-7}	1×10^{-7}	3×10^{-6}
	Ir 194	S	7×10^{-8}	6×10^{-7}	2×10^{-8}	1×10^{-6}
Iron (26)	Fe 55	S	9×10^{-7}	6×10^{-6}	1×10^{-6}	8×10^{-6}
	Fe 59	S	3×10^{-7}	2×10^{-6}	1×10^{-7}	6×10^{-6}
Krypton (36)	Kr 85m	Sub	2×10^{-7}	5×10^{-6}	3×10^{-7}	2×10^{-6}
	Kr 85	Sub	5×10^{-6}	2×10^{-5}	1×10^{-6}	6×10^{-6}
	Kr 87	Sub	1×10^{-6}	5×10^{-6}	2×10^{-7}	2×10^{-6}
	Kr 88	Sub	2×10^{-7}	9×10^{-7}	1×10^{-7}	4×10^{-6}
Lanthanum (57)	La 140	S	1×10^{-7}	6×10^{-7}	4×10^{-8}	2×10^{-6}
Lead (82)	Pb 203	S	4×10^{-7}	1×10^{-6}	1×10^{-7}	4×10^{-6}
	Pb 210	S	1×10^{-8}	1×10^{-7}	4×10^{-9}	2×10^{-7}
	Pb 212	S	2×10^{-7}	1×10^{-6}	1×10^{-7}	4×10^{-6}
Lutetium (71)	Lu 177	S	2×10^{-6}	1×10^{-5}	6×10^{-7}	3×10^{-5}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-6}	6×10^{-8}	3×10^{-6}
	Mn 54	S	6×10^{-7}	3×10^{-6}	2×10^{-7}	1×10^{-5}
	Mn 56	S	2×10^{-6}	1×10^{-5}	7×10^{-7}	3×10^{-5}

QUESTION B.16 [1.0]

Which of the following is the Technical Specification REQUIRED MARGIN the reactor must be SUBCRITICAL if the maximum worth rod is fully withdrawn from the core?

a. 30 cents

b. 50 cents

c. $1.00

d. $3.00

ANSWER

b.

REFERENCE

ARRR T.S. 5.3

QUESTION B.17 [1.0]

What is the MAXIMUM amount of explosive material that may be placed in the RADIATION FIELD of the radiography facilities?

a. 0.5 pound equivalent TNT

b. 1.0 pound equivalent TNT

c. 5.0 pounds equivalent TNT

d. 1000 grains equivalent TNT

ANSWER

b.

REFERENCE

ARRR T.S. 9.11.4.1

End of Category B
Go To Next Category

CATEGORY C

Plant and Radiation
Monitoring Systems

QUESTION C.01 [1.0]

Which one of the following represents the PRINCIPAL REFLECTOR used in the Aerotest reactor?

a. water

b. zirconium

c. aluminum

d. graphite

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION III PG 4

QUESTION C.02 [1.0]

The Aerotest reactor contains three control rods which contain a sintered neutron absorber material to control core reactivity. What material is used as the NEUTRON ABSORBER?

a. aluminum oxide

b. graphite powder

c. boron carbide

d. zirconium hydride

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 2 SECTION III PG 4

QUESTION C.03 [1.0]

Which one of the following materials is used for the CLADDING of the control rods of the Aerotest reactor?

a. galvanized steel

b. stainless steel

c. perforated aluminum

d. aluminum

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 PG III - 15

QUESTION C.04 [1.0]

Where is the WATER RADIOACTIVITY MONITOR of the demineralizer loop located?

a. In the reactor pool.

b. On the wall cabinet east of the reactor shield.

c. In the demineralizer building on the discharge of the demineralizer pump.

d. In the ~~demineralizer~~ Heat Exchanger building on the suction of the demineralizer pump.

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 FIGURE V-3

QUESTION C.05 [1.0]

What component is electro-magnetically coupled to the ELECTROMAGNET when a standard control rod is being raised out of the core?

a. pull rod

b. piston

c. armature

d. draw tube

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 2 PG III-20

QUESTION C.06 [1.0]

The Technical Specifications state limitations on the amount of SPECIAL NUCLEAR MATERIAL (SNM) that may be contained in an experiment. Which one of the following statements describes the limitations required for SNM?

a. 5 grams of a solid material, or 3 grams of a liquid solution.

b. 3 grams of a solid material, or 5 grams of a liquid solution.

c. 5 grams of either a solid or liquid solution.

d. 3 grams of either a solid or liquid solution.

ANSWER

a.

REFERENCE

ARRR T.S. 9.10

QUESTION C.07 [1.0]

Based on the Technical Specifications, what is the REACTIVITY LIMIT (Keff) for the storage in the reactor pool fuel storage racks?

a. Keff must be less than 0.95 for all conditions of moderation.

b. Keff must be less than 0.90 for all conditions of moderation.

c. Keff must be less than 0.85 for all conditions of moderation.

d. Keff must be less than 0.80 for all conditions of moderation.

ANSWER

d.

REFERENCE

ARRR T.S. 11.2

QUESTION C.08 [1.0]

Figure IV-1 shows a sectional drawing of the pneumatic fuel element handling tool. Which of the indicated components provides the mechanism for LOCKING onto the fuel element?

a. Item A.

b. Item B.

c. Item C.

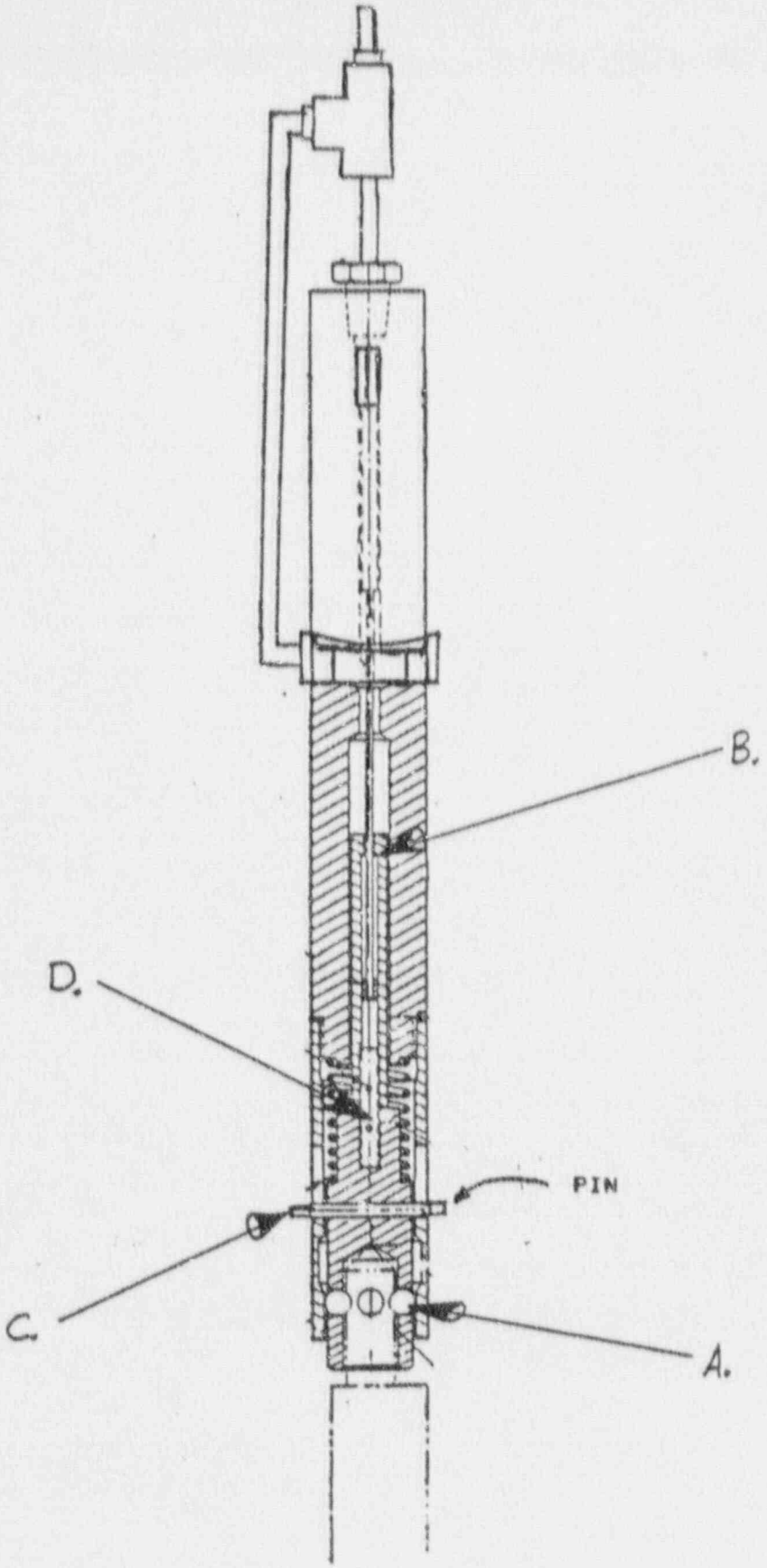
d. Item D.

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 2 SECTION IV PG 1, FIGURE IV-1



--Cross Section of Fuel Element Handling Tool

Figure IV-1

QUESTION C.09 [1.0]

Which of the following describes the NEUTRON SOURCE utilized in the Aerotest reactor?

a. Intrinsic (Natural)

b. Plutonium - Beryllium

c. Antimony - Beryllium

d. Americium - Beryllium

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION III PG 11

QUESTION C.10 [1.0]

Which of the following is an APPROVED EXPERIMENTAL FACILITY for the Aerotest reactor but is not currently installed?

a. Large-Component Irradiation Box

b. Glory Hole Facility

c. Thermal Column

d. Vertical Tube (six inch diameter)

ANSWER

a.

REFERENCE

ARRR Reference Material VOL 2 SECTION III PG 9

QUESTION C.11 [1.0]

Which of the following describes the PRINCIPAL design feature of the demineralizer system that minimizes CLOGGING of the mixed bed demineralizer?

a. The rotary vane flow switch will stop the pump if flow in the system drops below 4 gpm.

b. The temperature switch will switch off the pump if the temperature of the pool water rises to the point that damage will occur to the resin, causing clogging.

c. The skimmer prevents 100 micron or larger particles from entering the demineralizer system.

d. The string filter prevents the passage of small particles into the mixed bed demineralizer.

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION V PG 7

QUESTION C.12 [1.0]

Channel 1 of the Aerotest reactor nuclear instrumentation is a proportional counter utilizing a detector lined with a Boron 10 coating. Which of the following describes how Channel 1 DISCRIMINATES between Gamma and Neutron radiation?

a. The Boron 10 coating permits only a reaction from the Neutron radiation to occur in the detector chamber.

b. A reverse voltage is applied to the detector to cancel out the effect of the Gamma radiation on the signal.

c. The detector is connected to a pulse height analyzer that only allows the higher current pulse of the neutrons to pass.

d. A logarithmic count rate amplifier is connected to the output from the detector to separate the constant count rate of the Gamma radiation from the variable Neutron count rate.

ANSWER

c.

REFERENCE

ARRR Reference Material VOL 2 SECTION VIII PG 1

QUESTION C.13 [1.0]

Figure IX-2 shows a simplified circuit representation of the motor control circuit for the control rod drive motors. What function is provided by the ONE MILLIFARAD CAPACITOR in the circuit?

a. The capacitor provides a current limiting function to prevent contact arcing when the switch contacts are opened.

b. The capacitor provides a shift in current phase which allows the motor to rotate when current is removed from one of the windings by depressing (opening) a switch.

c. The capacitor provides a shift in current phase to promote dynamic braking when the rod is moved up or down.

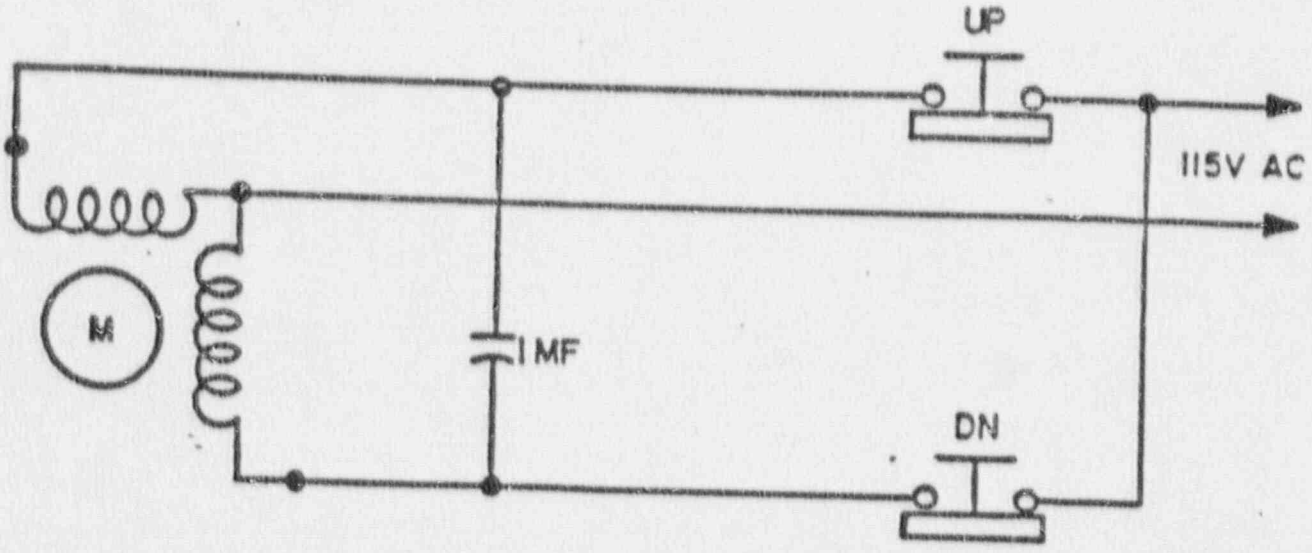
d. The capacitor provides impedance matching between the power supply and the motor for efficient operation (lower current need).

ANSWER

b.

REFERENCE

ARRR Reference Material VOL 2 SECTION IX PG 3



Simplified Motor-Control Circuit

Figure IX-2

QUESTION C.14 [1.0]

Which of the following ventilation equipment will be de-energized by the EMERGENCY SHUT-OFF switch?

a. Control Room air conditioner.

b. Quality Control Complex air conditioner.

c. Film Processing Chemical Room vent.

d. N-Ray Set-up Room air conditioner.

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION 2 PG 4

QUESTION C.15 [1.0]

Which of the following describes the feature that prevents a LOSS OF PRIME for the primary cooling loop pump?

a. The intake for the primary cooling system is located one foot below the water surface.

b. The intake for the primary cooling system is located 16 feet below the water surface.

c. There is a foot valve located at the discharge end of the primary cooling system.

d. There is a foot valve located at the suction end of the primary cooling system.

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION V PG 3

QUESTION C.16 [3.0]

Which of the following design features of the control rod drive mechanism and assembly DECELERATES the control rod near the end of it's travel after a SCRAM?

a. The piston connected to the connecting rod passes a section of the barrel of the rod drive mechanism that provides a "dashpot" action.

b. The armature of the connecting rod contacts the foot of the pull rod compressing the spring holding the contact of the down limit switch open.

c. The motor of the rod drive provides dynamic braking just before the rod reaches the bottom of it's drop.

d. Friction provided by the control rod guide tube restricts the rate at which rod will fall and increases as the rod reaches the bottom of it's drop.

ANSWER

a.

REFERENCE

ARRR Reference Material VOl 2 SECTION III PG 15, 20

QUESTION C.17 [1.0]

Which of the following describes the type of DETECTOR used in the pool water radioactivity monitor?

a. Gas Proportional

b. Geiger-Mueller

c. Boron Triflouride

d. Gamma Scintillation

ANSWER

d.

REFERENCE

ARRR Reference Material VOL 2 SECTION VIII PG 4

End of Category C
End of Examination