January 9, 2001

Dr. Stephen E. Binney
Director
Oregon State University
100 Radiation Center
Corvallis, OR 97331-5903

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-243/OL-01-01

Dear Dr. Binney:

During the week of December 4, 2000, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Oregon State University 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/index.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 by phone at 301-415-1058 or by 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. 50-243

Enclosures: 1. Initial Examination Report
No. 50-243/OL-01-01
2. Examination and answer key (RO/SRO)

cc w/encls:
Please see next page

C = COVER

E = COVER & ENCLOSURE

N = NO COPY

OFFICIAL RECORD COPY

ADAMS ACCESSION #: ML003778465

TEMPLATE NRR-074

DATE CE

REXB:CE

12/ 22 /00 PDoyle:dr

E

IOLB

01/ 03 /01 EBallmill

E

REXB:BC/DBC

LMarsh/JTappert

01/ 08 /01

Fac [illegible] Docket No. 50-243 by [illegible]

2. Exam [illegible] No. 50-243/OL-01 Examination Report

REXB r/f AAdams

January 9, 2001

Office [illegible] Programs

CBassett, RIV PDoyle

DMatthews

3. 2. 1. po

the ex

The NRC thanked the facility for their suppor Paul Doyle, Chief Examiner, NRC

OPERATOR LICEN

U. S. NUCLEAR

Paul Doyle, Chief Examiner

Paul Doyle, Chief Examiner

Date

REPORT DETAILS

2/0	2/0	2/0	**RO PASS/FAIL**
0/0	0/0	0/0	**SRO PASS/FAIL**
2/0	2/0	2/0	**TOTAL PASS/FAIL**

OREGON STATE UNIVERSITY

With Answer Key

OPERATOR LICENSING EXAMINATION

December 4, 2000

ENCLOSURE 2

d. c. b. a. Which of the six factor formula terms is the major contributor to the production and depletion of Xe in the reactor?

Fast Fission Factor Thermal Utilization Factor Reproduction Factor Resonance Escape Probability

[1.0 point]

STEADY-STATE OPERATING reactor?

[1.0 point]

[1.0 point]

4. 3. 2. 1.

Neutron Radioactive Decay

Neutron Radioactive Decay

QUESTION A.8 Which of the following isotopes ...

a. Uranium ^{238}

b. Carbon ^{12}

c. Hydrogen ^{2}

d. Hydrogen ^{1}

[1.0 point]

Reproduction ... Erbium ... Hydrogen

[1.0 point]

atoms

INCREASE in the number of neutrons during

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

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

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

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

[1.0 point]

d. c. b. a.

Rod Height

Same Same Lower Higher

1.018 1.013 0.987 0.982

% full power

SECOND

one you stop for 10 minutes to answer the phone. For the seco

[1.0 point]

[1.0 point]

[1.0 point]

Count Rate

Higher Lower Same Same

d. c. b. a.

fuel temperature coefficient ... 30 seconds ... fission

[1.0 point] [1.0 point] [1.0 point]

QUESTION A.19b

Which of the following is the [illegible]

a. [illegible]

b. [illegible]

c. [illegible]

d. Delayed [illegible] greater effect.

[1.0 point]

[1.0 point]

d. c. b. a.

[2.0 points, 0.5 each]

[2.0 points, 0.5 each]

4. 3. 2. 1.

d. c. b. a. the

100 mR/hr 75 mR/hr 50 mR/hr 25 mR/hr

[1.0 point]

[1.0 point]

[1.0 point]

10 CFR50.54(y) states that

(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

TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)

d. c. b. a. __Acquisition Technical Specification

0.95 0.90 0.85 0.80

$1.0 $.75 $.50 $.25

is less than …

50 rem 25 rem 10 rem 5 rem

8 6 4 2

[1.0 point]

[1.0 point]

[1.0 point]

QUESTION B.14 … Which of the following … Emergency … reactor?

a. General Emergency

b. Alert

c. Notification of Unusual Event

d. Personnel … Operational Event

[1.0 point]

$^{3}_{1}H$ $^{41}_{18}Ar$ $^{16}_{7}N$ $^{135}_{54}Xe$

QUESTION … radioisotopes … PRIMARY source … (irradiation of … Oregon State …

Air

Irradiation of **Water**, or **Fission** products

[1.0 points, ¼ each]

d. c. b. a.

[1.0 point] [1.0 point]

f. e. d. c. b. a.

[2.0 point, each]

[1.0 point]

4. 5. 3. 2. 1.

3. 2.

d. c. b. a. a

A pis

[1.0 point]

[1.0 point]

d. c. b. a. st

a We 4h 30 30 se

C and you go up to the maximum bulk temperature allowed."

A vac 1/4 in

[1.0 point]

[1.0 point]

d. c. b. a. col

Central

[1.0 point] [1.0 point] [1.0 point]

d. c. b. a. Which of the following parameters should be measured to determine the primary treatment efficiency?

pH Conductivity Flow rate Temperature

[1.0 point]

(differential time) output for period

[1.0 point] [1.0 point]

REF. 14 REF. 13 REF. 12 REF. 11 REF. 10 K_eff = 1/(1+SDM) = 1/(1 + 0.0129081) = 0.987 = (1-0.98)/0.98 = 0.02/0.99 = 0.02041 or 0.02041/.0075 = $2.72, or a reactivity

Oregon State University

p. 50.

10

Fast Fission Factor

p. 6.

e

Criticality in the Presence of a Neutron Source

0.1054 × 10

Prompt Jump or Drop

p. 39.

1.054 × 10

Moderators

p. 12.

Fundamentals and Basic Reactor Physics

p.71.

Oregon State University Training Reactor

Question deleted per facility comment

c

$$\ln\left(\frac{P}{P_0}\right) = \frac{t}{t} \quad t = \frac{60\text{sec}}{\ln(2)} = 86.56$$

Delayed Neutrons

p.

REF.17 REF.16 REF.15 REF.14 REF.13 REF.12 REF.11 REF.10 REF.9 REF.8 REF.7 REF.6 REF.5 REF.4 REF.3 REF.2 REF.1 Section B

administer

T.S. § 4.3.2, p. 20.

Administrative and Personnel Procedures, § VI.B.5, p. 24. Also NRC examination

Definitions, p. 2-1.

b, Air;

c, Water;

d, Fission

Definitions

b, 3;

b, check;

c, 3;

d, 4

b, LSSS

c, che

Section C

REF: C.1 REF: C.2 REF: C.3 REF: C.4 REF: C.5 REF: C.6 REF: C.7 REF: C.8 REF: C.9 REF: C.10 REF: C.11 REF: C.12 REF: C.13 REF: C.14 REF: C.15

REF: Standard NRC question.

Oregon State Training Manual Volume 1,

b, A; c, B; d, C; e, D; f, G

b, 1; c, 1 d, 4; e, 4; f, 4

b, 1; c, 3;

Reactor Water Systems, pp. 106 – 116.

Reactor Water Systems, Figure 1.60 p. 107.

Control Rod Drives, p. 50.

Control Rod Drives, p. 44

Standard Control Rods, p. 42.

Demineralizer, p. 116

Central Thimble, p. 89.

Fuel Moderator Elements p. 33. 1 ¶, last sentence.

Reactor Bay Exhaust Fan, pp. 146 – 148.

$$Power(kilowatt) = \frac{20.280\left(\frac{kWh}{°C}\right)(\Delta Temp)}{\Delta Time\ (hours)}$$

$$Time(hours) = \frac{20.280(49-19)}{1000\ kW} = \frac{20.280 \times 30}{1000\ kW} = 0.6084\ hours = 36.5\ minutes$$

All work done on this examination is my own. I have not [illegible]

	A.	B.	C.	TOTALS
Category Value	60	20	20	20
Total % of	33	33	33	
Candidate's Score				
Category Value				
% of				
Category	Plant and Radiological Systems	Principles of Nuclear Power Plant Operation, Thermodynamics, and		

CANDIDATE'S [illegible]

FINAL GRADE

Candidate's Signature

NON-POWER INITIAL R

U. S. NUCLEAR REGU

IV Oregon State Univers

13. 12. 11. 10. 9. 8. 7. 6. 5. 4. 3. 2. 1. During the administrat

examination

observed

answer sheet.

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

EQUATION SHEET

$$\dot{Q} = \dot{m}c_p\, \beta T = \dot{m}\, \beta H = UA\, \beta T$$

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

$$\ell^* = 1\ x\ 10^{-4}\ seconds$$

$$SCR = \frac{S}{-\beta} \approx \frac{S}{1 - K_{eff}}$$

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

$$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$

$$CR_1(-\beta_1) = CR_2(-\beta_2)$$

$$SUR = 26.06\left[\frac{\beta_{eff}\beta}{\beta - \beta}\right]$$

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}}$$

$$M = \frac{1}{1 - K_{eff}} = \frac{CR_1}{CR_2}$$

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

$$SDM = \frac{(1 - K_{eff})}{K_{eff}}$$

$$P = P_0\ e^{\frac{t}{\beta}}$$

$$\beta = \frac{\ell^*}{\beta\ -\ \bar{\beta}}$$

$$P = \frac{\beta(1 - \beta)}{\beta - \beta}\ P_0$$

$$\beta\beta = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1} \times K_{eff_2}}$$

$$\beta = \frac{\ell^*}{\beta} + \left[\frac{\bar{\beta} - \beta}{\beta_{eff}\beta}\right]$$

$$T_{½} = \frac{0.693}{\beta}$$

$$\beta = \frac{(K_{eff} - 1)}{K_{eff}}$$

$$DR = DR_0\ e^{-\beta t}$$

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

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

$$\frac{(\beta_2 - \beta)^2}{Peak_2} = \frac{(\beta_1 - \beta)^2}{Peak_1}$$

1 Mw = 3.41 x 10^6 BTU/hr

1 kg = 2.21 lbm

Ci — curies, R — feet

E — Mev, DR — Rem,

1 Curie = 3.7 x 10^{10} dis/sec

1 hp = 2.54 x 10^3 BTU/hr

c_p = 1.0 BTU/lbm-°F

1 gal H_2O ≈ 8 lbm

c_p = 1 cal/sec/gm/°C

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

A.8 A.7 A.6 A.5 A.4 A.3 A.2 A.1a A.1a A.1a A.1a Section A

a b c d a b c d a b c d a b c d a b c d a b c d a b c d 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 ___

A N S W E R S

A.19 A.18 A.17 A.16 A.15 A.14 A.13 A.12 A.11 A.10 A.9

a b c d a b c d a b c d a b c d a b c d a b c d a b c d a b c d a b c d a b c d


B.6 B.5 B.4 B.3d B.3c B.3b B.3a B.2d B.2c B.2b B.2a B.1d B.1c B.1b B.1a Section B
B.17 B.16 B.15 B.14 B.13d B.13c
B.13b B.13a B.12 B.11 B.10 B.9 B.8
ANSWER S

C.7a C.6 C.5 C.4 C.3f C.3e C.3d C.3c C.3b C.3a C.2 C.1d C.1c C.1b C.1a Section C

A B C a D b E c F d G e a b c d 1 2 3 1 4 2 5 3 1 4 2 5 3 1 4 2 5 3 1 4 2 5 3 1 4 2 5 a 3 b 4 c 5 d 1 2 3 1 2 3 1 2 3 1 2 3 ___

ANSWER S

C.7f C.7e C.7d C.7c C.7b

C.16 C.17 C.15 C.14 C.13 C.12 C.11 C.10 C.9 C.8

A B C A D B E C F A D G B E C F A D G B E C F A D G B E C F A D G

a b a c b d a c d b c d a b c d ___ a b c d a b c d a b c d a b c d a b c d a b c d ___