August 4, 2009

Dr. Dongok Choe
Reactor Supervisor
122 S. Central Campus Drive
University of Utah
Salt Lake City, UT 84112

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-407/OL-09-01, UNIVERSITY OF UTAH

Dear Dr. Choe:

During the week of June 29, 2009, the NRC administered operator licensing examinations at your University of Utah Reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, 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 Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.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 Mr. Phillip T. Young at (301) 415-4094 or via internet e-mail Phillip.Young@nrc.gov.

Sincerely,

/RA/
Johnny H. Eads, Jr., Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-407

Enclosures: 1. Initial Examination Report No. 50-407/OL-09-01
2. Written examination with facility comments incorporated

cc without enclosures:
Please see next page

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<u>DISTRIBUTION</u> w/ encls.:
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RidsNRRDPRPRTB Facility File (CRevelle) O-07 F-08

ADAMS ACCESSION #: ML092020487 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PYoung:		CRevelle		JEads	
DATE	07/28/2009		07/28/2009		08/4/2009	

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

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

REPORT NO.: 50-407/OL-09-01

FACILITY DOCKET NO.: 50-407

FACILITY LICENSE NO.: R-126

FACILITY: University of Utah Reactor

EXAMINATION DATES: June 30, 2009

SUBMITTED BY: ______________________________ __________
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of June 29, 2009, the NRC administered operator licensing examinations to one Senior Reactor Operator candidate. The applicant passed the written examination, but was not successful on the Operating Test.

REPORT DETAILS

1. Examiners: Phillip T. Young, Chief Examiner, NRC

2. Results:

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

3. Exit Meeting:
Phillip T. Young, Chief Examiner, NRC
John T. Nguyen, Examiner Trainee, NRC
Dr. Dongok Choe, Reactor Administrator, CENTER/NEP, University of Utah

At the conclusion of the site visit, the examiner met with representatives of the facility staff to discuss the some pre-determination results of the examinations. The examiner thanked the facility for their support of the examination.

ENCLOSURE 1

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

University of Utah

Operator License Examination

Written Exam with Answer Key

June 30, 2009

ENCLOSURE 2

Question A.001 [1.0 point] {1.0}
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.

Answer: A.001 b.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.002 [1.0 point] {2.0}
WHICH ONE of the following describes the MAJOR contributions to the production and depletion of xenon in the reactor?

a. Produced directly from fission and depletes by neutron absorption only.
b. Produced from radioactive decay of iodine and depletes by neutron absorption only.
c. Produced directly from fission and depletes by radioactive decay and neutron absorption.
d. Produced from radioactive decay of iodine and depletes by radioactive decay and neutron absorption.

Answer: A.002 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.003 [1.0 point] {3.0}
Core excess reactivity changes with…

a. Fuel burnup
b. Neutron Level
c. Control Rod Height
d. Reactor Power Level

Answer: A.003 a.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.004 [1.0 point] {4.0}
Control Rod withdrawal predominantly changes K_{eff} by changing the …

a. fast fission factor (ε).
b. thermal utilization factor (f).
c. neutron reproduction factor (η).
d. resonance escape probability (p).

Answer: A.004 b.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.005 [1.0 point] {5.0}
The reactor supervisor tells you the reactor is shutdown with a shutdown margin of 12%. An experimenter inserts an experiment in the core and nuclear instrumentation increases form 100 counts per minute to 200 counts per minute. What is the new K_{eff} of the reactor?

a. 0.920
b. 0.946
c. 0.973
d. 1.000

Answer: A.005 b.

$$K_{eff_1} = \frac{1}{1+SDM} = \frac{1}{1+0.12} = 0.892857$$

Reference:

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

$$1-K_{eff_2} = \frac{100}{200}(1-0.892857) = (0.0535715)$$

$$K_{eff_2} = 0.9464285$$

Question A.006 [1.0 point] {6.0}
The term K_{eff} is defined as …

a. absorption/(production + leakage)
b. (production + leakage)/absorption
c. (absorption + leakage)/production
d. production/(absorption + leakage)

Answer: A.006 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.007 [2.0 points, ½ each] {8.0}
Match each of the terms in column A with the correct definition from column B.

Column A	Column B
a. Fast neutrons	1. Neutrons released directly from fission.
b. Prompt neutrons	2. High energy neutrons.
c. Slow neutrons	3. Neutrons releases from decay of fission products.
d. Delayed neutrons	4. Low energy neutrons.

Answer: A.007 a. = 2; b. = 1; c. = 4; d. = 3
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.008 [1.0 point] {9.0}
Reactor power increases from 30 watts to 60 watts in one minute. Reactor period is …

a. 30 seconds
b. 42 seconds
c. 60 seconds
d. 87 seconds

Answer: A.008 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

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

Question A.009 [1.0 point] {10.0}
Which ONE of the following is an example of alpha decay?

a. $_{35}Br^{87} \rightarrow {}_{33}As^{83}$
b. $_{35}Br^{87} \rightarrow {}_{35}Br^{87}$
c. $_{35}Br^{87} \rightarrow {}_{34}Se^{86}$
d. $_{35}Br^{87} \rightarrow {}_{36}Kr^{87}$

Answer: A.009 a.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.010 [1.0 point] {11.0}
When compared to β, β_{eff} is …

a. smaller, because delayed neutrons are born at lower energies than prompt neutrons.
b. larger, because delayed neutrons are born at lower energies than prompt neutrons.
c. smaller, because delayed neutrons are born at higher energies than prompt neutrons.
d. larger, because delayed neutrons are born at higher energies than prompt neutrons.

Answer: A.010 b.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.011 [1.0 point] {12.0}
Five minutes following shutdown, reactor power is 3×10^6 counts per minute. Which ONE of the following is the count rate you would expect to see three minutes later?

a. 10^6
b. 8×10^5
c. 5×10^5
d. 3×10^5

Answer: A.011 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.012 [1.0 point] {13.0}
The reactor is on a CONSTANT positive period. Which ONE of the following power changes will take the longest time to complete?

a. 5%, from 95% to 100%
b. 10%, from 80% to 90%
c. 15%, from 15% to 30%
d. 20%, from 60% to 80%

Answer: A.012 c.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §
Time is related to ratio of final power to initial power. 2:1 is the largest ratio.

Question A.013 [1.0 point] {14.0}
Which of the following atoms will cause a neutron to lose the most energy during an elastic scattering reaction?

a. O^{16}

b. C^{12}

c. U^{235}

d. H^{1}

Answer: A.013 d.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §

Question A.014 [1.0 point] {15.0}
The reactor supervisor tells you that the K_{eff} for the reactor is 0.955. How much reactivity must you add to the reactor to reach criticality?

a. +0.0471

b. +0.0450

c. -0.0471

d. -0.0450

Answer: A.014 a.
Reference: Burn, R., Introduction of Nuclear Reactor Operations, © 1988, §
$\Delta\rho = (K_{eff1} - K_{eff2}) \div (K_{eff1} * K_{eff2})$ $\Delta\rho = (0.9550 - 1.0000) \div (0.9550 * 1.0000)$
$\Delta\rho = -0.0450 \div 0.9550 = -0.0471$

Question A.015 [1.0 point] {16.0}
Following a significant reactor power increase, the moderator temperature coefficient becomes increasingly more negative. This is because:

a. as moderator density decreases, less thermal neutrons are absorbed by the moderator than by the fuel.

b. the change in the thermal utilization factor dominates the change in the resonance escape probability.

c. a greater density change per degree F occurs at higher reactor coolant temperatures.

d. the core transitions from an under-moderated condition to an over-moderated condition.

Answer: A.015 c.
Reference: DOE Fundamentals Handbook, Nuclear Physics and Reactor Theory Volume 2, Module 3, Enabling Objective 2.4, p. 26.

Question B.001 [2.0 points, ½ each] {2.0}
Identify each of the following as either a Safety Limit (SL), Limiting Safety System Setting (LSSS) or a Limiting Condition for Operation (LCO)

a. The rate of reactivity insertion shall not exceed 30¢ per second.

b. The temperature in a stainless-steel-clad high hydride fuel element shall not exceed 1000°C.

c. During steady-state operation a minimum of two reactor power level channels shall be operable.

d. The temperature in an aluminum-clad low hydride fuel element located in the B-hexagonal ring shall not exceed 460°C.

Answer: B.001 a. = LCO; b. = SL; c. = LCO; d. = LSSS
Reference:R

Question B.002 [1.0 point] {3.0}
The CURIE content of a radioactive source is a measure of

a. the number of radioactive atoms in the source.

b. the amount of energy emitted per unit time by the source

c. the amount of damage to soft body tissue per unit time.

d. the number of nuclear disintegrations per unit time.

Answer: B.002 d.
Reference: Basic Radiation principles

Question B.003 [1.0 point] {4.0}
Which ONE of the following scrams built in to the Mark III console is NOT required by Technical Specifications?

a. Reactor Period

b. Fuel Temperature

c. Reactor Tank Water Level

d. Reactor Power Level (Nuclear Instrumentation)

Answer: B.003 a.
Reference: Modification Authorization MA-2, and Technical Specifications, § 3.3.3 Table.

Question B.004 [1.0 point] {5.0}
Two sheets of ¼ inch thick lead shielding reduces a radiation beam from 200 mR/hr to 100 mR/hr at 1 foot. What will the radiation read at 1 foot if you add another ¼ inch thick lead sheet (for a total of 3 sheets)?

a. 71 mR/hr
b. 50 mR/hr
c. 35 mR/hr
d. 17 mR/hr

Answer: B.004 a.
Reference: From the stem 2 sheets equal 1 half thickness $I = I_0\ (½)^{1.5}$ = 200 × 0.3535 = 70.71

Question B.005 [1.0 points, ¼ each] {6.0}
Match the 10CFR55 requirements for maintaining an active operator license in column A with the corresponding time period from column B.

Column A	Column B
a. Renew License	1 year
b. Medical Exam	2 years
c. Pass Requalification Operating Test	4 years
d. Pass Requalification Written Examination	6 years

Answer: B.005 a. = 6; b. = 2; c. = 1; d. = 2
Reference: 10CFR55.

Question B.006 [2.0 points, ½ each] {8.0}
Identify each of the following actions as either a CHANNEL **CHECK**, **C**HANNEL **TEST** or a CHANNEL **CAL**IBRATION.

a. Verifying overlap between Nuclear Instrumentation channels.

b. During reactor shutdown you verify the period meter reads -80 seconds.

c. Performing a calorimetric (heat balance) calculation on the primary system, then adjusting the Nuclear Instrumentation to agree.

d. Replacing a Resistance Temperature Detector (RTD) with a precision resistance decade box, to verify proper channel output for a given resistance.

Answer: B.006 a. = CHECK; b. = CHECK; c. = CAL; d. = TEST
Reference: T.S. DEFINITIONS

Question B.007 [1.0 points, ¼ each] {9.0}
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

Answer: B.007 a. = 20; b. = 1; c. = 1; d. = 10
Reference: 10CFR20.100x

Question B.008 [1.0 point] {10.0}
Following an evacuation of the facility during an emergency. Who by title, may authorize reentry (according to the Emergency Plan)?

a. CENTER Director
b. Reactor Supervisor, with advice of Radiation Safety Officer
c. Any Senior Operator, with advice of Radiation Safety Officer
d. Any NRC licensed Operator, with advice of any health physics technician.

Answer: B.008 b.
Reference: Emergency Plan, § 3.4

Question B.009 [1.0 point] {11.0}
Which ONE of the following correctly identifies the Technical Specification experiment reactivity limits for single unsecured and secured experiments respectively?

a. 57¢ and $1.00
b. $1.00 and $1.80
c. $1.00 and $2.80
d. $2.00 and $3.80

Answer: B.009 c.
Reference: Technical Specification 3.1(3) and (5)

Question B.010 [1.0 point] {12.0}
Who may authorize reactor restart following an accident which causes a Safety Limit to be exceeded.

a. Licensed Senior Operator on call.
b. Reactor Supervisor
c. CENTER Director
d. U.S. NRC

Answer: B.010 d.
Reference: Technical Specification 6.7

Question B.011 [1.0 point] {13.0}
Per Technical Specifications the maximum amount of time the ventilation system may be out of service (with the reactor running) is …

a. 2 hours
b. 1 days
c. 2 days
d. one week

Answer: B.011 c.
Reference: Technical Specification 3.5

Question B.012 [1.0 point] {14.0}
Per the Emergency Plan, Emergency Action Level(s) is (are) …

a. Projected radiological dose or dose commitment values to individuals that warrant protective action following a release of radioactive material.

b. the person or persons appointed by the Emergency Coordinator to ensure that all personnel have evacuated the facility or a specific part of the facility.

c. A condition that requires immediate action, beyond the scope of normal operating procedures, to avoid or mitigate an accident or event and its consequences.

d. Radiological dose rates; specific contamination levels of airborne, waterborne, or surface deposited concentrations of radioactive materials; or specific instrument readings that may be used as thresholds for initiating specific emergency measures.

Answer: B.012 c.
Reference: Technical Specifications

Question B.013 [1.0 point] {15.0}
CAM alarms are set at …

a. 10% of MPC
b. 50% of MPC
c. 100% of MPC
d. 5 times MPC

Answer: B.013 b.
Reference: VI Auxiliary Surveillance Equipment, § II.A p. 97.

Question B.014 [1.0 point] {16.0}
The Emergency Response Plan defines "Emergency Planning Zone (EPZ)" as …

a. the area within a 100 meter radius of the reactor core centerline.

b. within the walls of the CENTER (Rooms 1205A-G).

c. within the walls of the Merrill Engineering Building.

d. Geographical Area within the U of U campus

Answer: B.014 c.
Reference: Emergency Response Plan § 1.0 Definitions: Emergency Planning Zone.

Question B.015 [1.0 point] {17.0}
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

Answer: B.015 b.
Reference: 10CFR55.

Question C.001 [1.0 point] {1.0}
WHICH ONE of the following detectors is used primarily to measure N^{16} release to the environment?

a. NONE, N^{16} has too short a half-life to require environmental monitoring.
b. TA BAM-3H Continuous Air Monitor Particulate Channel
c. TA BAM-3H Continuous Air Monitor Gaseous Channel
d. TA BAM-3H Continuous Air Monitor Iodine Channel

Answer: C.001 a.
Reference: Chart of the Nuclides.

Question C.002 [1.0 point] {2.0}
Fuel temperature must be limited in the aluminum clad, low hydride fuel elements in order to avoid fuel element failure due to which of the following mechanisms?

a. Melting the aluminum cladding due to high temperature.
b. Distortion of the fuel element due to a phase change of the zirconium hydride.
c. Damage to fuel cladding due to excessive pressure from expansion of fission product gasses.
d. Damage to fuel cladding due to excessive pressure from hydrogen produced by disassociation of the zirconium and hydrogen.

Answer: C.002 b.
Reference: Technical Specifications Section 2.1 bases.

Question C.003 [1.0 point] {3.0}
How long will the single phase backup generator operate, before it must be refueled?

a. 2 hours
b. 12 hours
c. 24 hours
d. 48 hours

Answer: C.003 c.
Reference: VI, Auxiliary Surveillance Equipment, § III. Auxiliary Power System, 3rd ¶.

Question C.004 [1.0 point] {4.0}
A pipe flange fails just downstream of the primary pump. What design feature of the primary system prevents draining of the pool?

a. Signal from a float switch shuts off the primary pump.
b. Signal from a float switch shuts a valve in the pump suction line.
c. Level in the pool drops below siphon break holes in the primary suction pipe.
d. Level in the pool drops below the Net Positive Suction Head pressure minimum required to operate the pump.

Answer: C.004 c.
Reference: III, Maintenance and Surveillance, § I.B.7.d 1st ¶, p. 41

Question C.005 [1.0 point] {5.0}
Which ONE of the following is NOT an input signal into the AUTOMATIC circuit for the regulating rod?

a. Power Demand Level
b. Log-N Period
c. Linear Power
d. Count Rate

Answer: C.005 d.
Reference: Modification Authorization MA-1, figure 6.

Question C.006 [2.0 points, ½ each] {7.0}
For each of the gasses listed in column A identify its primary source (i.e. neutron irradiation of **air**, neutron irradiation of **W**ater or **F**ission **P**roduct).

a. H^3
b. N^{16}
c. Ar^{41}
d. Xe^{138}

Answer C.006 a = W; b = W; c = Air; d = FP
Reference: Standard NRC Question

Question C.007 [1.0 point] {8.0}
Which ONE of the following may be used for the storage of UNIRRADIATED Fuel, but NOT used for the storage of IRRADIATED Fuel?

a. Reactor Tank
b. Secured Storage Pits
c. Cf^{252} room (room 1205B)
d. Radio Chem Lab (room 1205K)

Answer: C.007 c.
Reference: II, Reactor Operations, § F.3

Question C.008 [1.0 point] {9.0}
Which ONE of the following is the reason that the ventilation system maintains a negative pressure in the reactor room?

a. To reduce pressure on the reactor tank.
b. To ensure proper operation of the Continuous Air Monitor.
c. To facilitate opening of the door between the control room and the reactor room.
d. To ensure that any radioactive contaminants go through the stack, vice through any cracks in the room.

Answer: C.008 d.
Reference: III, Maintenance and Surveillance, § I.B.7.c, 1st ¶

Question C.009 [1.0 point] {10.0}
CENTER-015, specifies equipment required to be on-hand for an emergency. It requires a Radiation-Exposure survey meter to be in the control room. This meter is a

a. Personnel Dosimeter
b. Scintillation radiation detector
c. Ion Chamber radiation detector
d. Geiger-Muller radiation detector

Answer: C.009 c.
Reference: Standard NRC question

Question C.010 [1.0 point] {11.0}
To prevent serious damage never allow the water temperature to drop below about ___ while the recirculation system is on.

a. 0º C

b. 5º C

c. 10º C

d. 20º C

Answer: C.010 b
Reference: V. TRIGA Reactor Console pg. 77, ¶ Water Temperatures

Question C.011 [1.0 point] {12.0}
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.

Answer C.011 a.
Reference: Procedure 13.1.4

Question C.012 [1.0 point] {13.0}
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. generation of tritium ($_1H^3$) in the pool.

d. activation of dissolved materials in the pool.

Answer: C.012 d.
Reference: Modification MA-2, Reactor Control System 3rd ¶.

Question C.013 [2.0 points, ½ each] {15.0}
Identify the type of heat mechanism (listed in column B) primarily responsible for removing heat for each of the facility regions listed in column A.

Column A	Column B
a. Centerline to outside edge of fuel	1. Conduction
b. Core to pool water	2. Forced Convection
c. Pool water to heat exchanger	3. Natural Convection
d. Heat exchanger to Freon	4. Radiative

Answer: C.013 a = 1; b = 3; c = 2; d = 2
Reference: Standard NRC question

Question C.014 [1.0 point] {16.0}
What design feature of the purification system prevents draining of the pool on a piping break.

a. The piping has a vacuum breaker at the its highest point.
b. No piping extends into the pool more than 5 feet below the pool surface.
c. All piping has small holes (siphon breaks) located about 2 feet below the pool surface.
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.

Answer: C.014 d.
Reference: SER § 5.1, Technical Specifications § 5.7.

Question C.015 [1.0 point] {17.0}
The pneumatic tube system uses ___ to move the sample.

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

Answer C.015 a.
Reference: IV.C, Pg. 54