July 14, 2006

Mr. William Bonzer, Acting Reactor Director
226 Fulton Hall
University of Missouri–Rolla
Rolla, MO 65409-0170

SUBJECT: RETAKE EXAMINATION REPORT NO. 50-123/OL-06-02, UNIVERSITY OF MISSOURI–ROLLA

Dear Mr. Bonzer:

During the week of May 29, 2006, the NRC administered an operator licensing examination at your University of Missouri–Rolla Reactor. The examination was conducted according to NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1.

In accordance with 10 CFR 2.390 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/

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

Docket No. 50-123

Enclosures:
1. Initial Examination Report No. 50-123/OL-06-02
2. Facility comments with NRC resolution
3. Examination and answer key

cc w/encls:
Please see next page

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Facility File (EBarnhill) O-6 F-2	PIsaac	

ADAMS ACCESSION #: ML061790297 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE	IOLB:LA	PRTB:BC
NAME	PDoyle:tls*	Ebarnhill*	JEads:tls*
DATE	6/28/2006	7/13/2006	7/14/2006

OFFICIAL RECORD COPY

cc:

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

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

REPORT NO.: 50-123/OL-03-02

FACILITY DOCKET NO.: 50-123

FACILITY LICENSE NO.: R-79

FACILITY: University of Missouri–Rolla

EXAMINATION DATES: June 1, 2006

SUBMITTED BY: _/RA/_______________________________ 6/28/2006
Paul V. Doyle Jr., Chief Examiner Date

SUMMARY:

The NRC sent the University of Missouri-Rolla reactor facility management a retake examination (Section A only), for administration to one Reactor Operator license candidate. The facility licensee administered the examination on June 1, 2006. The candidate passed the examination.

REPORT DETAILS

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

2. Results:

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

3. Exit Meeting:
Paul V. Doyle Jr., NRC, Examiner

There was no exit meeting held. The facility forwarded their comments to the examiner via e-mail. The comments and their resolutions are included as enclosure 2 to this document.

Mr. Paul Doyle,

We are presenting our review of the written operator licensing examination (Section A) given at the University of Missouri - Rolla Nuclear Reactor Facility during the afternoon of June 1, 2006. We have reviewed the test and received comments from the trainee after he completed the test that we wish to respond to. The following question has answers we would like you to address.

Question A.6.b. lists beta (β) as the correct answer for ${}_{35}Br^{87}$ * ${}_{35}Br^{86}$. We believe the correct answer is neutron (n) decay.

Question A.6.c. lists neutron (n) as the correct answer for ${}_{35}Br^{87}$*${}_{34}Se^{86}$. We believe the correct answer is proton (p) decay and is not listed as an answer. We would like the question removed from the exam.

Question A.6.d. lists gamma (γ) as the correct answer for ${}_{35}Br^{87}$ * ${}_{36}Kr^{87}$. We believe the correct answer is beta (β) decay.

We reference our suggested corrections to Burn, Robert Reed Introduction to Nuclear Reactor Operations , 1982.

See page 2-33, top of page.

Sincerely,

Daniel N. Estel

Training Coordinator

William Bonzer

UMRR Interim Director

License Number R-79
Facility Docket Number 50-123

NRC RESOLUTION: All comments accepted as written. Question A.06 will be modified as suggested. Also question value changed to keep question worth 2 points (⅔ each).

ENCLOSURE 2

U.S. Nuclear Regulatory Commission
OPERATOR LICENSING EXAMINATION
Section A *ONLY*
With Answer Key

UNITED STATES NUCLEAR REGULATORY COMMISSION

UNIVERSITY OF MISSOURI-ROLLA
RESEARCH REACTOR
June 1, 2006

ENCLOSURE 3

QUESTION A.1 [1.0 point]

The number of neutrons passing through a square centimeter per second 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)

A.1 c
REF:

QUESTION A.2 [1.0 point]

Which ONE of the following is the definition of the term "*Cross-Section*?"

a. The probability that a neutron will be captured by a nucleus.

b. The most likely energy at which a charge particle will be captured.

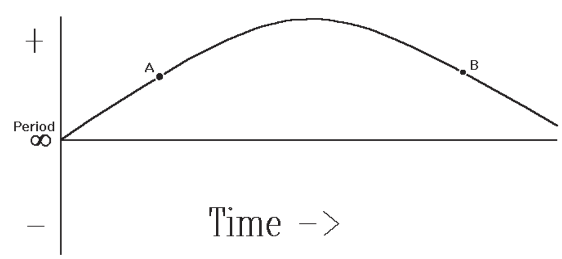
c. The length a charged particle travels past the nucleus before being captured.

d. The area of the nucleus including the electron cloud.

A.2 a
REF:

QUESTION A.3 [1.0 point]

Shown to the right is a trace of reactor **PERIOD** as a function of time. Between points A and B reactor **POWER** is …



a. continually increasing.

b. continually decreasing.

c. increasing, the decreasing.

d. constant.

A.3 a
REF:

(***** Category A continued on next page *****)

QUESTION A.4 [1.0 point]
The difference between a moderator and a reflector is that a reflector …

a. increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

b. increases the neutron production factor and a moderator increase the fast fission factor.

c. increases the neutron production factor, and a moderator decreases the thermal utilization factor.

d. decreases the fast non-leakage factor, and a moderator increases the thermal utilization factor.
A.4 a
REF:

QUESTION A.5 [1.0 point]
The term "*reactivity*" may be described as …

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

b. negative when K_{eff} is greater than 1.0.

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

d. equal to $.50 when the reactor is prompt critical.
A.5 c
REF:

QUESTION A.6 [~~2.0 points, ½ each~~] [2.0 points, ⅔ each]
Identify each of the listed radio-active decays as either alpha (α), beta (β), gamma (γ) or neutron (n).

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

b. ${}_{35}Br^{87}$ o ${}_{35}Br^{86}$

~~c. ${}_{35}Br^{87}$ o ${}_{34}Se^{86}$~~ This part deleted per facility comment

d. ${}_{35}Br^{87}$ o ${}_{36}Kr^{87}$
A.6 a, α; b, ~~β~~ n; ~~c, n;~~ d, ~~γ~~ β
REF:

QUESTION A.7 [1.0 point]
What is the kinetic energy range of a thermal neutron?

a. > 1 MeV

b. 100 KeV – 1 MeV

c. 1 eV – 100 KeV

d. < 1 eV
A.7 d
REF:

(*** Category A continued on next page *****)**

QUESTION A.8 [1.0 point]
In a reactor at full power, the thermal neutron flux (φ) is 2.5 x 10^{12} neutrons/cm^2/sec. and the macroscopic fission cross-section Σ_f is 0.1 cm^{-1}. The fission reaction rate is:

a. 2.5 x 10^{11} fissions/sec.

b. 2.5 x 10^{13} fissions/sec.

c. 2.5 x 10^{11} fissions/cm^3/sec.

d. 2.5 x 10^{13} fissions/cm^3/sec.
A.8 c
REF:

QUESTION A.9 [2.0 points, ½ each]
Using the drawing of the Integral Rod Worth Curve provided, identify each of the following reactivity worths.

a. Total Rod Worth	1. B - A
b. Actual Shutdown Margin	2. C - A
c. Technical Specification Shutdown Margin Limit	3. C - B
d. Excess Reactivity	4. D - C
	5. E - C
	6. E - D
	7. E - A

A.9 a, 7; b, 5; c, 6; d, 2
REF:

QUESTION A.10 [1.0 point]
The Fast Fission Factor (ε) is defined as "The ratio of the number of neutrons produced by …

a. fast fission to the number produced by thermal fission.

b. thermal fission to the number produced by fast fission.

c. fast and thermal fission to the number produced by thermal fission.

d. fast fission to the number produced by fast and thermal fission
A.10 c
REF:

(***** Category A continued on next page *****)

QUESTION A.11 [1.0 point]
Given the data in the table to the right, which ONE of the following is the closest to the half-life of the material?

TIME	ACTIVITY
0 minutes	2400 cps
10 minutes	1757 cps
20 minutes	1286 cps
30 minutes	941 cps
60 minutes	369 cps

a. 11 minutes

b. 22 minutes

c. 44 minutes

d. 51 minutes

A.11 b
REF:

QUESTION A.12 [1.0 point]
Which ONE of the following describes the characteristics of good moderators and reflectors?

a. High scattering cross-section and low absorption cross-section.

b. Low scattering cross-section and high absorption cross-section.

c. Low scattering cross-section and low absorption cross-section.

d. High scattering cross-section and high absorption cross-section.

A.12 a
REF:

QUESTION A.13 [1.0 point]
The number of neutrons passing through a square centimeter per second 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)

A.13 c
REF:

(***** Category A continued on next page *****)

QUESTION A.14 [1.0 point]
Regulating rod worth for a reactor is 0.001 ΔK/K/inch. Moderator temperature **INCREASES** by 9ΕF, and the regulating rod moves 4½ inches inward to compensate. The moderator temperature coefficient α_{Tmod} is …

a. $+5 \times 10^{-4}$ ΔK/K/ΕF

b. -5×10^{-4} ΔK/K/ΕF

c. $+2 \times 10^{-5}$ ΔK/K/ΕF

d. -2×10^{-5} ΔK/K/ΕF
A.14 b
0.001 ΔK/K/~~inch~~ × 4.5 ~~inch~~ ÷ 9ΕF = 0.001 ÷ 2 = 0.0005 = 5×10^{-4} ΔK/K/ΕF
REF: Glasstone, S. and Sesonske, A, *Nuclear Reactor Engineering,* Kreiger Publishing, Malabar, Florida, 1991, §

QUESTION A.15 [1.0 point]
When performing rod calibrations, many facilities pull the rod out a given increment, then measure the time for reactor power to double (doubling time), then calculate the reactor period. If the doubling time is 42 seconds, what is the reactor period?

a. 29 sec

b. 42 sec

c. 61 sec

d. 84 sec
A.15 c
REF: ln (2) = -time/τ τ = time/(ln(2)) = 60.59 . 61 seconds

QUESTION A.16 [1.0 point]
A thin foil target of 10% copper and 90% aluminum is in a thermal neutron beam. Given $\sigma_{a\,Cu}$ = 3.79 barns, $\sigma_{a\,Al}$ = 0.23 barns, $\sigma_{s\,Cu}$ = 7.90 barns, and $\sigma_{s\,Al}$ =1.49 barns, which ONE of the following reactions has the highest probability of occurring? A neutron …

a. scattering reaction with aluminum

b. scattering reaction with copper

c. absorption in aluminum

d. absorption in copper
A.16 a
REF:

(***** Category A continued on next page *****)

QUESTION A.17 [1.0 point]
Which ONE of the following atoms will cause a neutron to lose the most energy in an elastic collision?

a. Uranium (U^{238})

b. Carbon (C^{12})

c. Deuterium (H^{2})

d. Hydrogen (H^{1})

A.17 d
REF:

QUESTION A.18 [1.0 point]
Which ONE of the following statements concerning reactor poisons is **NOT** true?

a. Following shutdown, Samarium concentration will increase to some value then stabilize.

b. Following shutdown, Xenon concentration will initially increase to some value then decrease exponentially

c. During reactor operation, Samarium concentration is independent of reactor power level.

d. During reactor operation, Xenon concentration is dependent on reactor power level.

A.18 c
REF: