March 17, 2010

Dr. Warren D. Reece, Director
Texas A&M University System
Nuclear Science Center
1095 Nuclear Science Road
MS 3575
College Station, Texas 77843-3575

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-128/OL-10-01, TEXAS A&M UNIVERSITY

Dear Dr. Reece:

During the week of February 8, 2010, the NRC administered an operator licensing examination at your Texas A&M University TRIGA Reactor. 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 (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site 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 Mr. Phillip T. Young at (301) 415-4094 or via internet e-mail Phillip.Young@nrc.gov.

Sincerely,

/RA/
Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Initial Examination Report No. 50-128/OL-10-01
2. Facility Comments with NRC Resolution
3. Corrected Written Exam

cc: w/o enclosures: See next page

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ADAMS ACCESSION #: ML100601263 **TEMPLATE #:NRR-074**

OFFICE	PROB:CE		IOLB:OLA	E	PROB:BC	
NAME	PYoung		CRevelle		JEads	
DATE	3/11/2010		3/17/2010		3/17/2010	

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Test, Research and Training
Reactor Newsletter
202 Nuclear Sciences Center
University of Florida
Gainesville, FL 32611

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

REPORT NO.: 50-128/OL-10-01

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: Texas A&M University TRIGA Reactor

EXAMINATION DATES: February 9, 2010

SUBMITTED BY: ______________________________ __________
Phillip T, Young, Chief Examiner Date

SUMMARY:

During the week of February 8, 2010, the NRC administered an operator licensing examination to one Reactor Operator candidate. The candidate passed the examination.

REPORT DETAILS

1. Examiners: Phillip T, Young, Chief Examiner, NRC
   Trainee: G. Mike Morlang, NRC

2. Results:

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

3. Exit Meeting:
   Phillip T, Young, Chief Examiner, NRC
   G. Mike Morlang, Examiner Trainee, NRC
   Jerry Newhouse, Reactor Supervisor, Texas A&M University TRIGA Reactor

   The examiner thanked the facility for their support during the examination.

ENCLOSURE 1

Section A ℞ Theory, Thermo & Facility Operating Characteristics

FACILITY COMMENTS WITH NRC RESOLUTION

Question A.12

Comment: The answer given in the key is b. withdrawn from 25 to 40%. However, the reference states that the center of the shim provides the highest worth, which would imply the answer should be c. withdrawn from 40 to 60%. Also, checking the worth on the curve itself shows 25 to 40% to have a worth of 55.9 cents and 40 to 60% to have a worth of 92.9 cents. Especially given what the reference says, this just looks like a typo in the key.
Justification: Rod Worth Curve

Question A.12

NRC Resolution: Comment accepted. Answer key corrected per facility comment.

Question A.16

Comment: The answer given in the key is c. The Tech Specs limit the reactivity worth of any single experiment to $2.0. Using beta to convert from delta-k/k, none of the answers correspond to $2.0. Answer c would be $0.857, and answer d would be $2.857.
Justification: Tech Specs.

Question A.16

NRC Resolution: Comment Accepted. Question withdrawn.

Question B.04

The answer given in the key is c. Our EP states that there are no credible accidents at our facility that could warrant a Site Area Emergency or a General Emergency, therefore they are not addressed in the plan or in any of our training.
Justification: Emergency Plan

Question B.04

NRC Resolution: Comment Accepted. Question withdrawn.

Question C.08

The answer given in the key is c. We agree this is true. However, a recent system upgrade allows us to discharge waste from the liquid waste tanks directly to the A&M sewer system. The upgrade took away our ability to discharge waste to the creek. Therefore, draining liquid waste to the creek is no longer an option either.
Justification: Waste System Diagram

Question C.08

NRC Resolution: Comment noted for future exams.

Section A Ŗ Theory, Thermo & Facility Operating Characteristics

QUESTION A.01 [1.0 point]
Which ONE of the following is the **MOST** affected factor in the six factor formula when a poison in the control rods is changed from **BORON (B)** to **CADMIUM (Cd)**?

a. Fast fission factor.

b. Reproduction factor.

c. Thermal utilization factor.

d. Fast non leakage probability.

QUESTION A.02 [1.0 point]
The injection of a sample results in a 50 millisecond period. If the scram setpoint is ***1 MEGAWATT*** and the scram delay time is 0.1 second, which ONE of the following is the peak power of the reactor at shutdown?

a. 2.5 MW.

b. 6.0 MW.

c. 7.5 MW.

d. 22.0 MW.

QUESTION A.03 [1 point]
Which ONE of the following best describes the beta decay (β_{-1}) of a nuclide?

a. The atomic mass number unchanged, and the number of protons increases by 1.

b. The atomic mass number unchanged, and the number of protons decreases by 1.

c. The atomic mass number increases by 1, and the number of protons decrease by 1.

d. The atomic mass number increases by 2, and the number of protons increase by 1.

QUESTION A.04 [1.0 point]
During a reactor startup, criticality occurred at a **LOWER ROD HEIGHT** than the last startup. Which ONE of the following reasons could be the cause?

a. Xe^{135} increased.

b. Fuel temperature decreased.

c. Moderator temperature increased.

d. Adding an experiment with negative reactivity.

QUESTION A.05 [1.0 point]
About two minutes following a reactor scram, the reactor period has stabilized and the power level is decreasing at a **CONSTANT** rate. Given that reactor power at time t_0 is 1000 kW, what is the time for the reactor power decreases to 100 kW from time t_0?

a. 1 minute.

b. 2 minutes.

c. 3 minutes.

d. 5 minutes.

QUESTION A.06 [1.0 point]
The FAST FISSION FACTOR is defined as a ratio of:

a. the number of fast neutrons produced by all fission over the number of fast neutrons produced by thermal fission.

b. the number of fast neutrons produced by fission in a generation over the number of total neutrons produced by fission in the previous generation.

c. the number of fast neutrons produced by U-238 over the number of thermal neutrons absorbed in fuel.

d. the number of neutrons that reach thermal energy over the number of fast neutrons that start to slow down.

QUESTION A.07 [1.0 point]
Which ONE of the following is the correct amount of reactivity (Δρ) added if the multiplication factor, k, is increased from 0.700 to 0.950?

a. 0.250.

b. 0.263.

c. 0.357.

d. 0.376.

QUESTION A.08 [1.0 point]
Which ONE of the following is the time period in which the MAXIMUM amount of Xe 135 will be present in the core?

a. 7 to 11 hours after a power increase from 0% to 50%.

b. 7 to 11 hours after a power increase from 50% to 100%.

c. 7 to 11 hours after a start up to 100%power.

d. 7 to 11 hours after a scram from 100% power.

QUESTION A.09 [1.0 point]
A reactor is **SHUTDOWN** by 8.6 % Δk/k. When a control rod with a worth of -3.1 % Δk/k is removed from the core, a rate of 1000 counts per second (cps) is measured. What was the previous count rate (cps)? Given βeff = 0.0078.

a. 660.

b. 750.

c. 850.

d. 1170.

QUESTION A.10 [1.0 point]
Most text books list β for a U^{235} fueled reactor as 0.0065. However, your SAR lists β_{eff} as being 0.007. Why is β_{eff} larger than β?

a. The fuel includes U^{238} which has a relatively large β for fast fission.

b. Some U^{238} in the core becomes Pu^{239} (by neutron absorption) which has a larger β for fission.

c. Delayed neutrons are born at lower energies than prompt neutrons resulting in a less loss due to leakage for these neutrons.

d. Delayed neutrons are born at higher energies than prompt neutrons resulting in a greater worth for these neutrons.

QUESTION A.11 [1.0 point]
Excess reactivity is the amount of reactivity …

a. associated with sample's worth.

b. needed to achieve prompt critical.

c. needed to keep a reactor shutdown when a SHIM blade is fully up.

d. available above cold criticality with all of the shim blades withdrawn from the point where the reactor is exactly critical.

QUESTION A.12 [1.0 point]
Which ONE of the following ranges of the Shim Safety #1 rod position provides the **HIGHEST** worth during operation?

a. withdrawn from 0 to 25%.

b. withdrawn from 25 to 40%..

c. withdrawn from 40 to 60%.

d. withdrawn from 75 to 100%.

QUESTION A.13 [1.0 point]
Given the following worth: ρ_{excess} = 0.60% Δk/k, SHIM blade 1 = 0.30% Δk/k
SHIM blade 2 = 0.45 % Δk/k, SHIM blade 3 = 0.50% Δk/k, REG blade= 0.10 % Δk/k

Calculate the ***TECHNICAL SPECIFICATION LIMIT*** of Shutdown Margin for this core.

a. 0.15% Δ k/k

b. 0.65% Δ k/k

c. 1.25% Δ k/k

d. 1.75% Δk/k

QUESTION A.14 [1.0 point]
A reactor has an effective delayed fraction (β_{eff}) of 0.0074. If a control rod withdrawal in this reactor increases the effective multiplication (k_{eff}) from 0.9985 to 1.0074, the reactor is:

a. subcritical.

b. exactly critical.

c. supercritical.

d. prompt critical.

QUESTION A.15 [1.0 point]
Which ONE of the following describes the term **PROMPT JUMP**?

a. A reactor is critical at 80-second period.

b. A reactor has attained criticality on prompt neutrons alone.

c. The instantaneous change in power level due to inserting a control rod.

d. The instantaneous change in power level due to withdrawing a control rod.

QUESTION A.16 [1.0 point]
The absolute value of the reactivity worth of any single experiment shall **NOT** exceed _____;

a. 0.0010 Δ k/k

b. 0.0025 Δ k/k

c. 0.0060 Δ k/k

d. 0.0200 Δ k/k

QUESTION A.17 [1.0 point]
The effective target area, in cm^2, presented by a single nucleus to an incident neutron beam is defined as:

a. a neutron flux.

b. a mean free path.

c. a microscopic cross section.

d. a macroscopic cross section.

QUESTION A.18 [1.0 point]
Which ONE of the following combinations of characteristics makes a good reflector?

	Scattering Cross Section	Absorption Cross Section
a.	High	High
b.	Low	High
c.	High	Low
d.	Low	Low

QUESTION   A.19   [1.0 point]
A reactor is critical at 4.5 MW power. The SHIM blades with a worth of 0.1 Δk/k is rapidly inserted into the reactor core. Calculate the power level after immediate insertion of the control blades to the reactor core. Given βeff = 0.0078.

a. 125 KW.

b. 225 kW

c. 325 kW

d. 5.50 MW

QUESTION   A.20   [1.0 point]
Which ONE of the following is the principle source of heat in the reactor after a shutdown from extended operation at 10 MW?

a. Decay of fission products.

b. Spontaneous fission of U ^{238}.

c. Production of delayed neutrons.

d. Production of prompt gamma rays.

*****************   End of Section A ********************************

Section B Normal, Emergency and Radiological Control Procedures

QUESTION B.01 [1.0 point]
Which ONE of the following defines the Technical Specifications term "Channel Test?"

a. The adjustment of a channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures

b. The qualitative verification of acceptable performance by observation of channel behavior

c. The introduction of a signal into a channel for verification of the operability of the channel

d. The combination of sensors, electronic circuits and output devices connected to measure and display the value of a parameter

QUESTION B.02 [1.0 point, 0.25 each]
Match the type of radiation in column A with their quality factor in column B. Items in column B is to be used once, more than once or not at all.

	Column A		Column B
a.	Beta	1.	1
b.	Gamma	2.	5
c.	Alpha particles	3.	10
d.	Neutrons of unknown energy	4.	20

QUESTION B.03 [1.0 point]
A radioactive source reads 65 Rem/hr on contact. Four hours later, the same source reads 2.5 Rem/hr. How long is the time for the source to decay from a reading of 65 Rem/hr to 100 mRem/hr?

a. 6.0 hours.

b. 8.0 hours.

c. 9.0 hours.

d. 10.0 hours.

QUESTION   B.04   [1.0 point]
Given that the following emergency conditions occur at the reactor facility:

(a) Low level of coolant alarms
(b) Particulate monitor alarms
(c) Radiation levels at the nearest site boundary indicate 100 mRem for one hour.

Which ONE of the following is the appropriate Emergency Classification?

a. Notification of Unusual Event.

b. Alert.

c. Site Area Emergency.

d. General Emergency.

QUESTION   B.05   [1.0 point]
A radioactive material is **DECAYING** at a rate of 20% per hour. Determine its half-life?

a. 1.5 hours.

b. 2.0 hours.

c. 3.0 hours.

d. 5.0 hours.

QUESTION   B.06   [1.0 point]
During a reactor startup, the reactor operator calculates that the maximum excess reactivity for reference core conditions is 5.8% $\Delta k/k$. For this excess reactivity, which ONE of the following is the best action?

a. Continue to operate because the excess reactivity is within TS limit.

b. Increase power and verify the excess reactivity again.

c. Shutdown the reactor; immediately report the result to NRC due to excess being above TS limit.

d Continue operation, but immediately report the result to the supervisor.

QUESTION   B.07   [1.0 point]
An area in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 mRem/hr is defined as:

a. Radiation area.

b. Restricted Area.

c. High Radiation Area.

d. Very High Radiation Area.

QUESTION   B.08   [1.0 point]
The Emergency Planning Zone (EPZ) for the NSC is established at the ...

a. Site boundary

b. Reactor building

c. Reception room

d. NSC Radiation Protection Office

QUESTION   B.09   [1.0 point]
Which ONE of the following is the MINIMUM staffing requirement when a reactor startup is required?

a. 1 RO in the control room and 1 SRO in his office.

b. 1 RO and 1 staff member in the control room.

c. 1 RO Trainee and 1 SRO in the control room.

d. 1 RO and the Radiation Safety Officer (RSO) in the control room.

QUESTION B.10 [1.0 point]
"The reactor power level shall not exceed 1.3 megawatts under any condition of operation."
This is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

QUESTION B.11 [1.0 point]
Which ONE of the following definitions is the Total Effective Dose Equivalent (TEDE) as specified in 10 CFR Part 20?

a. The sum of thyroid dose and external dose.

b. The sum of the external deep dose and the organ dose.

c. The sum of the deep dose equivalent and the committed effective dose equivalent.

d. The dose that your whole body is received from the source, but excluded from the deep dose.

QUESTION B.12 [1.0 point]
Select the list that gives the order of types of radiation from the **LEAST** penetrating to the **MOST** penetrating (i.e. travels the further in air).

a. neutron, gamma, beta, alpha.

b. alpha, beta, neutron, gamma.

c. beta, alpha, gamma, neutron.

d. alpha, neutron, beta, gamma.

QUESTION   B.13   [1.0 point]
If an emergency situation requires personnel to search for and remove injured person(s), a planned emergency exposure to the whole body could be allowed up to ____ to save a life.

a. 25 rem

b. 50 rem

c. 75 rem

d. 100 rem

QUESTION   B.14   [1.0 point]
Your reactor operator license expires after _______   years.

a. 2

b. 4

c. 6

d. 8

QUESTION   B.15   [1.0 point]
The maximum rod scram-time shall not exceed:

a. 1.4 seconds.

b. 1.2 seconds.

c. 4.3 seconds.

d. 1.5 minutes.

QUESTION   B.16   [1.0 point]
A two curie source, with a 1.8 Mev gamma, is to be stored in the reactor building. How far from the source should a HIGH RADIATION AREA sign be posted?

a. 4 feet.

b. 15 feet.

c. 22 feet.

d. 66 feet.

QUESTION B.17 [1.0 point]
10CFR50.54(x) states: "A licensee may take reasonable action that departs from a license condition or a technical specification (contained in a license issued under this part) in an emergency when this action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent. 10CFR50.54(y) states that the minimum level of management which may authorize this action is ....

a. any Reactor Operator licensed at the facility

b. any Senior Reactor Operator licensed at the facility

c. Facility Manager (or equivalent at the facility).

d. NRC Project Manager

QUESTION B.18 [1.0 point]
An unscheduled shutdown is **NOT** defined as any unplanned shutdown of the reactor caused by:

a. actuation of the reactor safety system.

b. operator error.

c. equipment malfunction.

d. shutdowns during testing and checkout.

QUESTION B.19 [1.0 point]
The control rods will be inspected visually for deterioration at an interval not to exceed:

a. 6 months.

b. 12 months.

c. 18 months.

d. 24 months.

QUESTION   B.20   [1.0 point]
The ventilation system is required to be verified as operating properly at an interval of?

a. daily.

b. weekly.

c. monthly.

d semi-annually.

***************************** End of Section B ********************************

Section C Facility and Radiation Monitoring Systems

QUESTION   C.1   [1.0 point]

Which one of the following describes the yellow light associated with the beam port water shutters?

a. An illuminated yellow light indicates that the shutter tube is evacuated and the beam is active.

b. An illuminated yellow light indicates that a shutter flood permissive has been selected by the reactor operator.

c. The yellow light tells the experimenter that the beam has been cut off.

d. The yellow light warns the experimenter of the commencement of a reactor startup.

QUESTION   C.2   [1.0 point]

Which one of the following statements concerning Beam Port #4 is **False**?

a. To clear the interlock for evacuation of the water shutter, the movable shield block shall be in the closed position.

b. A 2 inch diameter pipe connects the beam port to the central exhaust system.

c. Positioning of samples for real-time radiography requires that the neutron beam be shut off.

d. With the reactor positioned within the east rail stop, a “C-2" device causes a reactor scram when the Sample Preparation Room door is opened.

QUESTION   C.3   [1.0 point]

Which one of the following statements describes the moderating properties of Zirconium Hydride?

a. The probability that a neutron will return to the fuel element before being captured elsewhere is a function of the temperature of the hydride.

b. The ratio of hydrogen atoms to zirconium atoms affects the moderating effectiveness for slow neutrons.

c. The hydride mixture is very effective in slowing down neutrons with energies below 0.025 eV.

d. Elevation of the hydride temperature increases the probability that a thermal neutron will escape the fuel-moderator element before being captured.

QUESTION C.4 [1.0 point]

Erbium is used in the TRIGA fuel because it:

a. acts as a moderator due to a high scattering cross section.

b. allows greater fuel loading and extends core life.

c. reduces the prompt negative temperature coefficient.

d. increases the total fission cross section of the fuel.

QUESTION C.5 [1.0 point]

In the event of a building ventilation isolation, the emergency exhaust system can be operated in a manual mode from:

a. the Emergency Operating Panel in the central mechanical chase.

b. the Air Handling Control Panel in the reception room.

c. the Radiation Release Monitoring Panel in the Health Physicist's Office.

d. the Supervisor's Console in the control room.

QUESTION C.6 [1.0 point]

Which one of the following Facility Air Monitoring System channels initiates a shutdown of the air handling system and building isolation on receipt of an alarm?

a. building gaseous monitor

b. building particulate monitor

c. stack gaseous monitor

d. stack particulate monitor

QUESTION   C.7   [1.0 point]

Which one of the following areas is **NOT** directly monitored by a channel of the Area Radiation Monitoring System?

a. Reception area

b. Material handling area

c. Demineralizer room

d. Research Lab No. 1

QUESTION   C.8   [1.0 point]

Which of the following is **NOT** an option provided by the Radioactive Liquid Waste Disposal System?

a.draining liquid waste to the creek

b. storing liquid waste for radioactive decay

c. evaporation and solidification of liquid waste

d. diluting liquid waste to comply with 10CRF20 limits

QUESTION   C.9   [1.0 point]

Which one of the following is the primary purpose of the safety plate assembly?

a. Provide additional support to the reactor grid plate for the use of the TRIGA fuel elements.

b. Ensure proper alignment of the shim-safety, regulating and transient rods.

c. Retain a shim-safety rod fuel follower if it becomes detached from its mounting.

d. Retain any debris resulting from an accident which has directly involved the fuel elements.

Section B Normal, Emergency and Radiological Control Procedures

QUESTION C.10 [1.0 point]

During reactor operation, a leak develops in the primary to secondary heat exchanger. Which one of the following conditions correctly describes how the system will react?

a. Pool level will increase due to leakage from the secondary, the automatic level control will maintain level in the secondary.

b. Cooling tower basin level will decrease due to leakage from the secondary, pool level will increase.

c. Cooling tower level will increase due to leakage from the primary, automatic level control will maintain level in the primary.

d. Cooling tower basin level will increase due to leakage from the primary, pool level will decrease.

QUESTION C.11 [1.0 point]

The reactor is at 50 watts in "SERVO" control when gamma compensating voltage for the Linear Power measuring NI channel is lost. What effect would this have on regulating rod position, and why?

a. Rod will drive in slightly, because indicated power will increase with demand remaining the same.

b. Rod will drive out slightly, because indicated power will decrease with demand remaining the same.

c. Rod will remain as is, because input to the control circuit is from the log power amplifier.

d. Rod will scram, due to a large increase in indicated power.

QUESTION C.12 [1.0 point]

Which one of the following provides a reactor scram in any mode of operation?

a. High fuel temperature.

b. Low pool level.

c. High power level.

d. High pool conductivity.

Section C Facility and Radiation Monitoring Systems

QUESTION   C.13   [1.0 point]

A mechanical stop prevents the withdrawal of the Transient Rod at reactivities greater than:

a. $2.00

b. $2.10

c. $2.95

d. $3.21

QUESTION   C.14   [1.0 point]

More than 95% of the facility's Ar-41 is produced:

a. in the beam ports.

b. in the pneumatic system.

c. in the reactor building atmosphere.

d. in the reactor pool.

QUESTION   C.15   [1.0 point]

The TAMU TRIGA fuel elements:

a. are about 20% enriched uranium with stainless steel clad and no burnable poison.

b. are about 70% enriched uranium with stainless steel clad and erbium burnable poison.

c. are about 20% enriched uranium with stainless steel clad and erbium burnable poison.

d. are about 70% enriched uranium with aluminum clad and no burnable poison.

Section B Normal, Emergency and Radiological Control Procedures

QUESTION   C.16   [1.0 point]

A 1-3/4 inch diameter hole through the grid plate is located at the southwest corner of the four rod fuel assemblies. The purpose of these holes is to:

a. accommodate a fuel followed control rod.

b. provide a mounting location for in-core experiments.

c. accommodate a zirconium rod after hydriding in the fuel elements is completed.

d. provide a coolant flow path through the grid plate.

QUESTION   C.17   [1.0 point]

Which one of the following is the purpose of the graphite slugs located at the top and bottom of each fuel rod?

a. To absorb neutrons, thereby reducing neutron embrittlement of the upper and lower guide plates.

b. To absorb neutrons, thereby reducing neutron leakage from the core.

c. To reflect neutrons, thereby reducing neutron leakage from the core.

d. To couple neutrons from the core to the nuclear instrumentation, thereby decreasing neutron shadowing effects.

QUESTION   C.18   [1.0 point]

In the TAMU reactor, an instrumented fuel element (IFE) is located in:

a. the hottest fuel element.

b. grid position 5E4

c. adjacent to the Transient Rod

d. grid position 5D3

Section C Facility and Radiation Monitoring Systems

QUESTION   C.19   [1.0 point]

The pneumatic sample system has several design features including:

a. An override so the control room can return a sample from the reactor to its origin.

b. The use of dry compressed CO_2 to minimize moisture in the system.

c. Control room permissive for each remote sample station.

d. Automatic return override if the samples get more exposure than expected.

QUESTION   C.20   [1.0 point]

The NSCR confinement building ventilation flow was designed to supply three unique zones:

a. based on human occupancy frequency and duration.

b. that are provided with independent systems for purposes.

c. which are based on the likelihood of airborne contamination.

d. which flow from the least to the most likely areas of contamination.

****************** End of Section C ****************************
****************** End of the Exam ***************************

A.01 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.2, page 3-19.

A.02 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982
$P = P_0 e^{t/\tau}$, $P = 1$ Megawatts $\times e^{0.1/0.05} = 10 \times e^2 = 7.39$ Megawatts

A.03 a
REF: Chart of the Nuclides

A.04 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 8.4, page 8-9.

A.05 c
REF: $P = P_0 e^{-T/\tau}$, 100 kW = 1000 kW $\times e^{(X/-80sec)}$, X = ln(0.1) $\times$ 80 sec ; X = 180 sec. or 3 min

A.06 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.1, page 3-16.

A.07 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 3.3.3, page 3-21.
The applicant can use one of the following methods:
a) At k=0.7; ρ = ΔKeff/Keff or ρ = Keff-1/Keff = -0.3/0.7 =-0.429. At k=0.95, ρ =-0.05/0.95 ρ = -0.053. The difference between ρ is the answer, i.e. -0.053-(-0.429) =0.376
b) Δ ρ = ρ1 – ρ2 where ρ1 = Keff1-1/Keff1 and ρ2 = Keff2-1/Keff2. Substitute ρ1 and ρ2 with Keff1 and Keff2 into the equation above, the result is Δρ = keff1-keff2/(keff1 x keff2)
Δρ = k1-k2/(k1 x k2) ; Δρ = 0.95-0.70/(0.95 x 0.70) =0.376

A.08 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Sec 8.4, page 8-9.

A.09 a
REF ρ_1=-0.086; K_{eff1}=1/1- ρ_1
K_{eff1} =1/(1-(-.086)) —>K_{eff1}= 0.9208,
Remove ─3.1 % Δk/k from the core, means adding 3.1 % Δk/k to the core when removing the rod;
new worth = -0.086 + 0.031= -0.055,
K_{eff2} = 1/1+0.055; —>0.948
$Count_1$*(1-K_{eff1}) = $Count_2$*(1-K_{eff2})
$Count_1$*(1-0.9208) = $Count_2$*(1-0.948)
$Count_1$*(1-0.9208) = 1000(1-0.948); $Count_1$ = 657 cps

A.10 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § Section 3.3, page 3-14

A.11 d
REF: TS 1.0

A.12 ~~b~~, Changed to c per licensee comment.
REF: Rod Worth Curve dated 6/29/09(note: center of Shim blade provides the highest worth)

A.13 a
REF: Total rod worth – (excess + most active SHIM blade + REG blade)
(0.30+0.45+0.5+0.1) %Δk/k –(0.6+0.5+0.1) %Δk/k =(1.35 -1.2) %Δk/k = 0.15 %Δk/k

A.14 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Section 4.2, page 4-1.

A.15 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Page 4-21.

A.16 ~~c,~~ Question withdrawn per licensee commet.
REF TS 3.6.1

A.17 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, Section 2.51, page 2-36.

A.18 c
REF: Standard NRC Question

A.19 c
REF: P1 = P0 (βeff x (1 – ρ))/(βeff – ρ)
P1 = 4.5 MW (.0078 x (1 – (- 0.1)/ (0.0078 – (- 0.1)
P1 = 4.5 MW x (0.072); P1 = 325 kW

A.20 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, page 4-33

B.01 c
REF: Technical Specifications

B.02 a(1) b(1) c(4) d(3)
REF: 10 CFR 20

B.03 b
REF: $DR = DR_{\circ} * e^{-\lambda t}$
2.5 rem/hr $= 65$ rem/hr$* e^{-\lambda(4hr)}$
$Ln(2.5/65) = -\lambda*4$ --> $\lambda=0.8145$; solve for t: $Ln(.1/65)=-0.8145 *t$ → $t=7.95$ hours

B.04 ~~c~~, Question withdrawn per licensee comment.
REF: EP

B.05 c
REF: $DR = DR_{\circ} * e^{-\lambda t}$
20% is decayed, so 80% is still there
$80\% = 100\% * e^{-\lambda(1hr)}$
$Ln(80/100) = -\lambda*1$ -->$\lambda=0.223$ $t1/2=Ln(2)/\lambda$ -->.693/.223 t=3.1 hours

B.06 c
REF: TS 3.1.5

B.07 c
REF: 10 CFR 20

B.08 b
REF: Emergency Plan.

B.09 c
REF: Director Memo number 2009-0040

B.10 c
REF: Tech Specs 3.1.1

B.11 c
REF: 10 CFR 20.1003.

A.12 b
REF: NRC standard question

B.013 a
REF: EP

B.14 c
REF: 10CFR55

B.15 b
REF: TS 3.2.3

B.16 b
REF: 6CEN = R/hr @ 1 ft. -> 6 x 2 x 1.8 x 1 = 21.6 R/hr at 1ft. $I_0D_0^2 = I*D^2$
21.6 R/hr*1 ft = 0.1 R/hr *D^2
D= $\sqrt{(21.6/0.1)}$ = 14.7 ft.

B.17 b
REF: 10CFR 55.

B.18 d
REF: TS 1.41

B.19 d
REF: TS 4.3.1

B.20 b
REF: TS 4.4

C.1 a
REF SOP IV-D.3.b.10

C.2 d
REF SOP IV-F

C.3 d
REF GA - 3886 (Rev. A) TRIGA Mark III Reactor Hazards Analysis, Feb. 1965.

C.4 b
REF SAR III.C.2

C.5 b
REF SAR V.B.3, VIII-A; Modification Authorization M-14

C.6 d
REF SAR IX-F

C.7 a
REF SAR IX-G, Fig. 9.3

C.8 c
REF: SAR IX-B.2

C.9 c
REF SAR III-B.3

C.10 d
REF SAR IV-B.2 and figure 4-6.

C.11 a
REF SAR VII figure 7-2.

C.12 a, d
REF: SAR, Table V pg. 100

C.13 a
REF: SAR Sect. 4.5.11 & 13.5

C.14 d
REF: SAR IX-D

C.15 c
REF: SAR

C.16 a
REF SAR III-B.3

C.17 c
REF: SAR III-B.4

C.18 b
REF: SAR

C.19 c
REF: SOP IV-C

C.20 c
REF: SAR § 9.1.2