May 5, 2008

Dr. William A. Baeslack III, Dean,
College of Engineering and
Director, Engineering Experiment Station
142 Hitchcock Hall
2070 Neil Avenue
Ohio State University
Columbus, OH 43210-1278

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-150/OL-08-01, OHIO STATE UNIVERSITY

Dear Dr. Baeslack:

During the week of April 14, 2008, the U.S. Nuclear Regulatory Commission (NRC) administered an operator licensing examination at your Ohio State University reactor. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2, published in June 2007. Examination questions and preliminary findings were discussed at the conclusion of the examination with those members of your staff identified in the enclosed report.

In accordance with Title 10, Section 2.390 of the Code of Federal Regulations, 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 Public Electronic Reading Room). The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. If you have any questions concerning this examination, please contact Patrick Isaac at 301-415-1019 or via email at patrick.isaac@nrc.gov.

Sincerely,

/RA/

Johnny Eads, Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-150

Enclosures:
1. Examination Report No. 50-150/OL-08-01
2. Facility Comments with NRC Resolution
3. Corrected Written Examination

cc: Mr. Andrew Kauffman, Ohio State University
cc without enclosures: See next page

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Dear Dr. Baeslack:

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DISTRIBUTION w/ encls.:

PUBLIC PRTB r/f JEads Facility File CHart (O12-D19)

ADAMS ACCESSION #: ML081190249 P: ML08119017

OFFICE	**PRTB:CE**		**IOLB:LA**		**PRTB:BC**	
NAME	**PIsaac:PDoyle for**		**CHart cah**		**Mhv for JEads**	
DATE	**04/29/2008**		**05/02/2008**		**/ /2008**	

OFFICIAL RECORD COPY

cc:

Robert Owen, Chief
Bureau of Radiation Protection
Ohio Department of Health
246 North High Street
Columbus, OH 43215

Carol O'Claire
Radiological Branch Chief
Ohio Emergency Management Agency
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Columbus, OH 43235-2206

Thomas E. Blue, Director
Nuclear Reactor Laboratory
The Ohio State University
1298 Kinnear Road
Columbus, OH 43212

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

EXAMINATION REPORT NO: 50-150/OL-08-01

FACILITY: Ohio State University

FACILITY DOCKET NO.: 50-150

FACILITY LICENSE NO.: R-75

SUBMITTED BY: **/RA PDoyle for/** 4/29/08
Patrick J. Isaac, Chief Examiner Date

SUMMARY:

During the week of April 14, 2008, the NRC administered operator licensing examinations to one Senior Reactor Operator (SRO) candidate. The candidate passed the examinations.

REPORT DETAILS

1. Examiner: Patrick J. Isaac, Chief Examiner

2. Results:

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

3. Exit Meeting:

   Andrew Kauffman, Associate Director, OSU Nuclear Reactor Laboratory
   Patrick Isaac, NRC, Examiner

   The NRC Examiner thanked the facility for their support in the administration of the examinations.

ENCLOSURE 1

Facility Comments with NRC Resolution

Question (B. 12)

Which one of the following is a guidance/limit/recommendation for radiation exposures in the event of an emergency?

a. Planned whole body dose shall not exceed 100 Rem in life-saving situations.

b. Persons receiving emergency exposures should avoid procreation for a few months.

c. For corrective actions that mitigate the consequences of the emergency, the whole-body doses dose shall not exceed 100 Rem.

d. The youngest able-bodied volunteers should perform the rescue.

Answer: a

Facility Comment:

The E-Plan states a value of 25 rem, not 100 rem.

NRC Resolution:

Comment accepted. Due to the lack of a correct answer, question B.12 will be deleted from the examinations.

Question (B. 16)

During a Nuclear Emergency, who of the following is responsible for providing neutron and gamma sensitive survey equipment to the assembly area?

a. Director, Office of Radiation Safety

b. Operations Manager

c. Duty SRO

d. Duty RO

Answer: c

Facility Comment:

According to Procedure EP-01, the correct answer is (d), not (c)

NRC Resolution:

Comment accepted. The correct answer for question B.16 has been changed to “d”.

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

FACILITY: Ohio State University

REACTOR TYPE: Pool

DATE ADMINISTERED: April 14, 2008

CANDIDATE:

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

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	33.9	________	____	A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
19.00	32.2	________	____	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
20.00	33.9	________	____	C. FACILITY AND RADIATION MONITORING SYSTEMS
59.00		________ FINAL GRADE	____%	TOTALS

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

Candidate's Signature

ENCLOSURE 3

A N S W E R   S H E E T

Multiple Choice   (Circle or X your choice)
If you change your answer, write your selection in the blank.

MULTIPLE CHOICE

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a b c d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

019 a b c d ___

020 a b c d ___

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

A N S W E R   S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a ___ b ___ c ___ d ___

006 a ___ b ___ c ___ d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 1 ___ 2 ___ 3 ___ 4 ___

011 a b c d ___

012 a b c d ___

013 a b c d ___

014 a b c d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

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

C. PLANT AND RAD MONITORING SYSTEMS

A N S W E R S H E E T

Multiple Choice (Circle or X your choice)
If you change your answer, write your selection in the blank.

001 a b c d ___

002 a b c d ___

003 a b c d ___

004 a b c d ___

005 a b c d ___

006 a ___ b ___ c ___ d ___

007 a b c d ___

008 a b c d ___

009 a b c d ___

010 a b c d ___

011 a ___ b ___ c ___ d ___

012 a b c d ___

013 a b c d ___

014 a ___ b ___ c ___ d ___

015 a b c d ___

016 a b c d ___

017 a b c d ___

018 a b c d ___

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

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 <u>only</u> 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. 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.

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

EQUATION SHEET

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

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

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

$SCR = S/(1\text{-}Keff)$

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

$CR_1 (1\text{-}Keff)_1 = CR_2 (1\text{-}Keff)_2$

$SUR = \frac{26.06 (\lambda_{eff}\rho)}{(\beta - \rho)}$

$M = \frac{(1\text{-}Keff)_0}{(1\text{-}Keff)_1}$

$SUR = 26.06/\tau$

$M = 1/(1\text{-}Keff) = CR_1/CR_0$

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

$SDM = (1\text{-}Keff)/Keff$

$P = P_0 e^{(t/\tau)}$

$Pwr = W_f \dot{m}$

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

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

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

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

$\rho = (Keff-1)/Keff$

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

$\rho = \Delta Keff/Keff$

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

$\bar{\beta} = 0.0070$

$DR_1 D_1^2 = DR_2 D_2^2$

$DR = DR_o e^{-\lambda t}$

$DR = \frac{6CiE(n)}{R^2}$ DR ≡ R/hr, Ci ≡ Curies, E ≡ Mev, R ≡ feet

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 hp = 2.54×10^3 BTU/hr

1 Mw = 3.41×10^6 BTU/hr

1 BTU = 778 ft-lbf

°F = 9/5°C + 32

1 gal H_2O ≈ 8 lbm

°C = 5/9 (°F - 32)

Question A.1 [1.0 point]

A reactor scram has resulted in the instantaneous insertion of .006 ΔK/K of negative reactivity. Which one of the following is the stable negative reactor period resulting from the scram?

a. 45 seconds

b. 56 seconds

c. 80 seconds

d. 112 seconds

Question A.2 [1.0 point]

The count rate is 50 cps. An experimenter inserts an experiment into the core, and the count rate decreases to 25 cps. Given the initial K_{eff} of the reactor was 0.8, what is the worth of the experiment?

a. $\Delta\rho = -0.42$

b. $\Delta\rho = +0.42$

c. $\Delta\rho = -0.21$

d. $\Delta\rho = +0.21$

Question A.3 [1.0 point]

Given the lowest of the high power scrams is 110%, and the scram delay time is 0.5 sec. If the reactor is operating at 100% power prior to the scram, approximately how high will reactor power get with a positive 20 second period?

a. 113%

b. 116%

c. 124%

d. 225%

Question A.4 [1.0 point]

Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

c. available above that which is required to make the reactor subcritical.

d. available above that which is required to keep the reactor critical.

Question A.5 [1.0 point]

Which one of the following is the MAJOR source of energy recovered from the fission process?

a. Kinetic energy of the fission neutrons

b. Kinetic energy of the fission fragments

c. Decay of the fission fragments

d. Prompt gamma rays

Question A.6 [1.0 point]

Which statement illustrates a characteristic of Subcritical Multiplication?

a. As Keff approaches unity (1), for the same increase in Keff, a greater increase in neutron population occurs.

b. The number of neutrons gained per generation gets larger for each succeeding generation.

c. The number of fission neutrons remains constant for each generation.

d. The number of source neutrons decreases for each generation.

Question A.7 [1.0 point]

If reactor power is increasing by a decade every minute, it has a period of:

a. 13 sec

b. 26 sec

c. 52 sec

d. 65 sec

Question A.8 [1.0 point]

Which one of the following statements describes Count Rate characteristics after a control rod withdrawal in a subcritical as Keff approaches 1? (Assume the Rx remains subcritical.)

a. Count Rate will rapidly increase (prompt jump) then gradually increase to a stable value.

b. Count Rate will rapidly increase (prompt jump) then gradually decrease to the previous value.

c. Count Rate will rapidly increase (prompt jump) to a stable value.

d. There will be no change in Count Rate until criticality is achieved.

Question A.9 [1.0 point]

Given: Primary coolant flow rate is 500 gallons/minute and secondary flow rate is 700 gallons/minute. The ΔT across the primary side of the heat exchanger is 13°F and secondary inlet temperature to the heat exchanger is 73°F. Assuming both the primary and secondary coolants have the same Cp value, which ONE of the following is the secondary outlet temperature?

a. 82°F

b. 85°F

c. 89°F

d. 91°F

Question A.10 [1.0 point]

Select the condition NOT assumed when calculating shutdown margin.

a. The highest worth shim safety rod is fully withdrawn.

b. The regulating rod fully withdrawn.

c. The reactor is in the cold condition without Xe.

d. The reactor has been shutdown for greater than 48 hours.

Question A.11 [1.0 point]

As the moderator temperature increases, the resonance escape probability:

a. increases, since the moderator becomes less dense.

b. decreases, since the time required for a neutron to reach thermal energy increases.

c. remains constant, since the effect of moderator temperature change is relatively small.

d. increases, since the moderator-to-fuel ratio increases.

Question A.12 [1.0 point]

An element decays at a rate of 20% per day. Determine its half-life.

a. 3 hr.

b. 75 hr.

c. 108 hr.

d. 158 hr.

Question A.13 [1.0 point]

Which ONE of the following is the reason for the -80 second period following a reactor scram?

a. The negative reactivity added during a scram is greater than á-effective

b. The half-life of the longest-lived group of delayed neutron precursors is approximately 55 seconds

c. The fuel temperature coefficient adds positive reactivity as the fuel cools down, thus retarding the rate at which power drops

d. The amount of negative reactivity added is greater than the Shutdown Margin

Question A.14 [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. 8 to 10 hours after a startup to 100% power.

b. 4 to 6 hours after a power increase from 50% to 100%.

c. 4 to 6 hours after a power decrease from 100% to 50%.

d. 8 to 10 hours after a scram from 100%.

Question A.15 [1.0 point]

Which ONE of the following describes the difference between reflectors and moderators?

a. Reflectors decrease core leakage while moderators thermalize neutrons

b. Reflectors shield against neutrons while moderators decrease core leakage

c. Reflectors decrease thermal leakage while moderators decrease fast leakage

d. Reflectors thermalize neutrons while moderators decrease core leakage

Question A.16 [1.0 point]

Experimenters are attempting to determine the critical mass of a new fuel material. As more fuel was added the following fuel to count rate data was taken:

Fuel	Counts/Sec
1.00 kg	500
1.50 kg	800
2.00 kg	1142
2.25 kg	1330
2.50 kg	4000
2.75 kg	15875

Which one of the following is the amount of fuel needed for a critical mass?

a. 2.60 kg

b. 2.75 kg

c. 2.80 kg

d. 2.95 kg

Question A.17 [1.0 point]

With the reactor on a constant period, which transient requires the LONGEST time to occur?

A reactor power change of:

a. 5% power going from 1% to 6% power

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

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

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

Question A.18 [1.0 point]

The reactor has scrammed following an extended period of operation at full power.
Which one of the following accounts for generation of a majority of the heat one (1) hour after the scram?

a. Spontaneous fissions

b. Delayed neutron fissions

c. Alpha fission product decay

d. Beta fission product decay

Question A.19 [1.0 point]

The term "reactivity" is described as:

a. a measure of the core's fuel depletion.

b. negative when Keff is greater than 1.0.

c. a measure of the core's deviation from criticality.

d. being equal to $0.66 when the reactor is prompt critical.

Question A.20 [1.0 point]

Which one of the following is NOT a reason for or benefit of operating with a flat neutron flux profile?

a. A higher average power density is possible.

b. More even burn up of fuel results.

c. Moderator temperature is equalized throughout the core.

d. Control rod worth is made more uniform.

Question B.1 [1.0 point]

In order to ensure the health and safety of the public, in an emergency, 10CFR50 allows the operator to deviate from Technical Specifications. What is the minimum level of authorization needed to deviate from Tech. Specs?

a. USNRC

b. Reactor Supervisor

c. Licensed Senior Reactor Operator.

d. Licensed Reactor Operator.

Question B.2 [1.0 point]

“Steady state power level shall not exceed 500 kw thermal.” this is an example of a:

a. safety limit.

b. limiting safety system setting.

c. limiting condition for operation.

d. surveillance requirement.

Question B.3 [1.0 point]

Which one of the following statements 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.4 [1.0 point]

Which one of the following instruments should you use to survey a gamma source?

a. Thin window ion chamber.

b. GM tube.

c. Ion chamber (open window).

d. Neutron ball.

Question B.5 [2.0 points, 0.5 each]

Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

Question B.6 [2.0 points, 0.5 each]

Match the radiation reading from column A with its corresponding radiation area classification (per 10 CFR 20) listed in column B.

COLUMN A	COLUMN B
a. 10 mRem/hr	1. Unrestricted Area
b. 150 mRem/hr	2. Radiation Area
c. 10 Rem/hr	3. High Radiation Area
d. 550 Rem/hr	4. Very High Radiation Area

Question B.7 [1.0 point]

A radioactive source generates a dose of 100 mr/hr at a distance of 10 feet. Using a two inch thick sheet of lead for shielding the reading drops to 50 mr/hr at a distance of 10 feet. What is the minimum number of sheets of the same lead shielding needed to drop the reading to less than 5 mr/hr at a distance of 10 ft?

a. 1

b. 3

c. 5

d. 7

Question B.8 [1.0 point]

Which one of the following is the 10 CFR 20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)**?

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

b. The dose that your whole body receives from sources outside the body.

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

d. The dose to a specific organ or tissue resulting from an intake of radioactive material

Question B.9 [1.0 point]

A room contains a source which, when exposed, results in a general area dose rate of 175 millirem per hour. This source is scheduled to be exposed continuously for 25 days. Select an acceptable method for controlling radiation exposure from the source within this room.

a. Post the area with words "Danger-Radiation Area".

b. Equip the room with a device to visually display the current dose rate within the room.

c. Equip the room with a motion detector that will alarm in the control room.

d. Lock the room to prevent inadvertent entry into the room.

Question B.10 [2.0 points, 0.5 each]

Match the requirements (10 CFR 55) for maintaining an active operator license in column A with the correct time period from column B.

Column A	Column B
1. Renewal of license	a. 4 months
2. Medical examination	b. 1 year
3. Console manipulation evaluation	c. 2 years
4. Requalification exam (written)	d. 6 years

Question B.11 [1.0 point]

With the secondary coolant pump inoperable, reactor power cannot be increased above:

a. 10 Kw

b. 50 Kw

c. 120 Kw

d. 200 Kw

Question B.12 [1.0 point]

Which one of the following is a guidance/limit/recommendation for radiation exposures in the event of an emergency?

a. Planned whole body dose shall not exceed 25 Rem in life-saving situations.

b. Persons receiving emergency exposures should avoid procreation for a few months.

c. For corrective actions that mitigate the consequences of the emergency, the whole-body doses dose shall not exceed 100 Rem.

d. The youngest able-bodied volunteers should perform the rescue.

Question B.13 [1.0 point]

At the OSURR the Emergency Support Center (ESC) is ...

a. the control room

b. the office of the Campus Police

c. the Office of Radiation Safety.

d. the University Hospital.

Question B.14 [1.0 point]

Which one of the following does NOT require NRC approval for changes?

a. Facility License

b. Requalification plan

c. Emergency Implementation Procedures

d. Emergency Plan

Question B.15 [1.0 point]

Which one of the following is a duty of the Reactor Operator (RO) during an emergency which requires a facility evacuation?

a. Turn off the building fans as you leave the Control Room.

b. Verify all persons are accounted for.

c. Assure that reactor is secured.

d. Verify all doors to the reactor building are closed.

Question B.16 [1.0 point]

During a Nuclear Emergency, who of the following is responsible for providing neutron and gamma sensitive survey equipment to the assembly area?

a. Director, Office of Radiation Safety

b. Operations Manager

c. Duty SRO

d. Duty RO

Question B.17 [1.0 point]

It is April 1, 2007. You have stood watch for the following hours during the last quarter:

Jan. 11, 2007	0.5 hours
Feb. 24, 2007	1.5 hours
Mar. 16, 2007	1.0 hours

What requirements must you meet in order to stand an RO watch today?

a. None. You've met the minimum requirements of 10 CFR 55.

b. You must perform 4 hours of shift functions under the direction of a licensed operator or licensed senior operator as appropriate.

c. You must perform 6 hours of shift functions under the direction of a licensed operator or licensed senior operator as appropriate.

d. You must submit a new application form to the NRC requesting a waiver to reactivate your license.

(*** End of Section B ***)

Question C.1 [1.0 point]

Which ONE of the following describes a standard fuel element?

a. 19.5% enriched uranium contained within stainless steel plates.

b. 37.5% enriched uranium contained within aluminum plates.

c. 19.5% enriched uranium contained within aluminum plates.

d. 37.5% enriched uranium contained within stainless steel plates.

QUESTION: 002 [1.0 point]

All positions in the core grid plate are occupied by some type of assembly. This is done so that:

a. there is an even weight distribution on the grid plate.

b. there is no uneven coolant flow distribution through the core.

c. the core is as symmetric as possible to maintain an even reactivity distribution.

d. a predictable control rod worth is maintained.

QUESTION: 003 [1.0 point]

Which ONE of the following statements is true regarding operation of the neutron source?

a. The neutron source may be moved at any time.

b. The neutron source cannot be moved out of its storage cask while simultaneously withdrawing any control rod.

c. The source is a 5-curie Sb-Be source which provides about $1x10^7$ neutrons/second.

d. When the source is in its fully raised position, it is located near the top of the fuel elements.

QUESTION: 004 [1.0 point]

Which ONE of the following channels has a signal which will generate a "FAST" scram?

a. Linear Power Monitoring Channel

b. Period Monitoring Channel

c. Period Safety Channel

d. Startup Channel

QUESTION: 005 [1.0 point]

The aluminum shrouds which surround each control rod have holes in the lower sections. The purpose of these holes is to:

a. provide viscous damping during reactor scrams.

b. provide a cooling water path through the shrouds.

c. provide points where a shroud lifting tool can be attached.

d. smooth out the thermal neutron flux distribution at the bottom of the core.

QUESTION: 006 (2.00)

Match the Area Radiation Monitor location listed in Column A with the correct detector listed in Column B. Items listed in Column B may be used more than once or not at all.

Column A		Column B
a. Above reactor pool	1.	Proportional counter
b. Thermal column and beam ports	2.	Ionization Chamber
c. Primary coolant heat exchanger	3.	GM detector
d. Water processing system	4.	Scintillation detector

QUESTION: 007 [1.0 point]

The building evacuation system is activated by two switches. The switch located on the slow scram console in the control room only ______________________ while the switch located underneath the wall-mounted telephone in the control room only_____________________.

a. sounds the evacuation horn;
   turns off all ventilation fans exhausting to the outside of the building.

b. turns off all ventilation fans exhausting to the outside of the building;
   sounds the evacuation horn.

c. sounds the evacuation horn and turns off all ventilation fans exhausting to the outside of the building;
   sounds the evacuation horn.

d. sounds the evacuation horn;
   sounds the evacuation horn and turns off all ventilation fans exhausting to the outside of the building.

QUESTION: 008 [1.0 point]

Which ONE of the following will prevent the withdrawal of a control rod?

a. Startup source moving out of the core.

b. Movement of fission chamber into the core.

c. Movement of fission chamber out of the core.

d. Green light on in Control Rod Positioning System.

QUESTION: 009 [1.0 point]

For a control rod, the orange light is ON, the green light is OFF, and the white light is ON. These indicate that:

a. The rod and drive are not in contact, the rod is full out and the drive is full in.

b. The rod and drive are both full out.

c. The rod and drive are both full in.

d. The rod and drive are not in contact, the drive is full out and the rod is full in.

QUESTION: 010 [1.0 point]

When the building gaseous effluent monitor alarms, which ONE of the following occurs?

a. The reactor scrams.

b. The ventilation exhaust fan stops.

c. The building evacuation horn sounds.

d. No action occurs.

QUESTION: 011 (2.00)

Match the instrument channel listed in Column A with the correct detector listed in Column B. Items listed in Column B may be used more than once or not at all.

Column A	Column B
a. Logarithmic Power	1. Proportional counter
b. Startup	2. Fission chamber
c. Linear power	3. GM detector
d. Power Level Safety	4. Compensated Ion Chamber
	5. Uncompensated Ion chamber

QUESTION: 012 [1.0 point]

Input to the servo system is provided by the:

a. Logarithmic Power Channel.

b. Linear Power Channel.

c. Power Level Channel #1.

d. Power Level Channel #2.

QUESTION: 013 [1.0 point]

Which ONE of the following switch positions will prohibit a startup?

a. Effluent Monitor Compressor “On”.

b. Period Generator Switch Position “Off”.

c. Log N Amplifier Calibrate Switch “Test”.

d. Log Period Amplifier Calibrate Switch “Norm”.

QUESTION: 014 [1.0 point]

The reactor is operating at 500 kilowatts, when the SECONDARY coolant pump trips on overload. Assuming NO OPERATOR ACTION, which ONE of the following trips would most likely cause a reactor scram?

a. High Flux

b. Short Period

c. High Coolant Inlet Temperature

d. High power, No pumps

QUESTION: 015 [1.0 point]

Water from the Makeup Water System is added to the reactor pool:

a. at the suction of the Water Process System pump.

b. at the inlet of the demineralizer in the Water Process System.

c. at the inlet of the ion exchange filters in the Water Process System.

d. at the outlet of the ion exchange filters in the Water Process System.

QUESTION: 016 [1.0 point]

Which ONE of the following scram functions results in ONLY a slow scram?

a. Reactor fast period.

b. Reactor overpower.

c. Low count rate.

d. Core inlet temperature below setpoint.

QUESTION: 017 [1.0 point]

The gamma rays incident upon the Startup Channel do not cause a pulse to be counted. Which ONE of the following describes the reason gamma pulses are not counted?

a. The Startup Channel detector has compensating voltage to subtract the gamma pulses from the signal.

b. The design of the detector allows gamma rays to pass through the detector with no interaction.

c. The detector uses a pulse height discriminator, which prevents the smaller gamma pulses from being counted.

d. The number of gamma rays is much smaller than the number of neutrons.

QUESTION: 018 [1.0 point]

An annunciator lamp switch flashes and an audible signal is emitted to alert the operator to a slow or fast scram condition. Acknowledging the condition will always:

a. silence the alarm and extinguish the light.

b. silence the alarm only if the condition has returned to normal.

c. silence the alarm.

d. extinguish the light.

(*** End of Examinatiuon ***)

A.1 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 4.6, p. 4-16.

A.2 a
REF:
$CR_1 / CR_2 = (1 – Keff_2) / (1 – Keff_1) \rightarrow 50 / 25 = (1 – Keff_2) / (1 – 0.8)$
Therefore $Keff_2 = 0.6$
$\Delta\rho = Keff_2 – Keff_1 / Keff_2 \cdot Keff_1 = (0.6 – 0.8) / (0.6 \cdot 0.8) = - 0.41667$/CR2=(1-Keff2)/(1-Keff1)

A.3 a
REF: $P = P_0 e^{t/\tau}$ $P_o = 110\%$ $\tau = 20$ sec. $t = 0.5$ $P = 110 e^{0.5/20} = 112.78\%$

A.4 d
REF: Glasstone and Sesonske, *Nuclear Reactor Engineering*, Chapter 5, Section 5.114

A.5 b
REF: Standard NRC Reactor Theory Question

A.6 a
REF: Standard NRC Reactor Theory Question

A.7 b
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991,
$P = P_o e^{t/T}$ $10 = 1e^{60/T}$ ln 10 = 60/T 2.3 = 60/T T = 60/2.3 T = 26 seconds

A.8 a, c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1982, § 5.7, pp. 5-28 — 5-38

A.9 a
REF: $\Delta T_{sec}= (Flow_{pri}/Flow_{sec}) \times \Delta T_{pri}$ $\Delta T_{sec}= (500/700) \times 13°F = 9.28°F$
Secondary outlet = 73°F + 9.28°F = 82.3°F

A.10 d
REF: NSC Tech Spec 3.1.3

A.11 b
REF: Lamarsh, Introduction to Nuclear Engineering, 2nd Edition, pg. 313.

A.12 b
REF: $A = A_o e^{-\lambda t}$ $\lambda = .693 / T2 \rightarrow \text{Ln } A/A_o = - .693\, t / T2$
$T2 = - .693 \cdot 24\text{hr} / \ln 0.8 = 75$ hr

A.13 b
REF: Introduction to Nuclear Reactor Operations, Reed Robert Brown, Section 3.2.2, Delayed Neutrons.

A.14 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988

A.15 a
REF: Introduction to Nuclear Reactor Operations, Reed Robert Brown, Section 5.4, Inverse Multiplication, p. 5-14.

A.16 c
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §§ 3.161 — 3.163, pp. 190 & 191.

A.17 a
REF: Introduction to Nuclear Reactor Operations, Reed Robert Brown, Section 4.3, Reactor Period and Reactor Power

A.18 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988 pg. 3-4.

A.19 c
REF: Lamarsh, J.R., *Introduction to Nuclear Engineering,* Addison-Wesley Publishing, Reading, Massachusetts, 1983. § , p. 282.

A.20 c
REF: Reactor Physics Notes

B.1 c
REF: 10CFR50.54(y)

B.2 b
REF: TS 2.2

B.3 c
REF: TS 1.3

B.4 b
REF: Nuclear Power Plant Health Physics and Radiation Protection, Ch. 10

B.5 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

B.6 a, 2; b, 3; c, 3; d, 4
REF: 10 CFR 20.1003, Definitions

B.7 c
REF: Two inches = one-half thickness ($T_{½}$). Using 5 half-thickness will drop the dose by a factor of $(½)^5$ = 1/32 □ 100/32 = 3.13

B.8 a
REF: 10 CFR 20.1003 *Definitions*

B.9 d
REF: 10 CFR 20.1601

B.10 1 d 2 c 3 b 4 c
REF: 10CFR55

B.11 c
REF: Technical Specifications, § 3.3.1

~~B.12 a~~ *DELETED*
~~REF: Emergency Plan~~

B.13 a
REF: Emergency Plan

B.14 c
REF: 10 CFR 50.54 q; 10 CFR 50.59; 10 CFR 55.59

B.15 a
REF: Emergency Procedure

B.16 d
REF: Emergency Procedure

B.17 c
REF: 10CFR55.53(e) & (f) (*** End of Section B ***)

C.1 c
REF: SAR page 27.

C.2 b
REF: SAR page 27.

C.3 a
REF: SAR pages 67.

C.4 c
REF: OSU SAR, §§ 3.3.13, 14, 15 & 17

C.5 b
REF: SAR page 36.

C.6 a, 3 b, 3 c, 3 d, 3
REF: SAR page 78.

C.7 a
REF: SAR page 77.

C.8 c
REF: SAR page 67.

C.9 b
REF: SAR page 64.

C.10 d
REF: EP-03.

C.11 a, 4 b, 2 c, 4 d, 5
REF: SAR page 45.

C.12 b
REF: SAR page 69.

C.13 c
REF: Technical Specifications, Section 3.2.3.

C.14 d
REF: Facility Comment.

C.15 d
REF: SAR Figure 3.16.

C.16 c
REF: SAR Table 3.2.

C.17 c
REF: SAR page 69.

C.18 c
REF: SAR page 77.

(***** End of Examination *****)