

June 27, 2000

Dr. David M. Slaughter
122 S. Central Campus Drive
Room 104
University of Utah
Salt Lake City, Utah 84112

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-407/OL-00-02

Dear Dr. Slaughter:

During the week of May 29, 2000, the NRC administered an initial examination to employees of your facility who had applied for a license to operate your University of Utah 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 placed in the NRC Public Document Room.

Should you have any questions concerning this examination, please contact Paul Doyle via phone 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. 50-407

Enclosures: 1. Initial Examination Report
No. 50-407/OL-00-02
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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TEMPLATE #:NRR-079

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|--------|--------------|---|--------------|---|-----------------|
| OFFICE | REXB:CE | E | IOLB | E | REXB:D |
| NAME | PDoyle:rdr | | EBarnhill | | LMarsh/JTappert |
| DATE | 06/ 21 /2000 | | 06/ 26 /2000 | | 06/ 27 /2000 |

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Facility Comments with NRC Resolutions

NOTE: Original letter lost in U.S. Mail System, attached is the second E-mail from M. Krahenbuhl, Reactor Supervisor for University of Utah Reactor. This E-mail was received June 20, 2000.

June 6, 2000

U.S. Nuclear Regulatory Commission
Attn: Paul Doyle
Mail Stop O-11 D-19
11555 Rockville Pike
Rockville, MD 20852-2738

Dear Mr. Doyle,

This exam was well written and represents a reasonable exam for the SRO candidates. I appreciate the time and effort you and NRC support staff put forth. I have identified three questions that I feel should be amended.

- B.6. This question is about 10CFR50.54 and the minimum level of management that can authorize emergency action. This regulation requires a senior reactor operator to authorize emergency action. Based on the Emergency Plan page 7, the RS has the final authority over on-site activity. The RS can not delegate this responsibility to another person. A SRO can assume responsibility only until relieved by the RS. The answer is (C) the reactor supervisor.
- C.4. This question is about the Thermal Power calibration and which measured parameter L (height of water) or T (temperature) results in the least conservative estimation of the power. The answer key indicates (A) initial temperature readings were lower than actual, but in a previous exam the correct answer was given as initial pool level reading is lower than the actual level. (C10 in exam administered in Jan 2000). The question is confusing and technical arguments can be made for both answers. We recommend that both (A) and (B) be accepted as correct answers.
- C.17. This question is about the pneumatic tube system. The answer key indicates (D) air from a blower. The answer is an air compressor (A). Based on the Description of Operation pg. 54.

If you have any questions or concerns, please contact me at (801) 581- 4188 or by e-mail at mpk@eng.utah.edu.

Respectfully,

Melinda Krahenbuhl
Reactor Supervisor

NRC RESOLUTION

- B.6 Agree in part. B is correct, however for Utah the more conservative answer c is also correct, therefore the answer key has been changed to accept both b or c as correct.
- C.4 Agree in full.
- C.17 Agree in full.

University of Utah
With Answer Key

OPERATOR LICENSING
EXAMINATION
Week of May 22, 2000

ENCLOSURE 3

Question B.1 [2.0 points, ½ per response]

Identify each of the following as either a Safety Limit (**SL**), a Limiting Safety System Setting (**LSSS**) or a Limiting Condition for Operations (**LCO**).

- a. The temperature in a aluminum-clad low hydride fuel element shall not exceed 530°C.
- b. The scram time from the instant that a safety system setting is exceeded to the instant that the slowest programmable rod reaches its fully inserted position shall not exceed 2 seconds.
- c. For a core composed entirely of stainless steel clad, high hydride fuel elements or a core composed of steel clad, high hydride fuel elements with low hydride fuel elements in the F or G hexagonal ring only, ... the maximum temperature of the instrumented fuel rod in the A ring is 800°C.
- d. The Shutdown Margin referred to the cold-critical xenon-free condition, with the highest worth rod fully, withdrawn is greater than \$0.50.

Question B.2 [1.0 point]

Following a spill, you would obtain yellow and magenta tape from ...

- a. The cabinet immediately outside the control room entrance.
- b. The locked box at the classroom entrance.
- c. The control room, behind the console.
- d. The CENTER Director's office.

Question B.3 [2.0 points, ½ per response]

Identify each of the following actions as either a Channel **CHECK**, Channel **TEST** or a channel **CALIBRATION**. (Choices may be used more than once or not at all.)

- a. Verifying fuel element temperature is as expected for a given power level.
- b. Replacing a Thermal couple Temperature Detector with a precision microvolt source, to verify proper channel output for a given voltage.
- c. Checking Area Radiation Monitor responds to a test radioactive source.
- d. Placing a Temperature detector in a bucket of ice-water, verifying temperature reads 0°C (32°F).

Question B.4 [2.0 points, ½ per response]

Match the radiation reading from column A with its corresponding radiation area classification (per 10CFR20) listed in column B. (Items listed in column B may be used more than once or not at all.)

- | <u>Column A</u> | <u>Column B</u> |
|-----------------|-----------------------------|
| 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.5 [1.0 point]

Which ONE of the following is the **MINIMUM** number of hours per calendar quarter per 10CFR55 you must perform the duties of an SRO to maintain your license active?

- a. 2 hours
- b. 4 hours
- c. 6 hours
- d. 8 hours

Question B.6 [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) state that the minimum level of management which may authorize this action is ...*

- a. Any NRC licensed Reactor Operator
- b. Any NRC licensed Senior Reactor Operator
- c. The Reactor Supervisor
- d. The Facility Director

Question B.7 [1.0 point]

The Quality Factor (**QF**) 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.

Question B.8 [1.0 point]

Which ONE of the following is the 10CFR20 definition of **TOTAL EFFECTIVE DOSE EQUIVALENT**?

- a. The sum of the deep dose equivalent and the committed 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.9 [1.0 point]

Which ONE of the following is the facility you would send a contaminated injured person per the Emergency Plan?

- a. St. Mark's Hospital
- b. LDS Hospital
- c. University Medical Center and Hospital
- d. InterMountain Health Care

Question B.10 [1.0 point]

Maintenance on which ONE of the listed instrument channels requires the reactor to be in the shutdown condition with all control rods fully inserted, and power to the control-rod magnets and actuating solenoid switched off and the key removed?

- a. Continuous Air Radiation Monitor
- b. Reactor Tank Water Level
- c. Startup Count Rate
- d. Fuel Element Temperature

Question B.11 [1.0 point]

Which ONE of the following is the lowest level of U. Utah personnel who may authorize exceeding 10CFR20 limits to save a life?

- a. Senior Reactor Operator
- b. Reactor Supervisor
- c. Radiation Safety Officer
- d. CENTER Director

Question B.12 [1.0 point]

When changing power the minimum period per Memorandum (Administrative Controls) from David M. Slaughter is ...

- a. 77 seconds
- b. 42 seconds
- c. 23 seconds
- d. 18 seconds

Question B.13 [1.0 point]

The reactor is in the Cold Critical condition when it is critical with the fuel and bulk water temperature are both below ...

- a. 80°C
- b. 60°C
- c. 40°C
- d. 20°C

Question B.14 [1.0 point]

A gamma source emits 8 R/hour @ 1 foot. How long could you work four (4) feet from the source without exceeding your yearly Whole body limit from 10CFR20? Assume you have already received 3 R this year.

- a. 1 hour
- b. 2 hours
- c. 4 hours
- d. 8 hours

Question B.15 [1.0 point]

Technical Specification 4.3.3 requires the Radiation Monitoring system to be calibrated annually and to be verified operable ...

- a. quarterly
- b. monthly
- c. weekly
- d. daily

Question B.16 [1.0 point]

Fuel shall be stored in a geometrical array where the K_{eff} is less than ...

- a. 0.7
- b. 0.75
- c. 0.8
- d. 0.85

Question B.17 [1.0 point]

Which ONE of the following types of experiments is **NOT** required to be doubly encapsulated?
Experiments which contain ...

- a. explosive materials.
- b. Iodine isotopes 131 through 135.
- c. materials corrosive to reactor components.
- d. compounds highly reactive with water.

Question C.1 [1.0 point]

The purpose of the cleanup system is to minimize corrosion of the cladding on the fuel elements and to minimize the...

- a. need for cooling the pool
- b. growth of algae in the pool
- c. activation of dissolved materials in the pool.
- d. generation of tritium (${}_1\text{H}^3$) in the pool.

Question C.2 [1.0 point]

The purpose of removing the source at 1 watt is to ...

- a. minimize depletion of the Plutonium.
- b. minimize depletion of the Beryllium.
- c. prevent invalid readings on nuclear instrumentation.
- d. minimize radiation hazards due to the activation of the source.

Question C.3 [1.0 point]

Which ONE of the following heat transfer mechanisms provides cooling of the **CORE**?

- a. Forced Convection
- b. Natural Convection
- c. Conduction
- d. Mixed Convection

Question C.4 [1.0 point]

The semi-annual thermal power calibration uses temperature rise in the pool and the amount of evaporation that occurs during a power run to determine actual power level. Which ONE of the following conditions would result in a less conservative calculation of reactor power?

- a. Initial temperature readings were lower than actual.
- b. Initial pool level reading was lower than actual level.
- c. Recorded time for the power run was less than actual
- d. Water was drained from the pool during the power run.

Question C.5 [1.0 point]

What design feature of the purification system prevents draining of the pool on a piping break.

- a. No piping extends into the pool more than 5 feet below the pool surface.
- b. All piping has small holes (siphon breaks) located about 2 feet below the pool surface.
- c. The piping has a vacuum breaker at the its highest point.
- d. All piping either has small holes (siphon breaks) 2 feet below the pool surface or does not extend more than 5 feet below the pool surface.

Question C.6 [1.0 point]

Which ONE of the following facility scrams is NOT required by Technical Specifications?

- a. Loss of console power
- b. Magnet current key switch
- c. Chamber High Voltage
- d. Reactor Tank Water Level

Question C.7 [1.0 point]

Which ONE of the following parameters is NOT be measured in the Primary Coolant Circulation System Loop?

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

Question C.8 [1.0 point]

Using the figure provided which point represents where the thermocouples which measure fuel temperature measure the temperature?

- a. A
- b. B
- c. C
- d. D

Question C.9 [2.0 points, ¼ each]

Using the figure provided in the handout, Identify each of the labeled components in the recirculation system.

- a. 1. Rough cut demineralizer
- b. 2. Fine cut demineralizer
- c. 3. Conductivity Probe
- d. 4. Filter
- e. 5. Pre-Demineralizer Filter
- f. 6. Post Demineralizer Filter
- g. 7. Pump
- h. 8. Flow Meter

Question C.10 [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 concentric tubes one of which detects both neutrons and gammas the other only gammas, are wired 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.11 [1.0 point]

Which ONE of the following methods is used to reduce the mechanical shock to the shim-safety rods on a reactor scram?

- a. A small spring is located on the bottom of the absorber rod.
- b. A piston moves into a dashpot as the rod nears the bottom of its travel.
- c. An electro-mechanical brake is energized as the rod nears the bottom of its travel.
- d. A small spring is located at the top of the absorber rod.

Question C.12 [1.0 point]

Which ONE of the following elements is used as the neutron absorber in the Shim-Safety rods?

- a. Hafnium
- b. Aluminum Clad Boron Carbide
- c. Borated Stainless Steel
- d. Cadmium

Question C.13 [1.0 point]

An experimenter drops a radioactive source while transporting it. The container opens and the source is lying on the floor unshielded. Prior to entering the room, you would hold up a 1 to the door, to measure 2.

- a. Geiger-Müller, radiation dose (field)
- b. Geiger-Müller, contamination
- c. Ion Chamber, radiation dose (field)
- d. Ion Chamber, contamination

Question C.14 [1.0 point]

Which ONE of the following reflector materials is in the cans surrounding the core?

- a. Heavy water (D_2O)
- b. Graphite (C)
- c. Beryllium (Be)
- d. Polyethylene

Question C.15 [1.0 point]

Which ONE of the following contaminants is most efficiently removed by the recirculation system filters?

- a. Ar^{41} (dissolved gas)
- b. I^{135} (dissolved ionic impurity)
- c. mosquito larvae (suspended solid)
- d. Oil (contaminant liquid)

Question C.16 [1.0 point]

To prevent serious damage never allow the water temperature to drop below about ____ while the recirculation system is on.

- a. 0°C
- b. 5°C
- c. 10°C
- d. 20°C

Question C.17 [1.0 point]

The pneumatic tube system uses ____ to move the sample.

- a. High pressure air from an air receiver pressurized by an air compressor.
- b. Freon supplied by a compressor.
- c. Compressed Nitrogen from 2000 psi bottles.
- d. Air from a blower.

Question C.18 [2.0 points, 0.5 each]

Identify the detector type used from column B for each of the power sensing systems listed in column A.

- | <u>Column A</u> | <u>Column B</u> |
|-----------------------------|---|
| a. Linear Power Channel | 1. BF ₃ Proportional Counter |
| b. Log Power Channel | 2. Fission Chamber |
| c. Percentage Power Channel | 3. Compensated Ion Chamber |
| d. Startup Channel | 4. Uncompensated Ion Chamber |

Answer Key

B.1 a, SL; b, LCO; c, LSSS; d, LCO;
REF: Technical Specifications §§ 2.1, 2.2, 3.2(1) and 3.3.1

B.2 a
REF: Form CENTER-015

B.3 a, Check; b, Test; c, Test; d, Test
REF: Technical Specifications § 1.0 DEFINITIONS

B.4 a, 2; b, 3; c, 3; d, 4.
REF: 10CFR20.1003 *Definitions*

B.5 b (4)
REF: 10CFR55.

B.6 b or c **Second answer added per facility comment.**
REF: 10CFR50.54(y)

B.7 a
REF: 10CFR20.1003 *Definitions*, also *the University of Utah, Radiation Protection Program, Biological Effects of Radiation*, page 3.

B.8 a
REF: 10CFR20.1003 *Definitions*

B.9 c
REF: Emergency Plan § 7.5.2 2nd ¶.

B.10 d
REF: Technical Specifications § 3.3.2, Table Note (b), also § 3.3.3, Table Note (a)

B.11 b
REF: CENTER Emergency Plan § 3.5, p. 12

B.12 c
REF: Memorandum (Administrative Controls) from David M. Slaughter, dated 03/03/95.

B.13 c
REF: Technical Specifications § 1.0 *Definitions*

B.14 c

$$\text{REF: } D_1 R_1^2 = D_2 R_2^2 \quad D_2 = D_1 \frac{R_1^2}{R_2^2} \quad D_2 = 8 \frac{R}{hr} \frac{1^2}{4^2} = \frac{8 \frac{R}{hr}}{16} = \frac{1}{2} \frac{R}{hr}$$

Stay time = Total allowed dose (5R) less amount already received (3R) divided by $\frac{1}{2}$ R/hr.
 $2 \div \frac{1}{2} = 4$ hours.

B.15 b

REF: Technical Specification 4.3.3

B.16 c

REF: Technical Specification 5.5.

B.17 b

REF: Technical Specification 3.6.

Answer Key

C.1c

REF: Modification MA-2, Reactor Control System 3rd ¶.

C.2a

REF: Procedure 13.1.4

C.3b

REF: SER § 5 p. 5-1.

C.4a or b (Second answer added per facility comment)

REF: FORM NEL-012, Semi-Annual Thermal Power Calibration.

C.5d

REF: SER § 5.1, Technical Specifications § 5.7. NRC exam administered 12/21/1987.

C.6c

REF: Technical Specifications, § 3.3.3, *Reactor Safety System*, Table on p. 12.

C.7d

REF: SER § 5.0.

C.8b

REF: SER § 4.1.1

C.9a, 8; b, 2; c, 1; d, 4; e, 3; f, 6; g, 5; h, 7

REF: Form CENTER-006, Rev 3, Figures 1 and 2 (combined).

C.10 b

REF: Standard NRC question.

C.11 d

REF: Modification Authorization M-1. Figures 1 and 2.

C.12 b

REF: Modification Authorization M-1, figure 1.

C.13 c

REF: Standard NRC question

C.14 a

REF: Standard NRC Question

C.15 c

REF: III. Maintenance and Surveillance § 7.d

C.16 b

REF: V. TRIGA Reactor Console pg. 77, ¶ **Water Temperatures**

C.17 ~~d~~ **a Answer changed per facility comment.**

REF: IV.C, Pg. 54

C.18 a, 3; b, 4; c, 4; d, 2

REF: V.I. § D, pp. 67-68, also §§ I.3, 4, 5 & 6., pg. 70.