UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 16, 2026

Mr. Jere Jenkins, Director
Nuclear Science Center
Texas A&M Engineering
Experiment Station
1095 Nuclear Science Road, MS 3575
College Station, TX 77843-3575

SUBJECT: EXAMINATION REPORT NO. 50-128/OL-26-02, TEXAS A&M ENGINEERING EXPERIMENT STATION

Dear Mr. Jenkins:

During the week of March 30, 2026, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Texas A&M Engineering Experiment Station. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the *Code of Federal Regulations,* Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Amy Beasten at (301) 415-8341, or via email at Amy.Beasten@nrc.gov.

Sincerely,

Signed by Brown, Tony
on 04/16/26

Tony Brown, Chief
Non-Power Production and Utilization Facility
Oversight Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Examination Report No. 50-128/OL-26-02
2. Written examination

cc: w/ enclosures to GovDelivery Subscribers

SUBJECT: EXAMINATION REPORT NO. 50-128/OL-26-02, TEXAS A&M ENGINEERING EXPERIMENT STATION DATED: APRIL 16, 2026

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

REPORT NO.: OL-26-02

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: Texas A&M Engineering Experiment Station

EXAMINATION DATE(S): Week of March 30, 2026

SUBMITTED BY: April 2, 2026
Amy E. Beasten, PhD, Chief Examiner — Date

SUMMARY:
During the week of March 30, 2026, the NRC administered operator licensing examinations to three Reactor Operator (RO) candidates and one Senior Reactor Operator – Upgrade (SRO-U) candidate. All candidates passed all applicable portions of the examinations and tests.

REPORT DETAILS

1. Examiner: Amy E. Beasten, PhD, Chief Examiner, NRC

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	3/0	0/0	3/0
Operating Tests	3/0	1/0	4/0
Overall	3/0	1/0	4/0

3. Exit Meeting:
Amy E. Beasten, PhD, Chief Examiner, NRC
Jere Jenkins, Director, NESC
Cable Kurwitz, Associate Director of Operations, NESC

Prior to administration, adjustments to the written exam were accepted based on facility comments. These comments provided corrections and additional clarity to questions/answers and identified where changes were appropriate based on current facility conditions.

Upon completion of all operator licensing examinations, the NRC examiner met with facility staff representatives to discuss the results. At the conclusion of the meeting, the NRC examiner thanked the facility for their support in the administration of the examination.

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Texas A&M Engineering Experiment Station

Operator Licensing Examination

Week of March 30, 2026

Enclosure 2

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

FACILITY: Texas A&M University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 04/02/2026

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the Answer sheet provided. Attach all Answer sheets to the examination. Point values are indicated in parentheses for each question. A 70% in each category and a 70% overall are 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	33.0	_____	_____	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
20.00	33.0	_____	_____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.0	_____	_____	C. FACILITY AND RADIATION MONITORING SYSTEMS
60.00		_____	_____%	TOTALS
		FINAL GRADE		

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

_____
Candidate's Signature

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 neither received nor 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 and each Answer sheet.

6. Mark your Answers on the Answer sheet provided. Answers written on the line will be taken as the final answer. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

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

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

10. 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.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category and a 70 percent overall.

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

Candidate Name:_____

Category A: Reactor Theory, Thermodynamics, & Facility Operating Characteristics

A N S W E R S H E E T

Multiple Choice (Circle your choice, or write on the line)
If you change your answer, write your selection in the line. Answers written on the line will be taken as the final answer.

A01 a b c d ___

A02 a b c d ___

A03 a b c d ___

A04 a b c d ___

A05 a b c d ___

A06 a b c d ___

A07 a b c d ___

A08 a b c d ___

A09 a b c d ___

A10 a b c d ___

A11 a b c d ___

A12 a b c d ___

A13 a b c d ___

A14 a b c d ___

A15 a b c d ___

A16 a b c d ___

A17 a b c d ___

A18 a b c d ___

A19 a b c d ___

A20 a b c d ___

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

Candidate Name:_____

Category B: Normal/Emergency Operating Procedures and Radiological Controls

A N S W E R S H E E T

Multiple Choice (Circle your choice, or write on the line)
If you change your answer, write your selection in the blank. Answers written on the line will be taken as the final answer.

B01 a b c d ___

B02 a b c d ___

B03 a b c d ___

B04 a b c d ___

B05 a b c d ___

B06 a b c d ___

B07 a b c d ___

B08 a b c d ___

B09 a b c d ___

B10 a b c d ___

B11 a _____ b _____ c _____ d _____ (0.25 each)

B12 a b c d ___

B13 a b c d ___

B14 a b c d ___

B15 a b c d ___

B16 a b c d ___

B17 a b c d ___

B18 a b c d ___

B19 a b c d ___

B20 a b c d ___

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

Candidate Name:_____

Category C: Facility and Radiation Monitoring Systems

A N S W E R S H E E T

Multiple Choice (Circle your choice, or write on the line)
If you change your answer, write your selection in the blank. Answers written on the line will be taken as the final answer.

C01 a b c d ___

C02 a b c d ___

C03 a b c d ___

C04 a b c d ___

C05 a b c d ___

C06 a b c d ___

C07 a b c d ___

C08 a b c d ___

C09 a b c d ___

C10 a b c d ___

C11 a b c d ___

C12 a b c d ___

C13 a _____ b _____ c _____ d _____ (0.25 each)

C14 a b c d ___

C15 a b c d ___

C16 a b c d ___

C17 a b c d ___

C18 a b c d ___

C19 a b c d ___

C20 a b c d ___

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

EQUATION SHEET

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

$$P_{\max} = \frac{(\beta - \rho)^2}{(2\alpha \ell)}$$

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

$$P = P_0 \, e^{t/T}$$

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

$$\ell^* = 1 \times 10^{-4} \sec$$

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

$$CR_1 (-\rho_1) = CR_2 (-\rho_2)$$

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

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

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

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

$$M = \frac{1 - K_{eff_1}}{1 - K_{eff\,2}}$$

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

$$T = \frac{\ell^*}{\rho - \overline{\beta}}$$

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

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

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{K_{eff_1} K_{eff_2}}$$

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

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

$$DR_1 \, d_1^{\,2} = DR_2 d_2^{\,2}$$

$$DR = \frac{6 Ci \, E(n)}{R^2}$$

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

DR – Rem, Ci – curies, E – Mev, R – feet

1 Curie = 3.7 x 10^{10} dis/sec

1 Horsepower = 2.54 x 10^3 BTU/hr

1 BTU = 778 ft-lb

1 gal (H_2O) ≈ 8 lb

c_P = 1.0 BTU/hr/lb/°F

1 kg = 2.21 lb

1 Mw = 3.41 x 10^6 BTU/hr

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

c_p = 1 cal/sec/gm/°C

Category A: Reactor Theory, Thermodynamics, and Facility Operating Characteristics

QUESTION A.01 [1.0 point]
Which ONE of the following statements best describes beta-plus (β+) decay?

a. A neutron is converted to a proton and an electron, and the daughter nuclide has its atomic number increased by 1.

b. A proton is converted to a neutron and a positron, and the daughter nuclide has its atomic number increased by 1.

c. A neutron is converted to a proton and an electron, and the daughter nuclide has its atomic number decreased by 1.

d. A proton is converted to a neutron and a positron, and the daughter nuclide has its atomic number decreased by 1.

QUESTION A.02 [1.0 point]
Which ONE of the following statements best describes the infinite multiplication factor, k_∞?

a. The ratio of all neutrons produced by fission in one generation to the number of neutrons lost through absorption in the preceding generation.

b. The ratio of fast neutrons produced by fission in one generation to the number of neutrons lost through absorption in the preceding generation.

c. The ratio of thermal neutrons produced by fission in one generation to the number of neutrons lost through absorption in the preceding generation.

d. The ratio of all neutrons produced by fission in one generation to the number of neutrons lost through leakage in the preceding generation.

QUESTION A.03 [1.0 point]
What is the remaining percentage of power following the prompt drop in the reactor power when a rod worth of 0.95 $\Delta K/K$ is rapidly inserted into a critical reactor? Assume β_{eff} = 0.0065

a. – 0.03%

b. 1.33%

c. 6.51 %

d. 13.2%

QUESTION A.04 [1.0 point]
Which ONE of the following statements is best describes the behavior of the microscopic cross-section of fission (σ_f) for U-235?

a. It has resonance peaks which expand as fuel temperature increases.

b. The values are highest for the thermal neutron energy range.

c. It increases linearly with increasing neutron energy.

d. It remains constant for all neutron energies.

QUESTION A.05 [1.0 point]
Which ONE of the following statements best describes the macroscopic cross section, Σ?

a. The probability of a given reaction causing a nucleus to separate into nuclear particles.

b. The probability of a given reaction occurring between a neutron and a nucleus.

c. The probability of neutron nucleus interaction per centimeter of neutron travel.

d. The average distance a neutron travels between collisions

QUESTION A.06 [1.0 point]
Following a reactor scram, the period meter will stabilize at _____ because _____.

a. Slightly positive; the neutron source is providing detectable neutron count rate to keep the reactor slightly supercritical.

b. 0 seconds; the reactor is subcritical and reactor power is decreasing.

c. -80 seconds; of the decay constant for the longest-lived neutron precursor.

d. -80 seconds; the fuel temperature coefficient adds positive reactivity as a result of the decrease in fuel temperature following a scram.

QUESTION A.07 [1.0 point]
A few minutes after a reactor scram from full power, the reactor period has stabilized and the power level is decreasing at a constant rate. What is the power level two minutes later from 15kW?

a. 3.3 kW

b. 6.7 kW

c. 7.1 kW

d. 154 mW

QUESTION A.08 [1.0 point]
Which ONE of the following statements describes the difference between pair production and the photoelectric effect?

a. In pair production, the gamma interacts with the electric field of the nucleus and is converted to an electron-positron pair. In the photoelectric effect, the gamma is absorbed, and an electron is ejected from the atom.

b. In pair production, a neutron is absorbed, and a pair of gamma rays are emitted. In the photoelectric effect, the gamma loses some of its energy to an orbital electron and both the gamma and an electron are ejected.

c. Pair production occurs when the incident gamma has an energy of 0.1 MeV or greater, and the photoelectric effect occurs when then incident gamma has an energy of less than 1 MeV.

d. Pair production is characteristic of low energy gamma ray interactions, and the photoelectric effect is characteristic of high energy gamma ray interactions.

QUESTION A.09 [1.0 point]
The current count rate is 250 cps. An experimenter inserts an experiment into the core and the count rate decreases to 130 cps. If the initial Keff was 0.859, what is the worth of the experiment?

a. + 0.207

b. - 0.207

c. + 0.805

d. - 0.805

Category A: Reactor Theory, Thermodynamics, and Facility Operating Characteristics

QUESTION A.10 [1.0 point]
Which ONE of the following statements best describes the fuel temperature coefficient of reactivity?

a. Power increases cause fuel temperature to increase, which results in a negative reactivity addition, slowing or stopping the power increase.

b. Power increases cause the moderator-to-fuel ratio to increase, which results in a negative reactivity addition, slowing or stopping the power increase.

c. Power increases cause moderator temperature to increase, which immediately results in a negative reactivity addition, slowing or stopping the power increase.

d. Power increases cause fuel temperature to increase, which results in a negative reactivity addition due to the corresponding change in the thermal utilization factor, slowing or stopping the power increase.

QUESTION A.11 [1.0 point]
Which ONE of the following statements best describes the function of a reflector around the core?

a. Decrease the probability of non-leakage at the edge of the core.

b. Reduce the power output of a reactor by slowing fission neutrons to thermal energies.

c. Provide additional radiological shielding to protect personnel working near the reactor.

d. Reduce the peak flux to the flux at the edge of the core fuel area.

QUESTION A.12 [1.0 point]
Which ONE of the following changes that occur during reactor operation in an under-moderated reactor would require the operator to INSERT control rods to maintain constant power?

a. Decrease in pool water temperature.

b. Increase in pool water temperature.

c. Increase in fuel temperature.

d. U-235 burnup.

QUESTION A.13 [1.0 point]
What is the effective multiplication factor, given the source strength is 17,000 neutrons per second (N/sec) and it produces the stable neutron count rate of 65,000 N/sec?

a. 0.74

b. 0.78

c. 0.83

d. 0.89

QUESTION A.14 [1.0 point]
Which ONE of the following factors in the six-factor formula is LEAST affected by changes in the moderator?

a. Reproduction factor (η)

b. Fast fission factor (ε)

c. Resonance escape probability (ρ)

d. Thermal non-leakage probability (L_T)

QUESTION A.15 [1.0 point]
During a reactor startup, criticality occurred at a lower rod height than the previous startup. Which ONE of the following explanations could be the reason for the change?

a. An experiment with negative reactivity was added.

b. A beam port plug was removed.

c. Moderator temperature was lower.

d. Nuclear Instrumentation drift.

QUESTION A.16 [1.0 point]
The reactor is increasing power from 10 kW to 100kW in a prompt criticality. Which one of the following best describes the values of Keff and ρ during the power increment?

a. Keff > 1 and ρ > 1

b. Keff < 1 and ρ > 1

c. Keff > 1 and 0 < ρ < βeff

d. Keff > 1 and βeff < ρ < 1

QUESTION A.17 [1.0 point]
All of the following factors in the Six Factor Formula are impacted by increasing the number of fuel elements in the core EXCEPT:

a. Thermal Non-Leakage Probability (L_T)

b. Fast Non-Leakage Probability (L_F)

c. Reproduction Factor (η)

d. Fast Fission Factor (ε)

QUESTION A.18 [1.0 point]
A subcritical reactor has a k_{eff} of 0.965. How much reactivity is added to change the k_{eff} to 1.078?

a. - 0.109

b. + 0.109

c. - 1.089

d. + 1.089

QUESTION A.19 [1.0 point]
All of the following statements regarding fission product poisoning are true EXCEPT:

a. During normal reactor operation, Sm-149 is removed from the core by neutron absorption.

b. Following a reactor shutdown, the concentration of Xe-135 reaches a peak based on the decay of I-135 in the core.

c. During normal reactor operation, Xe-135 is removed from the core by radioactive decay and neutron absorption.

d. Following a reactor shutdown, the concentration of Sm-149 reaches a peak because some fission is still occurring in the core.

QUESTION A.20 [1.0 point]
Which ONE of the following factors in the six-factor formula accounts for the probability that a fast neutron will be slowed to thermal energies without being absorbed in the fuel?

a. Fast fission factor (ε)

b. Reproduction factor (η)

c. Thermal utilization factor (f)

d. Resonance escape probability (p)

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

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.01 [1.0 point]
In accordance with 10 CFR 20, which ONE of the following statements best describes the Total Effective Dose Equivalent (TEDE)?

a. The dose equivalent at a tissue depth of 1 cm, applicable to external whole body exposure.

b. The sum of the effective dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

c. The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each irradiated organ or tissue.

d. The dose equivalent to organs or tissues from an intake of radioactive material by an individual during the 50-year period following intake.

QUESTION B.02 [1.0 point]
All of the following conditions would be a violation of 10 CFR Part 55 EXCEPT:

a. Your last medical exam was 25 months ago.

b. Last quarter, you were the console operator for 3 hours.

c. Your last requalification operating test was 14 months ago.

d. Your last requalification written examination was 12 months ago.

QUESTION B.03 [1.0 point]
A radioactive source reads 275 mRem/hr on contact. Ninety (90) minutes later, the same source reads 50 mRem/hr. Approximately how much longer will it take for this source to decay to 5 mRem/hr?

a. 52 minutes

b. 122 minutes

c. 178 minutes

d. 203 minutes

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.04 [1.0 point]
In accordance with the NESC Technical Specifications, all of the following experiments would be allowed EXCEPT:

a. An experiment containing 10 mg TRIGA fuel.

b. Two unsecured experiments with a reactivity worth of $1.00 each.

c. A doubly encapsulated experiment containing a small quantity of sulfuric acid.

d. An experiment containing 5 mg gunpowder in a vessel designed to withstand a detonation pressure of 25 mg TNT

QUESTION B.05 [1.0 point]
In accordance with SOP II-B, Reactor Startup, all of the following actions may be taken by the Reactor Operator without prior approval EXCEPT:

a. Adjusting the Area Radiation Monitor setpoints.

b. Turning on the diffusor pump.

c. Placing the reactor in automatic control mode.

d. Bypassing the reactor period scram.

QUESTION B.06 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following conditions would NOT be permissible for reactor operations?

a. Reactor pool water temperature 55 °C.

b. Reactor bay differential pressure is -0.1" H_2O.

c. Stack Xenon Monitor (FAM 5) inoperable.

d. Bulk pool water conductivity is 6×10^{-5} mhos/cm averaged over two weeks.

QUESTION B.07 [1.0 point]
In accordance with the NESC Emergency Plan, which ONE of the following statements best describes the Site Boundary?

a. The area within the confinement building.

b. The area within the chain-link fence surrounding the site.

c. The area within the confinement building, the reception room, and the lab building.

d. The area beyond the fence extending to the airfield.

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.08 [1.0 point]
Which ONE of the following changes would NOT require a 10 CFR 50.59 evaluation?

a. Eliminating the transient rod and all associate components.

b. Replacing the startup source with PuBe.

c. Removing the requirement for diffusor pump operation.

d. Updating SOP-II-C, Steady State Mode Operations, to correct spelling and provide additional clarification on prerequisites.

QUESTION B.09 [1.0 point]
What is the dose rate at 1 foot, given 60% of the decay of a 4 Curie source results in emission of a 300 keV gamma?

a. 2.29 R/hr

b. 4.32 R/hr

c. 5.18 R/hr

d. 7.85 R/hr

QUESTION B.10 [1.0 point]
In accordance with SOP II-J, Power Calibration, all of the following initial conditions must be met EXCEPT:

a. Secondary system has been running for at least two hours.

b. Primary system is discharging to the pool.

c. Building air conditioning equipment is operating properly.

d. Shutdown temperature readings shall be taken every 15 minutes for at least one hour.

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.11 [1.0 point, 0.25 each]
In accordance with the NESC Technical Specifications, match the surveillance activity in Column A with the required frequency in Column B. Options in Column B may be used once, more than once, or not at all.

Column A	Column B
a. Fuel element temperature calibration	1. Weekly
b. Inspection of at least four fuel elements which occupy the highest pulse temperature positions in the core	2. Semiannually
c. Pool water level alarm channel test	3. Annually
d. Visual inspection of the control rods	4. Biennially

QUESTION B.12 [1.0 point]
In accordance with SOP-II-I, Reactor Core Manipulation, which ONE of the following individuals is NOT required to be present during fuel movement?

a. A Senior Reactor Operator

b. A Reactor Operator

c. A Health Physicist

d. A member of the Reactor Safety Board

QUESTION B.13 [1.0 point]
In accordance with SOP IX D-4, Implementing Procedure for a Pool Level Alarm, all of the following actions should be taken EXCEPT:

a. Shutdown the reactor.

b. Secure the sump pumps.

c. Observe reactor bridge area radiation monitor readings.

d. Line up the demineralizer system to begin pool fill at 100 gpm.

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.14 [1.0 point]
In accordance with the NESC Emergency Plan and SOP IX-A, Emergency Classification Guide, which ONE of the following events would be considered an ALERT?

a. Pool level alarm where leakage exceeds makeup water capacity.

b. A fire in the control room which cannot be extinguished within 15 minutes.

c. Fuel damage indicated by high coolant fission product activity.

d. Alarm on Fission Gas Monitor (Channel 2).

QUESTION B.15 [1.0 point]
An irradiated sample has a dose rate of 2.0 rem/hr as indicated at a distance of 2 feet from the sample. How far from the irradiated sample will the dose rate read 50 mrem/hr?

a. 40 ft

b. 12.6 ft

c. 8.9 ft

d. 4.0 ft

QUESTION B.16 [1.0 point]
In accordance with SOP IX-C-4, Implementing Procedure for a Facility Air Monitor Alarm, all of the following actions should be taken for an alarm on the Facility Air Monitor (Channel 4) EXCEPT:

a. Attempt to secure the source of the contamination, if known and practical to do so.

b. Secure ventilation to prevent release of radioactive material to the environment.

c. Operate the ventilation controls from the Emergency Support Center to circulate and filter air in the confinement building.

d. Evacuate the confinement building.

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B. 17 [1.0 point]
In accordance with SOP-II-C, which ONE of the following conditions could cause automatic mode to disengage?

a. Pressing the regulating rod UP or DOWN pushbuttons.

b. Pressing the transient rod UP or DOWN pushbuttons.

c. Adjusting the Servo Controller to maintain constant power.

d. Pressing the Gang UP or DOWN pushbuttons.

QUESTION B.18 [1.0 point]
In accordance with the NESC Emergency Plan, the Emergency Director has all of the following responsibilities EXCEPT:

a. Minimizing releases of radioactive material.

b. Assessing the severity of the emergency.

c. Determine offsite dose projections.

d. Placing the facility in a safe shutdown condition.

QUESTION B.19 [1.0 point]
A seven-curie source emits an 5 MeV gamma 90% of the time. The source will be placed in the reactor storage room. How far from the source should a high radiation area sign be posted?

a. 4.35 ft

b. 17.7 ft

c. 43.5 ft

d. 51.2 ft

Category B: Normal/Emergency Operating Procedures and Radiological Controls

QUESTION B.20 [1.0 point]
A 30-mm thick sheet of lead placed at a certain location in a beam of gamma rays reduces the gamma radiation level from 400 mR/hr to 150 mR/hr. Approximately how much ADDITIONAL lead would be needed to reduce the gamma radiation level to 25 mR/hr?

a. 18 mm

b. 29 mm

c. 52 mm

d. 61 mm

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

Category C: Facility and Radiation Monitoring Systems

QUESTION C.01 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following statements best describes the reactor fuel?

a. UZrH containing 30 wt% uranium enriched to <20% in U-235, clad in stainless steel.

b. UZrH containing 30 wt% uranium enriched to <20% in U-235, clad in aluminum.

c. UZrH containing 20 wt% uranium enriched to <30% in U-235, clad in stainless steel.

d. UZrH containing 20 wt% uranium enriched to <30% in U-235, clad in aluminum.

QUESTION C.02 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following combinations best describes the Facility Air Monitor (FAM) Channels required for operation?

a. Stack Particulate (FAM 1), Stack Gas (FAM 3), Building Particulate (FAM 4), Building Gas (FAM 6)

b. Fission Product (FAM 2), Stack Gas (FAM 3), Building Particulate (FAM 4), Stack Xenon (FAM 5)

c. Stack Particulate (FAM 1), Stack Gas (FAM 3), Building Particulate (FAM 4), Stack Xenon (FAM 5)

d. Fission Product (FAM 2), Stack Gas (FAM 3), Stack Xenon (FAM 5), Stack Gas (FAM 6)

QUESTION C.03 [1.0 point]
In accordance with the NESC Safety Analysis Report, the Pulse Channel provides all of the following indications in pulse mode EXCEPT:

a. Percent power

b. Peak power

c. Energy second

d. Peak fuel temperature

Category C: Facility and Radiation Monitoring Systems

QUESTION C.04 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following statements best describes the purpose of the primary bulk water temperature limit?

a. Limiting temperature ensures adequate protection and safety of all reactor experiments.

b. Limiting temperature protects the demineralizer resin.

c. Limiting temperature prevents the limiting safety system setting from being reached.

d. Limiting temperature prevents boiling, formation of voids, and damage to core components.

QUESTION C.05 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following statements best describes the limit switches on the regulating rod?

a. Rod Down, Rod Jammed

b. Rod Up, Rod Jammed, Magnet Engaged

c. Rod Down, Magnet Engaged

d. Rod Up, Rod Down

QUESTION C.06 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following conditions will cause the ventilation system to shut down EXCEPT:

a. High alarm on any Facility Air Monitor.

b. High temperature sensor above the emergency filter bank exceeds the set point.

c. The exhaust fan shuts down.

d. High alarm on the Radiation Area Monitor.

Category C: Facility and Radiation Monitoring Systems

QUESTION C.07 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following statements best describes the purpose of the Shim Safety and Regulating Rod Position interlock?

a. This prevents the application of air to the transient rod unless the cylinder is fully inserted to prevent pulsing in steady state mode

b. This prevents the withdrawal of the shim safeties or regulating rod in pulse mode to prevent pulsing of the reactor on a positive period.

c. This prevents movement of the transient rod to prevent pulsing at powers above 1 kW to ensure the magnitude of the pulse will not cause the fuel element temperature to be exceeded

d. This prevents startup of the reactor at power levels less than 4 mW to ensure sufficient neutrons available for proper indication.

QUESTION C.08 [1.0 point]
In accordance with the NESC Safety Analysis Report, the primary cooling system is primarily made of _____ in order to _____.

a. aluminum; minimize activation of primary cooling system.

b. aluminum; minimize corrosion.

c. stainless steel; preserve pool water purity.

d. stainless steel; minimize corrosion.

QUESTION C.09 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following statements best describes how the fission chamber produces a signal in the low power ranges?

a. Neutrons at this power are too low energy to enter the chamber, so individual gamma interactions are counted and converted to a signal.

b. The detector has two chambers, one which is sensitive to gammas and neutrons, and the other, which is sensitive to only gammas, allows the gamma signal to be subtracted.

c. A current signal, similar to an ion chamber, is used since there is no need to discriminate between neutrons and gammas at such a low power.

d. Neutrons are distinguished from gammas using a pulse heigh discriminator, which converts pulses to a logarithmic power indication.

Category C: Facility and Radiation Monitoring Systems

QUESTION C.10 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following statements best describes the purpose of the “piston action” on the control rods?

a. For scrammable rods, rod movement is slowed within 6 inches of the bottom of travel to provide time for the carriage to reconnect with the rod following a reactor scram.

b. For scrammable rods, rod movement is slowed within 6 inches of the bottom of travel to reduce bottoming impact following a reactor scram.

c. For all rods, rod motion is slowed in the middle of the full range of travel to ensure proper reactivity removal and insertion rates.

d. For the transient rod, rod movement is slowed within 6 inches of the top of travel to reduce impact to the rod and carriage when the rod reaches its upper limit during a pulse

QUESTION C.11 [1.0 point]
In accordance with the NESC Technical Specifications, the Limiting Safety System Setting is _____.

a. 2100 °C

b. 975 °C

c. 1.25 MW

d. 1 MW

QUESTION C.12 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following areas may produce Ar-41 EXCEPT:

a. Open beam port tubes

b. Primary cooling system

c. Pneumatic transfer system

d. Secondary cooling system

Category C: Facility and Radiation Monitoring Systems

QUESTION C.13 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following statements reflect the purposes of the demineralizer/recirculation system EXCEPT:

a. Maintain pool water purity.

b. Provide a filtering mechanism for makeup water.

c. Provide a path for makeup water for pool fill.

d. Provides the earliest indications of fission product release.

QUESTION C.14 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following statements regarding the regulating rod are true EXCEPT:

a. The regulating rod uses a chain-driven motor.

b. The regulating rod has a lower worth than the shim or safety rod.

c. The regulating rod is a sealed aluminum tube containing powdered boron carbide.

d. The regulating rod uses a digital encoder to determine and display control rod position.

QUESTION C.15 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following materials are used in the design and construction of the beam ports EXCEPT:

a. Stainless steel

b. Boral

c. Tungsten

d. Lead

Category C: Facility and Radiation Monitoring Systems

QUESTION C.16 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following statements best describes the pressure in the reactor bay with respect to the surrounding environment.

a. The pressure in the bay is maintained positive to ensure radiological releases during abnormal operations do not escape to the environment.

b. The pressure in the bay is maintained positive to ensure out-leakage of airborne radioactivity to ensure staff inside the bay do not exceed their occupational dose limits.

c. The pressure in the bay is maintained negative to mitigate leakage of unmonitored airborne material to the environment.

d. The pressure in the bay is maintained negative to ensure appropriate climate control for sensitive equipment and experiments.

QUESTION C.17 [1.0 point]
In accordance with the NESC Technical Specifications, which ONE of the following statements best describes what happens when the Safety Limit is exceeded?

a. Fuel element cladding could be compromised due to the formation of voids between the fuel elements as a result of inadequate core cooling.

b. Fuel element cladding integrity could be compromised due to pressure build up between the fuel moderator and cladding from the disassociation of the hydrogen and zirconium in the fuel.

c. Exceeding the safety limit would cause power oscillations due to uneven fuel burnup.

d. The fuel could melt.

QUESTION C.18 [1.0 point]
In accordance with the NESC Safety Analysis Report, all of the following statements describe the pulse stop EXCEPT:

a. The pulse stop is a mechanical device installed on the shim, safety, and regulating rods to ensure they do not move during a reactor pulse.

b. The pulse stop limits transient rod reactivity to $2.95.

c. If the pulse stop is not installed, air may not be applied to the transient rod if the mode selector switch is in “Pulse.”

d. The pulse stop is a mechanical device installed on the transient rod to limit the range of motion of the transient rod during a pulse.

Category C: Facility and Radiation Monitoring Systems

QUESTION C.19 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following best describes how heat is removed from the secondary system in the cooling tower?

a. Radiative cooling

b. Natural convection

c. Forced convection

d. Evaporative cooling

QUESTION C.20 [1.0 point]
In accordance with the NESC Safety Analysis Report, which ONE of the following statements best describes the flow path through the ventilation system when the system is shut down?

a. All the air handlers are secured and the associated dampers closed, the exhaust fan stops, and the exhaust inlet and outlet dampers close.

b. All the air handlers are secured but the dampers remain open, air is diverted through the emergency filter bank, and the exhaust inlet damper closes.

c. Air handlers A and B are secured and the associated dampers close, the exhaust fan stops, and the exhaust inlet and outlet dampers close.

d. Air handler C is secured and the associated damper closes, and air is diverted through the emergency filter bank.

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

Category A: Reactor Theory, Thermodynamics, and Facility Operating Characteristics

A.01
Answer: d.
Reference: DOE Fundamentals Handbook, Volume 1, Module 1, p. 29

A.02
Answer: a.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3, p. 2

A.03
Answer: b.
Reference: $\frac{P_1}{P_0} = \frac{\beta_{eff} \cdot (1 - p)}{\beta_{eff} - p}$
P_1/P_0 = (0.0065 x (1+0.95)) / (0.0065+0.95)
P_1/P_0 = 0.00133
P_1/P_0 = 1.33%

A.04
Answer: b.
Reference: Burn, *Introduction to Nuclear Reactor Operations*, p. 2-37

A.05
Answer: c.
Reference: Burn, *Introduction to Nuclear Reactor Operations*, p 2-43

A.06
Answer: c.
Reference: DOE Handbook Nuclear Physics & Reactor Theory, Volume 2, Module 4, p. 32

A.07
Answer: a.
Reference: $P = P_0\ e^{-t/T}$
$P = 15\ e^{(120s/-80s)}$
$P = 15kW \cdot e^{-1.5}$
$P = 3.3$ kW

A.08
Answer: a.
Reference: DOE Fundamentals Handbook, Volume 1, Module 1, p. 66

A.09
Answer: b.
Reference: $CR_1 / CR_2 = (1 - K_{eff2}) / (1 - K_{eff1})$
$250 / 130 = (1 - K_{eff2}) / (1 - 0.859)$
$1.92 = (1 - K_{eff2}) / 0.141$
$0.271 = 1 - K_{eff2}$
Therefore $K_{eff2} = 0.729$
$\Delta\rho = (K_{eff2} - K_{eff1}) / (K_{eff2} * K_{eff1})$
$\Delta\rho = (0.729 - 0.859) / (0.729 * 0.859)$
$\Delta\rho = - 0.207$

Category A: Reactor Theory, Thermodynamics, and Facility Operating Characteristics

A.10
Answer: a.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3, p. 28

A.11
Answer: a.
Reference: DOE Fundamentals Handbook, Vol. 2, Module 4, p. 25

A.12
Answer: a.
Reference: Burn, Volume 4, Section 7.7, p. 7-17

A.13
Answer: a.
Reference: CR = S/(1-K)
65000 = 17000/(1 - K)
1 -K = 17000/65000
K = 0.74

A.14
Answer: a.
Reference: DOE Fundamentals Handbook, Vol. 2, Module 3, p 2-9

A.15
Answer: c.
Reference: Standard NRC question

A.16
Answer: d.
Reference: Burn, Volume 2, Section 4.2.1, p. 4-1

A.17
Answer: c.
Reference: DOE Fundamentals Handbook, Vol. 2, Module 3, p. 3

A.18
Answer: b.
Reference: $\Delta\rho = (k_{eff2} - k_{eff1}) / (k_{eff1} * k_{eff2})$
$\Delta\rho = (1.078-0.965) / (0.965 * 1.078)$
$\Delta\rho = 0.113/1.040$
$\Delta\rho = 0.109$

A.19
Answer: d.
Reference: DOE Fundamentals Handbook, Volume 2, Module 3, p. 30-47

A.20
Answer: d.
Reference: DOE Fundamentals Handbook, Vol. 2, Module 3, p. 3

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

Category B: Normal/Emergency Operating Procedures and Radiological Controls

B.01
Answer: b.
Reference: 10 CFR 20.1003

B.02
Answer: d.
Reference: 10 CFR Part 55

B.03
Answer: b.
Reference: $DR = DR^{*}e^{-\lambda t}$
$50\ mrem/hr = 275\ mrem/hr^{*}\ e^{-\lambda(1.5hr)}$
$\ln(50/275) = -\lambda^{*}1.5hr$
$\lambda = 1.1365$

Solve for t:
$\ln(5/50) = -1.1365t$
$t = 2.026$ hours or approximately 122 mins

B.04
Answer: a. or b.
Reference: NESC Technical Specifications 3.6.1, 3.6.2, 3.6.3

B.05
Answer: d.
Reference: NESC SOP-II-B, Reactor Startup

B.06
Answer: c.
Reference: NESC Technical Specifications 3.2.2, 3.3.2, 3.5.1, 3.8.1

B.07
Answer: b.
Reference: NESC Emergency Plan, Section 2

B.08
Answer: d.
Reference: 10 CFR 50.59

B.09
Answer: b.
Reference: 6 Cen = R/hr at 1 ft
(6 * 4 Ci) x (0.60 * 0.3)
4.32 R/hr at 1 ft

B.10
Answer: a.
Reference: SOP-II-J, Power Calibration

Category B: Normal/Emergency Operating Procedures and Radiological Controls

B.11
Answer: a. 2 (Semiannual); b. 3 (Annual); c. 1 (Weekly); d. 4 (Biennial)
Reference: NESC Technical Specifications 4.1.5, 4.2.2, 4.2.3, 4.8.2

B.12
Answer: d.
Reference: NESC SOP-II-I, Reactor Core Manipulation

B.13
Answer: b.
Reference: SIO IX D-4, Implementing Procedure for a Pool Level Alarm

B.14
Answer: a.
Reference: NESC Emergency Plan 4.2 and 4.3
NESC SOP-IX-A, Emergency Classification Guide

B.15
Answer: b.
Reference: $DR_1*(D_1)^2 = DR_2*(D_2)^2$
2000 mrem $(2)^2$ = 50 mrem $(d)^2$
D = 12.7 ft.

B.16
Answer: b.
Reference: NESC SOP-IX-C-4, Implementing Procedure for a Facility Air Monitor Alarm

B.17
Answer: d.
Reference: NESC SOP-II-C, Steady State Mode Operation

B.18
Answer: c.
Reference: NESC Emergency Plan, 3.1.1

B.19
Answer: c.
Reference: I=6CEn=R/hr@ft.
6*7Ci x 5Mev x 90% = 189 R/hr @ $(1ft)^2$ =
189 R/hr = 0.1 R/hr @ D2
$\sqrt{}$1890 R/hr = 43.5 ft.

Category B: Normal/Emergency Operating Procedures and Radiological Controls

B.20

Answer: c.

Reference: $DR = DR \cdot e^{-\mu x}$; Find μ

$150 = 400 \cdot e^{-30\mu}$

$0.375 = e^{-30\mu}$

$\ln(0.25) = \ln(e^{-40\mu})$

$-0.981 = -30\mu$

$\mu = 0.0327$

Find X:

$25 = 150 \cdot e^{-0.0327X}$

$\ln(0.1667) = \ln(e^{-0.03466X})$

$X = 52$ mm

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

Category C: Facility and Radiation Monitoring Systems

C.01
Answer: a.
Reference: NESC SAR 4.2.1

C.02
Answer: c.
Reference: NESC Technical Specifications 3.5.1

C.03
Answer: d.
Reference: NESC SAR 7.2.3.2

C.04
Answer: c.
Reference: NESC Technical Specification 3.8.3

C.05
Answer: a.
Reference: NESC SAR 7.3.1.2

C.06
Answer: a. or d.
Reference: NESC SAR 9.1.2

C.07
Answer: b.
Reference: NESC Technical Specification 3.2.1

C.08
Answer: c.
Reference: NESC SAR 5.2

C.09
Answer: d.
Reference: NESC SAR 7.3.2.1

C.10
Answer: b.
Reference: NESC SAR 7.3.1

C.11
Answer: b.
Reference: NESC Technical Specification 2.2

C.12
Answer: d.
Reference: NESC SAR 11.1.1.1

C.13
Answer: d.
Reference: NESC SAR 5.4.1

Category C: Facility and Radiation Monitoring Systems

C.14
Answer: a.
Reference: NESC SAR 7.3

C.15
Answer: c.
Reference: NESC SAR 10.1.1

C.16
Answer: c.
Reference: NESC Technical Specification 3.3.2

C.17
Answer: b.
Reference: NESC Technical Specification 2.1

C.18
Answer: a.
Reference: NESC SAR 13.5.3.1

C.19
Answer: d.
Reference: NESC SAR 5.3

C.20
Answer: a.
Reference: NESC SAR 9.1.2 and 9.1.3

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