August 19, 2008

Dr. Steven E. Reese, Director
Oregon State University
Radiation Center, A100
Corvallis, OR 97331-5903

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-243/OL-08-01, OREGON STATE UNIVERSITY

Dear Dr. Reese:

During the week of July 28, 2008, the NRC administered an operator licensing examination at your Oregon State University 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 pty@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. 50-243

Enclosures: 1. Initial Examination Report No. 50-243/OL-08-01
2. Facility Comments
3. Written examination with facility comments incorporated

cc without enclosures: See next page

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RidsNRRDPRPRTB Facility File (CHart) O-13 D-07

ADAMS ACCESSION #:ML082140719 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung pty		CHart cah		JEads jhe	
DATE	8/5/08		8/15/08		8/19/08	

OFFICIAL RECORD COPY

Oregon State University Docket No. 50-243

cc:

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Test, Research, and Training
Reactor Newsletter
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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-243/OL-08-01

FACILITY DOCKET NO.: 50-243

FACILITY LICENSE NO.: R-106

FACILITY: Oregon State University

EXAMINATION DATES: July 29, 2008

SUBMITTED BY: Phillip T. Young, Chief Examiner — 08/01/2008, Date

SUMMARY:

During the week of July 28, 2008, the NRC administered operator licensing examinations to one Reactor Operator candidate. The candidate passed the written examination and all portions of the operating test.

REPORT DETAILS

1. Examiners:
   Phillip T. Young, Chief Examiner, 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, NRC, Examiner
   Gary M. Wachs, Reactor Supervisor, Oregon State University
   Todd Keller, Reactor Administrator, Oregon State University

The NRC examiner thanked the facility staff for their cooperation during the examination. The examiner reported no generic weaknesses:

FACILITY COMMENTS on the WRITTEN EXAMINATION

Philip:

The following comments are attached to allow you to update you examination question bank as necessary. These are comments from the Oregon State University Reactor Operator examination provided on July 29, 2008.

Section A, **Question A.012:**

This question is technically correct, however we feel it does not apply to current fuel behavior. Although we are licensed to operate with standard fuel, we do not possess any standard fuel elements. In FLIP fuel, Doppler broadening plays only a small part in overall fuel temperature coefficient behavior. Spectral hardening coupled with parasitic Erbium absorption plays a much more significant role, and thus the fuel temperature coefficient does not become less negative with increasing temperature. Figure 3.24 in the training manual demonstrates that the FLIP fuel temperature coefficient is linearly dependent on temperature throughout the entire range of OSTR operation. Figure 3.22 demonstrates the fuel temperature (Doppler) coefficient becoming less negative at higher fuel temperatures, but applies only to standard fuel.

We request that you invalidate this question and reevaluate or restructure it for future use.

NRC Response:
The NRC agrees with all facility comments as written. Questions A.012 and B.010 have been deleted from the examination and questions C.001, C.003 and C.004 will be reviewed and modified as necessary for future examinations.

Section B, **Question B.010**

Although knowledge of license requirements is necessary for a Reactor Operator, this question was felt to be inappropriate for an RO level exam since it specifically addresses SRO recertification requirements.

We request that you invalidate this question and reevaluate or restructure it for future use.

Section C, **Question C.001**

Operating experience and testing with the fuel handling tool show that only one inch (rather than 3 inches) of travel is required to release a grappled fuel element. Appropriate changes to the OSTROP 11, Section IV.A.2. and the training manual will be made to correct this error.

We request that you invalidate this question and restructure it for future use.

ENCLOSURE 2

Section C, **Question C.003**

The percent power channel and the nvt circuit are driven by a compensated ion chamber operated in the uncompensated mode. This information is provided as exam feedback and we do not wish to contest the question. The training manual will be updated.

Section C, **Question C.004**

Per the Technical Specifications Basis (3.72), the tank temperature limit is based on maintaining tank integrity. Other sources indicate that this temperature limit also protects the demineralizer resin. This information is provided as exam feedback and we do not wish to contest the question.

Again, thank you for your timely response to our request for this examination slot and we hope to host another visit next year.

Gary Wachs
OSTR Reactor Supervisor
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US NRC

Oregon State University

Operator License Examination

Written Exam with Answer Key

July 29, 2008

ENCLOSURE 3

Question A.001 (1.0 point) {1.0}
Which of the following statements best characterizes Natural Circulation?

a. It needs a pump to get started.
b. The elevation of the heat source must be above that of the heat sink.
c. The driving force is a difference in density.
d. Heat transfer is more efficient if steam is mixed with water.

Answer: A.001 c.
Reference:

Question A.002 (1.0 point) {2.0}
Which one of the following is the reason for operating with thermal neutrons instead of fast neutrons?

a. Neutron absorption in non fuel material increases exponentially as neutron energy increases.
b. Doppler and moderator temperature coefficients become positive as neutron energy increases.
c. The fission cross section of the fuel is much higher for thermal energy neutrons than fast neutrons.
d. Increased neutron efficiency since thermal neutrons are less likely to leak out of the core than fast neutrons.

Answer: A.002 c.
Reference:

Question A.003 (1.0 point) {3.0}
Which ONE of the following describes the MAJOR contributor to the production and depletion of Xenon respectively in a STEADY-STATE OPERATING reactor?

	Production	Depletion
a.	Radioactive decay of Iodine and Tellurium	Radioactive Decay
b.	Radioactive decay of Iodine and Tellurium	Neutron Absorption
c.	Directly from fission	Radioactive Decay
d.	Directly from fission	Neutron Absorption

Answer: A.003 b.
Reference: Oregon State University Training Manual Volume 3, Reactor Operation and Xenon Poisoning, p. 22, 1st ¶.

Question A.004 (1.0 point) {4.0}
Which one of the following is the description of a thermal neutron?

a. A neutron possessing thermal rather than kinetic energy.

b. The primary source of thermal energy increase in the reactor coolant during reactor operation.

c. A neutron that experiences no net change in energy after several collisions with atoms of the diffusing media.

d. A neutron that has been produced in a significant time (on the order of seconds) after its initiating fission took place.

Answer: A.004 c.
Reference: Generic

Question A.005 (1.0 point) {5.0}
Which one of the following is the definition for INTEGRAL ROD WORTH?
Integral Rod Worth is defined as the reactivity:

a. due to control rod position.

b. change per unit of rod motion.

c. due to the difference in a control rods position.

d. still available for shutdown after control rod withdrawal.

Answer: A.005 a.
Reference:

Question A.006 (1.0 point) {6.0}
Which one of the following reactions describes how 7Nitrogen16 is produced?
7 Oxygen 16:

a. absorbes a neutron then decays by proton emition.

b. decays by neutron emition then absorbes a proton

c. absorbes a proton then decays by neutron emition

d. decays by a proton emition then absorbes a neutron

Answer: A.006 a.
Reference: Chart of the Nuclides

Question A.007 (1.0 point) {7.0}
Given the following Primary System Parameters.

Reactor Pool Volume	14,250 gals
Reactor Pool Temperature	104 F
Reactor Power Level	1 MW

Which one of the following is the amount of time that is available before the reactor is scrammed, at 118 F pool temperature, when primary coolant flow is lost?

a. 15 minutes
b. 22 minutes
c. 29 minutes
d. 36 minutes

Answer: A.007 c.
Reference:

Question A.008 (1.0 point) {8.0}
Which statement illustrates a characteristic of Subcritical Multiplication?

a. The number of source neutrons decreases for each generation.
b. The number of fission neutrons remain constant for each generation.
c. The number of neutrons gained per generation gets larger for each succeeding generation.
d. As Keff approaches unity (1), for the same increase in Keff, a greater increase in neutron population occurs.

Answer: A.008 d.
Reference:

Question A.009 (1.0 point) {9.0}
The purpose of the installed neutron source is to:

a. Compensate for neutrons absorbed in non-fuel materials in the core.
b. Provide a means to allow reactivity changes to occur in a subcritical reactor.
c. Generate a sufficient neutron population to start the fission chain reaction for each startup.
d. Generate a detectable neutron source level for monitoring reactivity changes in a shutdown reactor.

Answer: A.009 d.
Reference:

Question A.010 (1.0 point) {10.0}
Which ONE of the following coefficients will be the first one to start turning reactor power after a power excursion?

a. Moderator Coefficient
b. Void Coefficient
c. Doppler Coefficient
d. Poisons buildup

Answer: A.010 c.
Reference:

Question A.011 (1.0 point) {11.0}
Shutdown margin is the actual amount of reactivity:

a. inserted by burnable poisons at beginning of life.
b. due to Xenon and Samarium concentrations.
c. by which the reactor is subcritical.
d. which would be inserted by all control rods.

Answer: A.011 c.
Reference:

Question A.012 (1.0 point) {12.0} Question DELETED from EXAMINATION
~~Why does the fuel temperature (Doppler) coefficient becomes less negative at higher fuel temperatures?~~
~~a. As reactor power increases, the rate of increase in the fuel temperature diminishes.~~
~~b. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.~~
~~c. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.~~
~~d. The broadening of the resonance peaks diminishes per degree change in fuel temperature.~~
~~Answer: A.012 d.~~
~~Reference:~~

Question A.013 (1.0 point) {13.0}
The term "prompt jump" refers to:

a. a negative reactivity insertion which is less than β_{eff}.
b. the instantaneous change in power due to raising a control rod.
c. a reactor which has attained criticality on prompt neutrons alone.
d. a reactor which is critical using both prompt and delayed neutrons.

Answer: A.013 b.
Reference: OSU Training Manual Volume 3, Prompt Jump or Drop, p. 39.

Question A.014 (1.0 point) {14.0}
Which ONE of the following isotopes will cause a neutron to lose the most energy in an elastic collision?

a. $Uranium^{238}$
b. $Carbon^{12}$
c. $Hydrogen^{2}$
d. $Hydrogen^{1}$

Answer: A.014 d.
Reference: OSU Training Manual Volume 3, Moderators, p. 12.

Question A.015 (1.0 point) {15.0}
K_{eff} for the reactor is 0.98. If you place an experiment worth +$1.00 into the core, what will the new K_{eff} be?

a. 0.982
b. 0.987
c. 1.013
d. 1.018

Answer: A.015 b.
Reference: OSU Training Manual Volume 3,
SDM = $(1-k_{eff})/k_{eff}$ = (1-0.98)/0.98 = 0.02/0.99 = 0.02041 or
0.02041/.0075 = $2.72, or a reactivity worth (ρ) of -$2.72.
Adding +$1.00 reactivity will result in a SDM of $2.72 - $1.00 = $1.72, or
.0129081 ΔK/K K_{eff} = 1/(1+SDM) = 1/(1 + 0.0129081) = 0.987

Question A.016 (1.0 point) {16.0}
About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5}% full power what will the power be in three minutes.

a. 5×10^{-6}% full power
b. 2×10^{-6}% full power
c. 1×10^{-6}% full power
d. 5×10^{-7}% full power

Answer: A.016 c.
Reference: $P = P_0 e^{-T/\tau} = 10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

Question A.017 (1.0 point) {17.0}
Which ONE of the following isotopes has the largest microscopic cross-section for absorption for thermal neutrons?

a. Sm^{149}
b. U^{235}
c. Xe^{135}
d. B^{10}

Answer: A.017 c.
Reference: Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, Kreiger Publishing, Malabar, Florida, 1991, §

Question A.018 (1.0 point) {18.0}
A complete core load is in progress on a research reactor. The following data has been taken.

Number of Elements Installed	Detector A (cpm)	Detector B (cpm)
0	11	13
2	13	15
4	17	18
6	22	22
8	34	30

NUMBER OF ELEMENTS INSTALLED

Using the graph paper provided, determine which of the following is the approximate number of fuel elements that will be required to be loaded for a critical mass.

a. 8
b. 10
c. 12
d. 14

Answer: A.018 c.
Reference: OSU Training Manual Vol. 3, pp. 45-50

Question A.019 (1.0 point) {19.0}
Which ONE of the following conditions describes a critical reactor?

a. $K_{eff} = 1$; $\Delta k/k$ (ρ) = 1

b. $K_{eff} = 1$; $\Delta k/k$ (ρ) = 0

c. $K_{eff} = 0$; $\Delta k/k$ (ρ) = 1

d. $K_{eff} = 0$; $\Delta k/k$ (ρ) = 0

Answer: A.019 b.
Reference: OSU Training Manual Vol. 3, p. 11

Question A.020 (1.0 point) {20.0}
Initially Nuclear Instrumentation is reading 30 CPS and the reactor has a K_{eff} of 0.90. You add an experiment which causes the Nuclear instrumentation reading to increase to 60 CPS. Which ONE of the following is the new K_{eff}?

a. 0.91

b. 0.925

c. 0.95

d. 0.975

Answer: A.020 c.
Reference: $CR_2/CR_1) = (1 - K_{eff1})/(1 - K_{eff2})$ $60/30 = (1 - 0.900)/(1 - K_{eff2})$
$1- K_{eff2} = ½ \times 0.1 = 0.05$ $K_{eff2} = 1 - 0.05 = 0.95$

Question B.001 [1.0 point] {1.0}
According to the OSTROP 11, Fuel Element Handling Procedure, “even the least radioactive fuel element in the core has an associated dose rate of _____ at a distance of three feet in air after a week or so of decay.”

a. greater than 100 R/hr
b. greater than 500 R/hr
c. greater than 1000 R/hr
d. greater than 10000 R/hr

Answer: B.001 a.
Reference: OSTROP 11, Fuel Element Handling Procedure

Question B.002 [1.0 point] {2.0}
If the difference in core excess as measured just before and just after exchanging the two elements is _____ then the control rods will be recalibrated.

a. greater than 6 cents
b greater than 8 cents
c. greater than 10 cents
d. greater than 12 cents

Answer: B.002 b.
Reference: OSTROP 11, Fuel Element Handling Procedure

Question B.003 [1.0 point] {3.0}
In-core fuel handling is a form of reactor operation. Limiting conditions of operation in other Technical Specifications and OSTROPs relating to reactor operation will also be applicable to in-core fuel handling. Which one of the following is NOT applicable?

a. Ventilation system and stack monitor shall be operating.
b. In-core fuel handling shall only be performed by a licensed operator.
c. An area radiation monitor near the fuel movement shall be operational.
d. limitation on the crane positioning during reactor operation is applicable during fuel handling.

Answer: B.003 d.
Reference: OSTROP 11, Fuel Element Handling Procedure

Question B.004 [1.0 point] {4.0}
For each event listed, identify the appropriate action the console operator shall take (according to OSTROP 1, Emergency Operating Procedures) as either SHUTDOWN the reactor or SCRAM the reactor. Assume the condition(s) has been verified.

a. Stack gas high activity.
b. Stack monitor pump off.
c. Stack monitor filter failure.
d. Stack particulate high activity.

Answer: B.004 a. = scram b. = shutdown c. = shutdown d. = scram
Reference: OSTROP 1, Emergency Operating Procedures

Question B.005 [1.0 point, 0.25 each] {5.0}
Identify each of the following as either a Safety Limit (SL), a Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO)

a. The temperature in a TRIGA-FLIP fuel element shall not exceed 2100□F (1150□C) under any conditions of operation.
b. … shall be 510ºC (950ºF) as measured in an instrumented fuel element.
c. The shutdown margin provided by control rods shall be greater than $0.57 with: experimental facilities, and experiments in place and the highest worth non-secured experiment in its most reactive state, the most reactive control rod fully withdrawn, and the reactor in the cold condition without xenon.
d. The reactor shall not be operated if: The pool water bulk temperature exceeds 120ºF (49ºC).

Answer: B.005 a. = SL; b. = LSSS; c. = LCO; d. = LCO
Reference: Technical Specifications §§ 2.1, 2.2, 3.2 and 3.7.2

OL-01-01 Question B.006 [1.0 points, 0.25 each] {6.0}
Identify each of the following as either a Channel Check, a Channel Test or a Channel Calibration.

a. Dipping a temperature detector in ice water and verifying the channel reads 32ºF (0ºF)
b. Verifying proper overlap between Nuclear Instrumentation Channels during startup.
c. After receiving an alarm on an Area Radiation Monitor, you verify the reading with a hand-held meter.
d. Performing a reactor pool water rate-of-temperature-rise measurement, then adjusting the detectors to correct readout.

Answer: B.006 a. = test; b. = check; c. = check; d. = cal
Reference: Technical Specifications §§ 1.31, 1.32 and 1.33

Question B.007 [1.0 points, 0.25 each] {7.0}
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

Answer: B.007 a. = 2; b. = 3; c. = 3; d. = 4
Reference: 10 CFR 20.1003, Definitions

Question B.008 [1.0 point] {8.0}
The Quality Factor is used to convert …

a. dose in rads to dose equivalent in rems.
b. dose in rems to dose equivalent in rads.
c. contamination in rads to contamination equivalent in rems
d. contamination in rems to contamination equivalent in rads.

Answer: B.008 a
Reference: 10CFR20.1004.

Question B.009 [1.0 point] {9.0}
Two inches of shielding reduce the gamma exposure in a beam of radiation from 400 mR/hr to 200 mR/hr. If you add an additional four inches of shielding what will be the new radiation level? (Assume all reading are the same distance from the source.)

a. 25 mR/hr
b. 50 mR/hr
c. 75 mr/hr
d. 100 mr/hr

Answer: B.009 b.
Reference: Nuclear Power Plant Health Physics and Radiation Protection, Research Reactor Version©1988, § 9.2.3 "Half-Thickness and Tenth-Thickness"

QUESTION DELETED form the EXAMINATION per FACILITY COMMENT

~~Question B.010 [1.0 point] {10.0}~~

~~Per 10CFR55.53, an SRO who has not maintained active status must have an authorized representative of the facility licensee certify the following:~~

~~a. a minimum of six hours of shift functions under the direction of an operator or senior operator as appropriate and in the position to which the individual will be assigned has been completed.~~

~~b. a minimum of four hours of shift functions under the direction of an operator or senior operator as appropriate and in the position to which the individual will be assigned has been completed.~~

~~c. a minimum of six hours of shift functions under the direction of an operator or senior operator as appropriate and in the position to which the individual will be assigned has been completed and, that in part, the individual is current in all of the facility requalification program requirements.~~

~~d. a minimum of four hours of shift functions under the direction of an operator or senior operator as appropriate and in the position to which the individual will be assigned has been completed and, that in part, the individual has completed a requalification program written examination and operating test within the current calendar quarter.~~

~~Answer: B.010 c.~~

~~Reference: 10CFR55.53 and 10CFR55.59~~

Question B.011 [1.0 point] {11.0}

Technical Specification 5.4 requires “all fuel and fueled devices not in the core shall be stored in such a way that K_{eff} is less than …

a. 0.80

b. 0.85

c. 0.90

d. 0.95

Answer: B.011 a

Reference: Technical Specification 5.5, p. 27

Question B.012 [1.0 points, ¼ each] {12.0}

Identify the PRIMARY source (irradiation of Air, irradiation of Water, or Fission product) of <u>EACH</u> of the radioisotopes listed.

a. $_{1}H^{3}$

b. $_{18}Ar^{41}$

c. $_{7}N^{16}$

d. $_{54}Xe^{135}$

Answer: B.012 a. = Water; b. = Air; c. = Water; d. = Fission

Reference: Standard NRC Question.

Question B.013 [1.0 point] {13.0}
During operations the console operator encounters an unusual condition, prompting him/her to shutdown the reactor and suspend operations. Which one of the following is the concurrences required to restart the reactor?

a. The Console Operator, and the Reactor Supervisor.
b. The Reactor Supervisor and the Reactor Administrator.
c. The Console Operator, and the Reactor Supervisor.
d. The Console Operator, the Reactor Supervisor and the Reactor Administrator.

Answer: B.013 d
Reference: OSTROP 1, 6, Administrative and Personnel Procedures, § VI.B.5, p. 24.

Question B.014 [1.0 point] {14.0}
Which ONE of the following is the maximum number of times the reactor may be pulsed in a one hour period WITHOUT Reactor Supervisor permission?

a. Three
b. Six
c. Nine
d. Twelve

Answer: B.014 b.
Reference: OSTROP 4, Reactor Operation Procedures, p. 9.

Question B.015 [2.0 points, 0.5 each] {16.0}
Match the values from column B for the Technical Specification limits listed in column A. (Values in Column B may be used more than once or not at all. Each limit in section A should have only one answer.)

Column A	Column B
a. Minimum Shutdown margin with the most reactive control rod fully withdrawn cold, no xenon, experimental facilities and experiments in place, with highest worth non-secured experiment in its most reactive state.	1. $0.57 2. $1.00
b. Total Maximum Reactivity worth of all experiments.	3. $2.55
c. Total Maximum Reactivity worth of any single experiment	4. $3.00
d. Maximum allowable pulse (by Technical Specifications).	5. $4.25

Answer: B.015 a. = 1. $0.57; b. = 4. $3.00; c. = 3. $2.55 d. = 3. $2.55
Reference: Technical Specification §§ 3.2, 3.3 and 3.8

Question B.016 [1.0 point] {17.0}
A radiation survey instrument was used to measure an irradiated experiment. The results were 100 mrem/hr with the window open and 60 mrem/hr with the window closed. What was the beta dose rate?

a. 40 mrem/hr
b. 60 mrem/hr
c. 100 mrem/hr
d. 140 mrem/hr

Answer: B.016 a.
Reference: Instrument reads only γ dose with window closed. Instrument reads both β and γ dose with window open. Therefore, β dose is window open dose less window closed dose.

Question B.017 [1.0 point] {18.0}
You use a Geiger-Müller detector at the same distance from two point sources having the same curie strength. Source A's gammas have an energy of 1.0 MeV, while Source B's gammas have an energy of 2.0 MeV. Which ONE of the following would you expect for the readings due to each source?

a. The reading from source B is four times that of source A.
b. The reading from source B is twice that of source A.
c. The reading from source B is half that of source A.
d. Both readings are the same.

Answer: B.017 d.
Reference: GM tubes are NOT sensitive to energy level.

Question B.018 [1.0 point] {19.0}
Which ONE of the following conditions is a Reportable Occurrence per Technical Specifications?

a. Irradiation of a sample containing 20 milligrams of explosive material.
b. Operation of the reactor with a fuel temperature scram set at 500ºC.
c. Operation of the reactor with bulk water temperature at 45ºC.
d. Operation with pool water level 13 feet above the core.

Answer: B.018 d .
Reference: Technical Specifications, 2.2, 3.3.a, 3.6.d and 3.2.2 (Table 2)

Question B.019 [1.0 point] {20.0}
An individual receives 100 mRem of Beta (ß), 25 mRem of gamma (γ), and 5 mRem of neutron radiation. What is his/her total dose?

a. 275 mRem
b. 205 mRem
c. 175 mRem
d. 130 mRem

Answer: B.019 d.
Reference: 10 CFR 20.4 A rem is a rem is a rem

QUESTION DELETED form the EXAMINATION per FACILITY COMMENT

~~Question C.001 [1.0 point] {1.0}~~

~~To release the fuel element, from the flexible handling tool, it is necessary to _____.~~

~~a. pull the handle out approximately 1 inch.~~

~~b. push the handle in approximately 2 inches.~~

~~c. pull the handle out approximately 3 inches.~~

~~d. pull the handle out approximately 6 inches.~~

~~Answer: C.001 c.~~

~~Reference: OSU Trn Man Volume 1, Fuel Handling Equipment~~

Question C.002 [1.0 point] {2.0}

The gas used to move pneumatic tube "rabbit" samples into and out of the reactor is ...

a. H

b. Air

c. CO_2

d. N_2

Answer: C.002 b

Reference: OSU Trn Man Volume 1, Pneumatic Transfer System, Figure 1.40 p. 71.

Question C.003 [2.0 point, 0.33 each] {4.0}

Match the detector type in column B with the proper reactor channel in column A. (Note items from column B may be used more than once, or not at all.)

Column A	Column B
a. Linear Channel	1. Fission Chamber
b. Log-N Channel	2. BF_3 Counter
c. Period Channel	3. Compensated Ion Chamber
d. Safety Channel	4. Uncompensated Ion Chamber
e. Percent Power Channel	5. Cherenkov Detector
f. nv circuit Channel	

Answer: C.003 a. = 1; b. = 1; c = 1 d. = 4; e. = 4; f. = 4

Reference: OSU Trn Man Volume 2, § IV OSTR Neutron Detection Channels pp. 15 -116.

NOTE: For future reference, the per cent power channel and the nvt circuit are driven by a compensated ion chamber operated in the uncompensated mode.

Question C.004 [1.0 point] {5.0}
Which ONE of the following is the reason that primary temperature is maintained below 49ºC? Above this temperature the ...

a. purification system filter melts.
b. demineralizer resin rate of depletion increases.
c. diffusion of N^{16} from the pool increases dramatically.
d. bath temperature coefficient changes from negative to positive.

Answer: C.004 b.
Reference: OSU Trn Man Volume 1, Reactor Water Systems, pp. 106-116.
NOTE: per TS Basis (3.72) the tank temperature limit is based on maintaining tank integrity.

Question C.005 [1.0 point] {6.0}
Which ONE of the following is the actual method used to determine standard control rod position from fully inserted to fully withdrawn?

a. A logic circuit receives input from two sensors which count 100 pulses per revolution along with detecting direction, converting these signals to rod position.

b. As the rod moves up and down, the magnet opens and closes a series of 100s of limits switches which generate a signal which is converted to rod position.

c. A potentiometer, driven by the rod drive motor, generates a signal proportional to rod position.

d. As the rod moves, it moves into or out of a coil, generating a signal proportional to rod position.

Answer: C.005 c.
Reference: OSU Trn Man Volume 1, Control Rod Drives, p. 44.

Question C.006 [1.0 point] {7.0}
Fill in the blank: In the event of failure of the pool cooling system, the heat capacity of the reactor pool is sufficient to cool the reactor for about ____, with the reactor operating at 1000 Kilowatts. Assume starting temperature is 19ºC and you go up to the maximum bulk temperature allowed.

a. 30 seconds
b. 30 minutes
c. 4 hours
d. a Week

Answer: C.006 b.
Reference: OSU Trn Man Volume 1, Reactor Water Systems, pp. 106 - 11 6.

$$Power(kilowatt) = \frac{20.280\left(\frac{kWh}{^{\circ}C}\right)(\Delta Temp)}{\Delta Time\ (hours)} \qquad Time(hours) = \frac{20.280(49-19)}{1000\,kW} = \frac{20.280\times 30}{1000\,kW} = 0.6084\,hours = 36.5\,minutes$$

Note: The candidate is NOT required to know this equation. Instead the candidate should base his/her answer on experience operating the reactor, and performance of a power calibration.

Question C.007 [1.0 point] {8.0}
When a fuel element is engaged by the Fuel handling tool locking mechanism, the control cable should never be coiled in a circle of a diameter less than about 2 feet because?

a. A tight coil will break the cable.
b. A tight coil will stack too high causing a tripping hazard.
c. A tight coil will pull the inner wire and may release the fuel element.
d. A tight coil will require excessive force when going into or out of the locking position

Answer: C.007 c.
Reference: OSU Trn Man Volume 1, Fuel Handling Equipment

Question C.008 [1.0 point] {9.0}
Flow through the demineralizer loop is limited to 10 gallons per minute. This limit is to prevent

a. blowing resin out of the demineralizer thereby clogging the filter.
b. creating channels through the demineralizer reducing efficiency.
c. blowing the upstream filter into the demineralizer.
d. overpressurization of the demineralizer.

Answer: C.008 b.
Reference: OSU Trn Man Volume 1, Demineralizer, p. 116.

Question C.009 [1.0 point] {10.0}
A sample placed in which ONE of the following experimental facilities can be modified to supply a highly collimated beam of neutron and gamma radiation?

a. Lazy Susan
b. Central Thimble
c. Hollow Element Assembly
d. Pneumatic Transfer system

Answer: C.009 b.
Reference: OSU Trn Man Volume 1, Central Thimble, p. 89.

Question C.010 [1.0 point] {11.0}
The purpose of the graphite slugs located at the top and bottom of each fuel rod is to...

a. reflect neutrons, thereby reducing neutron leakage from the core.
b. absorb neutrons, thereby reducing neutron leakage from the core.
c. couple neutrons from the core to the nuclear instrumentation, decreasing shadowing effects.
d. absorb neutrons, thereby reducing neutron embrittlement of the upper and lower guide plates.

Answer: C.010 a.
Reference: OSU Trn Man Volume 1, Fuel-Moderator Elements, p. 33. 1st lf, last sentence.

Question C.011 [1.0 point] {12.0}
The ventilation system contains a static regulator which modulates a static pressure damper to maintain the reactor bay pressure at a ...

a. higher pressure than the Radiation center building.
b. higher pressure than the outside atmosphere.
c. lower pressure than the outside atmosphere.
d. pressure equal to atmospheric pressure.

Answer: C.011 c.
Reference: OSU Trn Man Volume 1, Reactor Bay Exhaust Fan, pp. 146 - 148.

Question C.012 [1.0 point] {13.0}
Which ONE of the following parameters is NOT measured in the Primary Cooling/Purification System Loops?

a. Temperature
b. Conductivity
c. Flow Rate
d. pH

Answer: C.012 d.

Reference: OSU Trn Man Volume 1, Reactor Water Systems, pp. 106 - 120.

Question C.013 [1.0 point] {14.0}

Primary system water returning to the pool is ejected from an angled nozzle, causing a swirling motion of the water in the pool. Which ONE of the following is the PRIMARY purpose for this design?

a. To increase the heat transfer rate due to increased convective flow.
b. To decrease the activation rate of O^{16} to N^{16} due to a decrease in time within the core.
c. To increase the transport time for N^{16} to reach the surface of the pool.
d. To break up O^{16} bubbles in the pool thereby decreasing the production of N^{16}.

Answer: C.013 c.
Reference: OSTR Training Manual Vol. I Reactor Water Systems, fig. 1.6.

Question C.014 [1.0 point] {15.0}

Which ONE of the listed Nuclear Instrumentation Channels/circuits listed below does NOT provide an input to the Regulating Rod Automatic Control Circuit.

a. Log-N
b. Linear Power
c. Percent Power
d. Percent Demand

Answer: C.014 c.
Reference: ORST Trn Man Volume II, Figure 2.16

Question C.015 [2.0 points, $^1/_2$ each] {17.0}

The core is shielded radially by (a) of graphite reflector, (b) of lead (inside the reflector can), (c) of water, and (d) of concrete. For the shielding items identified a – d in the question and listed in Column A chose the correct dimension from the items in Column B. Items in Column B may or may not be used.

	Column A	Column B
a.	graphite reflector.	2 inches
b.	lead.	8 inches
c.	water.	1.5 feet
d.	concrete.	8 feet
		15 feet

Answer: C.015 a. = 8”; b. = 2”; c. = 1.5’; d. = 8’
Reference: ORST Trn Man Volume I, Reactor Description

Question C.016 [2.0 points, $^1/_2$ each] {19.0}
Identify each of the control rods as having either a fuel follower or an air follower.

a. Shim
b. Safety
c. Transient
d. Regulating

Answer: C.016 a. = Fuel; b. = Fuel; c = Air; d.= Fuel
Reference: Volume 1, pages 40-44, OSU Triga Manual

Question C.017 [1.0 point] {20.0}
Which ONE of the following electrical loads is NOT powered by the Emergency Generator or inverter batteries on a loss of site power?

a. Argon Fan
b. Cypher Lock
c. Television Monitor
d. Stack Monitor Pump

Answer: C.017 a.
Reference: OSTROP 22