November 2, 2000

Dr. John Bernard, Director
of Reactor Operations
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, MA 02139

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-020/OL-00-01

Dear Dr. Bernard:

During the week of September 4, 2000, the NRC administered an initial examination to employees of your facility who had applied for a license to operate your Massachusetts Institute of Technology 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 NRC's "Rules of Practice," a copy of this letter and its enclosure 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/index.html. If you have any questions, please contact Patrick Isaac at 301-415-1019.

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. 50-020

Enclosures: 1. Initial Examination Report
No. 50-020/OL-00-01
2. Facility comments and NRC resolution of comments
3. Examination and answer key (RO)

cc w/enclosures:
Please see next page

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AAdams, PM
Facility File (EBarnhill)

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REXB r/f
DMatthews

ACCESSION NO: ML003760351 **TEMPLATE #: NRR-074**

OFFICE	DIPM:IOLB		REXB:CE		REXB:BC	
NAME	EBarnhill:rdr		PIsaac		LMarsh	
DATE	10/ 26 /2000		10/ 23 /2000		10/ 31 /2000	

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

Massachusetts Institute of
Technology

cc:

City Manager
City Hall
Cambridge, MA 02139

Assistant Secretary for Policy
Executive Office of Energy Resources
100 Cambridge Street, Room 1500
Boston, MA 02202

Department of Environmental
Quality Engineering
100 Cambridge Street
Boston, MA 02108

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

REPORT NO.:	50-020/OL-00-01
FACILITY DOCKET NO.:	50-020
FACILITY LICENSE NO.:	R-37
FACILITY:	Massachusetts Institute of Technology
EXAMINATION DATES:	September 4 - 7, 2000
EXAMINER:	Patrick Isaac, Chief Examiner
SUBMITTED BY:	***/RA/*** 10/16/00 Patrick Isaac, Chief Examiner Date

SUMMARY:

During the week of September 4, 2000, the NRC administered Operator Licensing Examinations to four Senior Reactor Operator Upgrade (SROU), and three Reactor Operator (RO) candidates. One SROU failed the examinations. All the other candidates passed their respective portions of the examinations.

ENCLOSURE 1

REPORT DETAILS

1. Examiners:

Patrick Isaac, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**3/0**	**N/A**	**3/0**
Operating Tests	**3/0**	**3/1**	**6/1**
Overall	**3/0**	**3/1**	**6/1**

3. Exit Meeting:

Personnel attending:

John A. Bernard, Director of Reactor Operations, NRL
Edward S. Lau, Asst. Superintendent for Reactor Operations, NRL
Frank Warmsley, Operations and Training Coordinator, NRL
Patrick Isaac, NRC, Chief Examiner

There were no generic concerns raised by the Chief Examiner.

d. c. b. a. The t[illegible]

the a[illegible] reactive rod. Provide [illegible]

1.00

NRC RESOL

ENCLOSURE 2

Comment Response

NRC Response

(1 sec/0.5 sec)

40 MW 32 MW 15 MW 9 MW

40.6 MW

Introduction to Nuclear Reactor Operations, © 1982, § 6

| | | |

the [illegible]

Ventilation [illegible] purge monitor.

temporary [illegible]

[illegible]

[illegible]

All work do[illegible] this [illegible]

NON-POWER INITIAL REA

U. S. NUCLEAR REGU

SYSTEMS PROCEDURES AND RADIOLOGICAL CONTROLS AND RADIATION [illegible]

Candidate's Signature

ENCLOSURE 3

12. 11. 10. 9. 8. 7. 6. 5. 4. 3. 2. 1. During the administrati

There is [illegible]

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

EQUATION SHEET

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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

$Pwr = W_f\, \dot{m}$

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

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

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

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

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

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

$\rho = \Delta Keff/Keff$

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

$\bar{\beta} = 0.0070$

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = \dfrac{6CiE(n)}{R^2}$ 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)

[illegible]

15th bundle [illegible] bundle

360 270 180 90

[1.0]

d. c. b. a. Which of the following is the reaction in a

QUESTION (A-6)

The reaction is at NOR-ASE 05 [illegible]

K/K, this would correspond to K_{eff} of:

Reactivity [illegible] 190.75 m 500 m 100 m 0.998 0.988 0.979 0.957

[1.0] [1.0] [1.0]

d. c. b. a. Which statement (A9) b. a. [illegible]

The [illegible] approaches unity (1), for the same increase in K_{eff} a greater increase in neutron

[1.0] [1.0]

d. c. b. a. Given the following condition, which [illegible]

Reactor [illegible] 1.00

[illegible]

[1.0] [1.0] [1.0]

(See attached figures on following page for [illegible] figures [illegible] of reactivity and allowing power to increase. The op

d c b a 4 3 2 1TIME

the same [illegible] of 2

K/K but greater

250 [illegible] for 24 hours;

[1.0] [1.0]

Section A

a

b

c

d

d. c. b. a. [illegible]

Beta [illegible]

[1.0] [1.0]

d. c. b. a. Which

radio

(*** End of Section A ***)

d. c. b. a. with [illegible]

57,36[illegible] R/hr Green Yellow Red Blue high [illegible]

[1.0] [1.0] [1.0]

d. c. b. a. nu[illegible]

125 days 31 days 25 days 12 days

Must [illegible]

[1.0] [1.0]

d. c. b. a. PeQUESTION (B.11) QUESTION (B.10) [illegible]

250 kW 100 kW 500 W 100 W Reactor [illegible] 1000 gpm

[1.0] [1.0] [1.0]

d. c. b. a. Co

record

[1.0]

[1.0]

d. c. b. a. [illegible]

Approximately [illegible] activity under [illegible]

[1.0] [1.0]

d. c. b. a. Which [illegible]

The [illegible]

[1.0] [1.0]

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

d. c. b. a. Which of the following is the alarm [illegible]

60 G 55 G 53 G 50 G

it would [illegible]

d. c. b. a. Of QUESTION: 008 (1.00) a. WHICH QUESTION: 007 (1.00) a. is NOT QUESTION: 006 (1.00) a. [illegible]

Spent Aluminum Tissue Provides [illegible] pressure.

d. c. b. a. due [illegible]

Operation [illegible]

d. c. b. a. The [illegible]

limit the [illegible]

d. c. b. a. Which of the following statements [illegible]

blade [illegible]

d. c. b. a. The [illegible]

one [illegible]

(******END OF EXAMINATION******)

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

$K_{eff2} = 1 - (0.5)(0.05) = 0.975$

$\phi_{k=1} = 0.9984$

$K_{eff2} = 1 - (0.5)(0.95) = 0.525

Glass [illegible]

ρ (3.46+1)=.007 ρ 0.1 x

ρ ρ

T = t/ln 2 = 24/.693 = 34.6 seconds

3.46 = .007-

ρ = .007/4.46 = .00157 ρ = .16% K/K

Introduction to Nuclear Reactor Operations

Introduction to Nuclear Reactor Operations

© 1982, § 8.5 — 8.7, pp. 8-16 — 8-18

© 1982, § 6.2.3, p. 3-4.

(*** End of Section A ***)

Introduction to Nuclear Reactor Operations, © 1982, § 4.9, pp. 4-23 — 4-26.

Shielde[illegible]

= .56 shielding value layer OR: I/Io = e (-ux)

= 3.37 mrem/hr

PMR52 [illegible]

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

REFERENCES

(**********END OF EXAMINATION **********)

020 019 018 017 016 015 014 013 012 011 010 009 008 007 006 005 004 003 002 001

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

A N S W E R

020 a19b a18b a17b a16b a15b a14b a13b a12b a11b a10b a09b a08b a07b a06b a05b a04b a03b a02b a01b a MULTIPLE CHOICE

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

ANSWER

020 019 018 017 016 015 014 013 012 011 010 009 008 007 006 005 004 003 002 001

(********** END OF EXAMINATION **********)

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

A N S W E R