February 22, 2001

Dr. Akira T. Tokuhiro, Reactor Director
Nuclear Reactor Facility
University of Missouri – Rolla
Rolla, Missouri 65401-0249

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-123/OL-01-01

Dear Dr. Tokuhiro:

During the week of January 29, 2001, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your University of Missouri – Rolla Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's 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 document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/indesx.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 Paul Doyle at (301)415-1058 or via Internet E-mail at pvd@nrc.gov.

Sincerely,

/RA/

Ledyard B. Marsh, Chief
Events Assessment, Generic Communications
and Non-Power Reactors Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-123

Enclosures:
1. Initial Examination Report No. 50-123/OL-01-01
2. Facility comments with NRC resolution
3. Examination and answer key (RO/SRO)

cc w/encls:
Please see next page

cc:

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1870 Miner Circle
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February 22, 2001

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<u>DISTRIBUTION</u> w/ encls.:

PUBLIC	REXB r/f	LMarsh
SHolmes	MMendonca	PDoyle
Facility File (EBarnhill) O6-D17		

ADAMS ACCESSION #: ML010520294 **TEMPLATE #:NRR-074**

*Please see previous concurrence

OFFICE	REXB:CE	E	IOLB	E	REXB:BC	
NAME	*PDoyle		*EBarnhill		LMarsh	
DATE	02/ 22 /01		02/ 22 /01		02/ 22 /01	

C = COVER **E = COVER & ENCLOSURE** **N = NO COPY**

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

REPORT NO.: 50-123/OL-01-01

FACILITY DOCKET NO.: 50-123

FACILITY LICENSE NO.: R-79

FACILITY: University of Missouri – Rolla

EXAMINATION DATES: January 31, 2001

EXAMINER: Paul Doyle, Chief Examiner

SUBMITTED BY: ***/RA/*** 2/13/01
Paul V. Doyle Jr., Chief Examiner Date

SUMMARY:

During the week of January 29, 2001, the NRC administered operator licensing examinations to one Senior Operator (Instant) license candidate, and one Senior Operator (Upgrade) license candidate. Both candidates passed all applicable portions of the examination.

REPORT DETAILS

1. Examiners:
   Paul V. Doyle Jr., Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	0/0	1/0	1/0
Operating Tests	0/0	2/0	2/0
Overall	0/0	2/0	2/0

3. Exit Meeting:
   Paul Doyle, NRC, Examiner
   Dr. Akira Tokuhiro, UMR, Facility Director
   Mr. William Bonzer, UMR, Reactor Supervisor

   Mr. Bonzer presented Mr. Doyle with a preliminary copy of facility comments on the written examination. Mr. Doyle told the facility staff that he did not note any generic weaknesses on the part of the candidates, and thanked the staff for their assistance in support of administering the examination. Mr. Bonzer subsequently E-mailed the rest of his comments. All facility comments along with their resolutions are included in attachment 2 to this report.

Facility Comments and NRC Resolution

During the exit meeting the Mr. Bonzer of the facility staff present Mr. Doyle with the following two comments:

A.15 did not list an answer, it should be "a".

Total Rod Worth	1.25% ΔK/K
- τ_{excess}	- 0.50% ΔK/K
- most worth Rod	- 0.55% ΔK/K
Shutdown Margin	0.20% ΔK/K

B.15 Control element drop times shall be done semiannually. TS 4.2.1(1). Surveillance time interval for semiannually shall not exceed 7½ months. T.S. definition page 7. Answer should be "d", March 15, 2001.

Both comments are accepted as written. The answer key has been modified accordingly.

E-Mail Comments

Question A.6 says that the operator performs two identical startups a week apart, during the second startup the operator stops for 10 minutes to answer the phone. You ask to compare the critical rod height and count rate to the first startup. It does not say when the 10 minute phone call occurred, it could be when the reactor is subcritical and we are performing rod withdrawals that are specified distances before instrument turnaround. It could be later. It appears the question is asking to compare the startups when the reactor is critical. Our SOPs say we level out somewhere between 2W and 20W. For the first stable power we obtain the rod heights will be the same and the count rate will be the same. It appears none of the answers are correct.

Question A.10, Akira answered the question believing the question was referring to the power decreasing at a constant rate. Akira is thinking for the power to decrease at a constant rate it has to be a linear decrease in power and not an exponential decrease. The term CONSTANT used for the power decrease is what he is questioning. The answer that he chose was the one closest to what he had calculated for a linear power decrease.

Question B.5. Parts a and b of this question are incorrect. The answer key should be changed to TEST, CHECK, CAL, TEST.

Thank You,

William Bonzer
Reactor Manager
Nuclear Reactor Facility
University of Missouri-Rolla

Comments on questions A.6 and B.5 accepted. Question A.6 which was missing a phrase describing plant conditions is deleted. Comment on Question A.10 is not accepted.

UNIVERSITY OF MISSOURI–ROLLA

With Answer Key

UNITED STATES NUCLEAR REGULATORY COMMISSION

OPERATOR LICENSING EXAMINATION

January 31, 2001

ENCLOSURE 3

QUESTION A.1 [2.0 points, 0.5 each]
Match each term in column A with the correct definition in column B.

	Column A		Column B
a.	Prompt Neutron	1.	A neutron in equilibrium with its surroundings.
b.	Fast Neutron	2.	A neutron born directly from fission.
c.	Thermal Neutron	3.	A neutron born due to decay of a fission product.
d.	Delayed Neutron	4.	A neutron at an energy level greater than its surroundings.

QUESTION A.2 [1.0 point]
You enter the control room and note that all nuclear instrumentation show a steady neutron level, and no rods are in motion. Which ONE of the following conditions **CANNOT** be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source has been removed from the core.

QUESTION A.3 [1.0 point]
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	Radioactive Decay
b.	Radioactive decay of Iodine	Neutron Absorption
c.	Directly from fission	Radioactive Decay
d.	Directly from fission	Neutron Absorption

QUESTION A.4 [1.0 point] (12)
Most text books list τ for a U^{235} fueled reactor as 0.65% delta k/k. However, your SAR lists τ_{eff} as being 0.7% delta k/k. Why is τ_{eff} larger than τ?

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

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

c. the fuel includes U^{238} which has a relatively large τ for fast fission.

d. some U^{238} in the core becomes Pu^{239} (by neutron absorption) which has a larger τ for fission.

QUESTION A.5 [1.0 point]
Which ONE of the following is an example of alpha decay?

a. ${}_{35}Br^{87} \rightarrow {}_{33}As^{83}$

b. ${}_{35}Br^{87} \rightarrow {}_{35}Br^{86}$

c. ${}_{35}Br^{87} \rightarrow {}_{34}Se^{86}$

d. ${}_{35}Br^{87} \rightarrow {}_{36}Kr^{87}$

~~QUESTION A.6 [1.0 point]~~
~~You perform two initial startups a week apart. Each of the startups has the same starting conditions, (core burnup, pool and fuel temperature, and count rate are the same). The only difference between the two startups is that during the **SECOND** one you stop for 10 minutes to answer the phone. For the second startup compare the critical rod height and count rate to the first startup.~~

	Rod Height	~~Count Rate~~
~~a.~~	~~Higher~~	~~Same~~
~~b.~~	~~Lower~~	~~Same~~
~~c.~~	~~Same~~	~~Lower~~
~~d.~~	~~Same~~	~~Higher~~

QUESTION A.7 [1.0 point]
Several processes occur that may increase or decrease the available number of neutrons. SELECT from the following the six-factor formula term that describes an **INCREASE** in the number of neutrons during the cycle.

a. Thermal utilization factor (f).

b. Resonance escape probability (p).

c. Thermal non-leakage probability ($\mathcal{L}_{th}$).

d. Reproduction factor (τ).

QUESTION A.8 [1.0 point]
Which ONE of the following atoms will cause a neutron to lose the most energy in an elastic collision?

a. $Uranium^{238}$

b. $Carbon^{12}$

c. $Hydrogen^{2}$

d. $Hydrogen^{1}$

QUESTION A.9 [1.0 point] (4)
The reactor supervisor tells you the K_{eff} for the reactor is 0.98. After placing an experiment worth into the core, count rate increases from 50 cpm to 55 cpm. What is the worth of the experiment?

a. +0.085% delta k/k

b. +0.189% delta k/k

c. -0.085% delta k/k

d. -0.189% delta k/k

QUESTION A.10[1.0 point]
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. 10^{-6}% full power

d. 5×10^{-7}% full power

QUESTION A.11[1.0 point]
Core excess reactivity changes with…

a. Fuel burnup

b. Control Rod Height

c. Neutron Level

d. Reactor Power Level

QUESTION A.12[1.0 point]
INELASTIC SCATTERING is the process by which a neutron collides with a nucleus and …

a. recoils with the same kinetic energy it had prior to the collision.

b. is absorbed, with the nucleus emitting a gamma ray, and the neutron with a lower kinetic energy.

c. is absorbed, with the nucleus emitting a gamma ray.

d. recoils with a higher kinetic energy than it had prior to the collision with the nucleus emitting a gamma ray.

QUESTION A.13[1.0 point]
The neutron microscopic cross-section for absorption τ_a generally …

a. increases as neutron energy increases

b. decreases as neutron energy increases

c. increases as target nucleus mass increases

d. decreases as target nucleus mass increases

QUESTION A.14[1.0 point]
Which one of the following is the definition of the FAST FISSION FACTOR?

a. The ratio of the number of neutrons produced by fast fission to the number produced by thermal fission

b. The ratio of the number of neutrons produced by thermal fission to the number produced by fast fission

c. The ratio of the number of neutrons produced by fast and thermal fission to the number produced by thermal fission

d. The ratio of the number of neutrons produced by fast fission to the number produced by fast and thermal fission

QUESTION A.15[1.0 point] (11)
Given the following: τ_{excess} – 0.50% delta k/k, control rod 1 – 0.25% delta k/k
control rod 2 – 0.45% delta k/k control rod 3 – 0.55% delta k/k
Calculate the ***TECHNICAL SPECIFICATION LIMIT*** for Shut Down Margin for this core.

a. 0.20% delta k/k

b. 0.75% delta k/k

c. 1.25% delta k/k

d. 1.75% delta k/k

QUESTION A.16[1.0 point]
Reactor Power increases from 15 watts to 65 watts in 30 seconds. The period of the reactor is:

a. 6.9 seconds

b. 13.6 seconds

c. 20.5 seconds

d. 130 seconds

QUESTION A.17[1.0 point]
WHICH ONE of the following is the MAJOR source of energy released during fission?

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.18[1.0 point]
The number of neutrons passing through a unit surface area per unit time is the definition of which one of the following?

a. Neutron Population (np)

b. Neutron Impact Potential (nip)

c. Neutron Flux (nv)

d. Neutron Density (nd)

QUESTION A.19[1.0 point]
Which ONE of the following is the correct reason that delayed neutrons enhance control of the reactor?

a. There are more delayed neutrons than prompt neutrons.

b. Delayed neutrons increase the average neutron generation time.

c. Delayed neutrons are born at higher energies than prompt neutrons and therefore have a greater effect.

d. Delayed neutrons take longer to reach thermal equilibrium.

QUESTION B.1 [1.0 point]
Which TWO of the following types of experiments **MUST** be specifically approved by the Radiation Safety Committee?

a. Experiments containing explosive materials and fueled experiments

b. Experiments containing explosive materials and experiments containing materials corrosive to reactor components.

c. Experiments containing materials corrosive to reactor components and fueled experiments

d. Experiments containing compounds highly reactive with water and explosive materials.

QUESTION B.2 [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.3 [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.4 [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 facility

b. any Senior Reactor Operator licensed at facility

c. Facility Manager (or equivalent at facility).

d. NRC Project Manager

QUESTION B.5 [2.0 points, ½ point each]
Identify each of the following actions as either a channel **CHECK**, a channel **TEST**, or a channel **CAL**ibration.

a. Prior to startup you place a known radioactive source near a radiation detector, noting meter movement and alarm function operation.

b. During startup you compare all of your nuclear instrumentation channels ensuring they track together.

c. At power, you perform a heat balance (calorimetric) and determine you must adjust Nuclear Instrumentation readings.

d. During a reactor shutdown you note a -80 second period on Nuclear Instrumentation.

QUESTION B.6 [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 does 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.7 [1.0 point]
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

QUESTION B.8 [1.0 point]
Your Reactor Operator license expires after _____ years.

a. 2

b. 4

c. 6

d. 8

QUESTION B.9 [1.0 point]
Per the Emergency plan, "If an emergency situation requires personnel to search for and remove injured person(s) or entry is necessary to prevent conditions that would probably injure numbers of people, 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.10[1.0 point]
Technical Specification 5.4.1 requires "the neutron multiplication factor of the fully loaded storage pit shall not exceed ____ under any conditions

a. 0.80

b. 0.85

c. 0.90

d. 0.95

QUESTION B.11[1.0 point]
According to Technical Specification 3.7.1 “Experiments worth more than _____ delta k/k shall be inserted or removed with the reactor shutdown.

a. 0.05

b. 0.4

c. 1.2

d. 1.5

QUESTION B.12[1.0 point]
In case of an emergency the **NORMAL** Emergency Support Center (evacuation not required) …

a. Physics Building Main Office(Room 102)

b. Reactor Control Room.

c. Nuclear Engineering Department Office (Room 101, 102, 102A, Fulton Hall).

d. Health/Information Security Building, Campus Police Main Office.

QUESTION B.13[1.0 point]
Which ONE of the following Emergency classifications is **NOT** used at UMRR?

a. Notification of Unusual Event

b. Alert

c. Site Area Emergency

d. General Emergency

QUESTION B.14[1.0 point]
A small radioactive source is to be stored in the reactor building. The source reads 2 Rem/hr at 1 foot. Assuming no shielding is to be used, a Radiation Area barrier would have to be erected from the source at least a distance of approximately:

a. 400 feet

b. 40 feet

c. 20 feet

d. 10 feet

QUESTION B.15[1.0 point]
The control element drop times were last measured on July 31, 2000. Which one of the following dates is the latest the maintenance may be performed again without exceeding a Technical Specifications requirement?

a. Oct. 31, 2000

b. Nov. 30, 2000

c. Jan. 31, 2001

d. Mar. 15, 2001

QUESTION B.16[1.0 point]
You must have the Health Physicist (or their designee) present to handle a radioactive sample reading greater than …

a. 1000 mrem/hr @ 1 foot

b. 500 mrem/hr @ 1 foot

c. 100 mrem/hr @ 1 foot

d. 50 mrem/hr @ 1 foot

QUESTION B.17[1.0 point, ¼ each]
Match the Federal Regulation chapter in column A with the requirements covered in column B.

	Column A		Column B
a.	10 CFR 20	1.	Operator Licenses
b.	10 CFR 50	2.	Facility Licenses
c.	10 CFR 55	3.	Radiation Protection
d.	10 CFR 73	4.	Special Nuclear Material

QUESTION C.1 [2.0 points, ½ each]
Match the purification system functions in column A with the purification component listed in column B

Column A	Column B
a. remove floating dust, bug larvae, etc.	1. Demineralizer (Ion Exchanger)
b. remove dissolved impurities	2. Skimmer
c. remove suspended solids	3. Filter
d. maintain pH	

QUESTION C.2 [1.0 point]
The gas used to move pneumatic tube “rabbit” samples into and out of the reactor is …

a. H_2

b. Air

c. CO_2

d. N_2

QUESTION C.3 [1.0 point]
The Ventilation system consists of three fans mounted on the Reactor Building roof. On a Building Evacuation Alarm from the Reactor Bridge Radiation Area Monitor, the

a. All three fans will secure automatically.

b. All three fans must be secured by the Reactor Operator.

c. The two normal exhaust fans will secure automatically, the emergency exhaust fan will start automatically.

d. The Reactor Operator must secure the two normal exhaust fans and start the emergency exhaust fan.

QUESTION C.4 [1.0 point]
Which ONE of the following is the reason that primary temperature is maintained below 57°C (135°F)? This temperature is based upon …

a. a jump in the diffusion of N^{16} from the pool.

b. the bath temperature coefficient changes from negative to positive.

c. the purification system filter melts.

d. the upper limit of the effective temperature range for the ion exchange resin.

QUESTION C.5 [1.0 point]
Inadvertent movement of the reactor bridge will result in …

a. illumination of a status light only.

b. a rod rundown.

c. a reactor scram.

d. an evacuation alarm.

QUESTION C.6 [1.0 point]
Which ONE of the following is the method used to minimize mechanical shock to the control rods on a scram?

a. A small spring located at the bottom of the rod.

b. A piston attached to the upper end of the safety rod enters a special damping cylinder as the rod approaches the full insert position.

c. An electrical-mechanical brake energizes when the rod down limit switch is energized.

d. A piston (part of the connecting rod) drives air out of a dashpot as the rod nears the bottom of travel.

QUESTION C.7 [2.0 points, ⅓ each]
Identify the correct protective action (SCRAM, RUNDOWN, rod withdrawal PROHIBIT, or OPERATOR response for each of the following situations …

a. Period < 30 seconds

b. Log N and Period Amp. Not Operative

c. Effluent Pool Demineralizer Conductivity high

d. High Neutron Flux in Beam Room

e. Safety Rods Below Shim Range

f. reg rod on insert limit in auto control

QUESTION C.8 [1.0 point]
Which ONE of the following is the actual design feature which prevents siphoning of pool water on a failure of the purification system?

a. A valve upstream of the primary pump will shut automatically.

b. A valve downstream of the primary pump will shut automatically.

c. "Vacuum breaks" are located in the system which prevent draining the pool below about 16 feet above the core.

d. The Emergency Fill system will automatically maintain pool level.

QUESTION C.9 [1.0 point]
The heat capacity of the reactor pool is sufficient to cool the reactor for ______, with the reactor operating at full power (200 Kilowatts. Assumption: Starting bulk temperature = 20°C. Note 135°F = 57.2°C.

a. about 10 Minutes

b. about an Hour

c. about a Day (24 hours)

d. about a Week (168 hours)

QUESTION C.10 [1.0 point]
An experimenter drops and breaks open a sample vial in a laboratory room. He immediately runs out of the room and closes the door. You are called in to assist in the cleanup. Prior to opening the door you would take a reading using a(n)

a. Ion Chamber portable radiation detector to determine the radiation field strength.

b. Geiger-Müller portable radiation detector to determine the radiation field strength.

c. Ion Chamber portable radiation detector to determine whether contamination is present.

d. Geiger-Müller portable radiation detector to determine whether contamination is present.

QUESTION C.11 [1.0 point]
Each shim/safety rods consists of a grooved,

a. hafnium rod.

b. boron-carbide rod.

c. boral (boron and aluminum alloy) rod.

d. boron steel rod.

QUESTION C.12 [1.0 point]
A sample placed in which ONE of the following positions will have the greatest effect on core reactivity?

a. Thermal Column

b. Pneumatic Transfer system

c. Core Access Element

d. Beam Tube

QUESTION C.13 [2.0 points, ½ each]
From Figure 11, attached, MATCH the correct items (a through d):

a. Control Rod Element

b. Core Access Element

c. Fuel Element

d. Isotope Production Element

QUESTION C.14 [1.0 point]
A student operating the reactor attempts to withdraw all four control rods simultaneously. Which ONE of the following describes the correct system response?

a. All four control rods will withdraw.

b. The three shim/safety rods will withdraw, an interlock will prevent the regulating rod from withdrawing.

c. The regulating rod will withdraw, an interlock will prevent the three shim/safety rods from withdrawing.

d. An interlock will prevent all four control rods from withdrawing.

QUESTION C.15 [1.0 point]
Which ONE of the following radiation monitors will energize the evacuation alarm?

a. Demineralizer RAM

b. Experiment Room RAM

c. Reactor Bridge RAM

d. CAM

QUESTION C.16 [1.0 point]
Which ONE of the following methods is used to compensate for gamma radiation in a Compensated Ion Chamber?

a. Pulses smaller than a height (voltage) are stopped by a pulse-height discriminator circuit from entering the instrument channel's amplifier.

b. The chamber contains two concentric tubes one of which detects both neutrons and gammas the other only gammas, the signals are added electronically to subtract the gamma signal, leaving only the signal due to neutrons.

c. The signal travels through a Resistance-Capacitance (RC) circuit, converting the signal to a power change per time period effectively deleting the signal due to gammas.

d. A compensating voltage equal to a predetermined "source gamma level" is fed into the pre-amplifier electronically removing source gammas from the signal. Fission gammas are proportional to reactor power and therefore not compensated for.

QUESTION C.17 [1.0 point]
Which ONE of the following parameters is NOT measured in the Purification System?

a. Pressure

b. Flow Rate

c. Conductivity

d. pH

A.1 a, 2; b, 4; c, 1; d, 3
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.2 c
REF: Standard NRC question

A.3 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.4 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.5 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

~~A.6 d~~
~~REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §~~

A.7 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.8 d
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.9 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §
$CR_1/CR_2 = (1-k_{eff2})/(1 - k_{eff1}) = (1 - keff_2) = (1 - 0.98) \times 50/55 = 0.02 \times 50/55 = -0.018182$ or $k_{eff} = 0.98182$
$\Delta\tau = (k_{eff2} - k_{eff1})/(k_{eff2}\ k_{eff1}) = (098182 - 0.98000)/(098182 \times 0.98000) = 1.890 \times 10^{-3} = 0.189\%$ delta k/k

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

A.11 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.12 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.13 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

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

A.15 a
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.16 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §
$P = P_0\ e^{t/\tau}$, $\ln(65/15) = 30sec/\tau$ $\tau = (30\ sec)/(\ln 4.3333) = 20.456$

A.17 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.18 c
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

A.19 b
REF: Burn, R., *Introduction to Nuclear Reactor Operations,* © 1988, §

B.1 a
REF: Technical Specifications § 5.7.2 (1), (2) and (3).

B.2 a, 20; b, 1; c, 1; d, 10
REF: 10CFR20.100x

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

B.4 b
REF: 10CFR50.54(y)

B.5 a, ~~Check~~ Test; b, ~~Test~~ Check; c, Cal; d, Check
REF: Technical Specification 1.3 Definitions, p. 2.

B.6 a
REF: 10 CFR 20.1003 *Definitions*

B.7 b
REF: Nuclear Power Plant Health Physics and Radiation Protection, Research Reactor Version©1988, § 9.2.3 "Half-Thickness and Tenth-Thickness"

B.8 c
REF: 10CFR55.55(a)

B.9 c
REF: Emergency Plan § 7.4.6 4th ¶, p. 18.

B.10 c
REF: Technical Specification 5.4.1

B.11 b
REF: Technical Specification 3.7.1

B.12 a
REF: Emergency Plan, § 8.1, *Emergency Support Center, p. 21.*

B.13 d
REF: Emergency Plan, §§ 4.1 through 4.3.

B.14 c
REF: $\frac{DR_1}{X_2^2} = \frac{DR_2}{X_1^2} X_2^2 = \frac{DR_1}{DR_2} X_1^2$ $X_2^2 = \frac{2000}{5} \times 1^2 = 400 ft^2 X_2 = 20f$

B.15 ~~c~~ d Answer changed per facility comment.
REFERENCE T.S. §§ 1.3 Definitions, p. 7, and 4.2.1 Specification (1), p. 27.

B.16 c
REFERENCE SOP 601, “Handling Radioactive Samples” § C.2 (a), (b), (c) and (d)

B.17 a, 3; b, 2; c, 1; d, 4
REFERENCE Facility License and 10 CFR Parts 20, 50, 55 and 73

C.1 a, 2; b, 1; c, 3; d, 1
REF: SAR § 5.2, pp. 5-1 – 5-3, also Figure 22, p. 5-4.

C.2 d
REF: SAR § 4.3, p. 4-5.

C.3 b
REF: SAR § 3.6.2, Radiation Monitoring System pp. 3-46 and 3-47.

C.4 d
REF: SAR § 5.2, p. 5-3.

C.5 c
REF: SAR § 3.2.6, p. 3.19.

C.6 b
REF: SAR § 3.2.3, p. 3-13

C.7 a, Prohibit; b, Scram; c, Operator; d, Operator; e, Prohibit; f, Rundown
REF: SAR 3-40, Table IX (***Add a rundown***)

C.8 c
REF: SOP 309 *Response to a Coolant System Leak*

C.9 c
REF: SAR, § 3.4.7, p. 3-28.

C.10 a
REF: Standard NRC question.

C.11 d
REF: SAR § 3.2.3, p. 3-11.

C.12 c
REF: SAR § 4 Experimental Facilities (pp. 4-1 through 4-6, and § 3.2.4, Core Access and Isotope Production Elements p. 3-17.

C.13 a, 2; b, 4; c, 1; d. 3
REF: SAR Figure 11, pg. 3-8

C.14 b
REF: SAR 3-35, also NRC Examination Question Bank.

C.15 c
REF: Facility Technical Specifications Table 3.3 and SAR § 3.6.2, pp. 3-46 – 3-48.

C.16 b
REF: Standard NRC question

C.17 d
REF: SAR § 5.2, Figure 22, p. 5-4.

ACCESSION NUMBER:

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-123/OL-00-01

	NAME	DATE
1.	PDOYLE	02/ /2001
2.	EBARNHILL	02/ /2001
3.	LMARSH	02/ /2001
4.	SECRETARY (dispatch)	02/ /2001

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