

January 8, 2004

Dr. Marye Anne Fox, Chancellor
Room A Holladay Hall
North Carolina State University
Post Office Box 7001
Raleigh, NC 27695-7001

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-297/OL-04-01, NORTH CAROLINA
STATE UNIVERSITY

Dear Dr. Fox:

During the week of December 15, 2003, the NRC administered an operator licensing examination at your North Carolina State University Reactor. The examination was conducted according to NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. 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 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 at (301) 415-1058 or via internet E-mail at pvd@nrc.gov.

Sincerely,

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-297

Enclosures: 1. Initial Examination Report No. 50-297/OL-04-01
2. Examination and answer key with facility comments incorporated

cc w/encls: Please see next page

North Carolina State University

Docket No. 50-297

cc:

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

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TEMPLATE #:NRR-074

OFFICE	RNRP:CE	IROB:LA	E	RNRP:SC
NAME	PDoyle	EBarnhill/EHylton		PMadden
DATE	12/ 23 /2003	12/ 24 /2003		12/ 30 /2003

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

REPORT NO.: 50-297/OL-04-01

FACILITY DOCKET NO.: 50-297

FACILITY LICENSE NO.: R-120

FACILITY: North Carolina State University

EXAMINATION DATES: December 13-14, 2003

SUBMITTED BY: /RA/ 12/19/2003
Paul Doyle, Chief Examiner Date

SUMMARY:

The NRC administered a Senior Reactor Operator (Instant) licensing examination to one candidate. The candidate passed all portions of the administered examination.

REPORT DETAILS

1. Examiners:
Paul Doyle, Chief Examiner
Kevin Witt, Examiner Trainee

2. Results:

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

3. Exit Meeting:
Paul Doyle, NRC, Examiner
Kevin Witt, NRC, Examiner Trainee
Ayman Hawari, Ph.D., NCSU, Director, Nuclear Reactor Program
Stephen Bilyj, NCSU, Reactor Operations Manager
Kerry Kincaid, NCSU, Chief Reactor Operator
Larry Broussard, NCSU, Chief of Reactor Maintenance
Andrew Cook, NCSU, Manager, Engineering and Operations

At the exit meeting, the examiner thanked the licensee and its staff for supporting and cooperating with the examiner during the administration of the operator licensing examination process. The examiner also noted that since there was only one candidate there were no generic weaknesses, and reminded the facility staff to send in any written examination comments as soon as possible.

ENCLOSURE 1

NORTH CAROLINA STATE UNIVERSITY
With Answer Key



OPERATOR LICENSING EXAMINATION
Sections B and C ONLY
December 15, 2003

ENCLOSURE 2

QUESTION B.1 [1.0 point]

With regard to the procedure "Operator Response to Abnormal Reactivity Changes?" An unanticipated reactivity change of ___?___ or more is considered a significant change.

- a. 50 pcm
- b. 100 pcm
- c. 150 pcm
- d. 200 pcm

QUESTION B.2 [1.0 point]

Water from the primary contains N^{16} which has a half-life of 7 seconds. If it takes 70 seconds (ten half-lives) from the time that the water leaves the core, to get to the ion exchanger (resin bed demineralizer), the radiation intensity of the N^{16} will have decreased by a factor of approximately ...

- a. 20
- b. 40
- c. 100
- d. 1000

QUESTION B.3 [1.0 point]

According to the Technical Specifications, if one filter train in the ventilation system is down for maintenance, the other filter train must be verified operable every ...

- a. 8 hours
- b. 24 hours
- c. 48 hours
- d. 72 hours

QUESTION B.4 [1.0 point]

During maintenance on a Nuclear Instrumentation Channel, the technician must work on the equipment, while it is still energized. The minimum level of permission required to work on energized equipment is the

- a. Senior Reactor Operator on Shift
- b. Chief Reactor Operator
- c. Chief Reactor Maintenance
- d. Reactor Operations Manager

QUESTION B.5 [1.0 point]

Per the North Carolina State University Radiation Protection Program (HP 1), as an Adult Radiation Worker your TEDE yearly limit is 5 Rem. Your Admin and ALARA Goal limits for TEDE are ...

- a. 20% (1000 mrem) and 10% (500 mrem) of this limit.
- b. 10% (500 mrem) and 5% (250 mrem) of this limit.
- c. 10% (500 mrem) and 2% (100 mrem) of this limit.
- d. 2% (100 mrem) and 1% (50 mrem) of this limit.

QUESTION B.6 [1.0 point]

Personnel should be considered contaminated if (using an open window frisker), the reading exceeds

- a. 50 net cpm
- b. 100 net cpm
- c. 200 net cpm
- d. 500 net cpm

QUESTION B.7 [1.0 point]

During which one of the following operations may the Over-the-Pool radiation monitor be bypassed for up to five (5) minutes?

- a. Pulse mode operations
- b. Removal of experiments from the reactor pool
- c. Immediately after starting the pneumatic blower system.
- d. During return of pneumatic rabbit capsule from the core.

QUESTION B.8 [1.0 point]

A Startup Checklist was completed on 12/16/03 at 08:15 hours. The reactor was operated at 60% power prior to a normal shutdown initiated at 23:30 hours. What is the latest time that a Key-On Startup may be performed? (Assume Confinement/Evacuation system operated satisfactorily 3 days ago.)

- a. 12/17/03 at 03:30 hours
- b. 12/17/03 at 05:30 hours
- c. 12/17/03 at 07:30 hours
- d. 12/17/03 at 08:15 hours

QUESTION B.9 [1.0 point]

A contaminated person requires prompt medical attention. Per the emergency Plan you should send him to...

- a. The NCSU Infirmary.
- b. Rex Hospital.
- c. Wake Memorial Hospital.
- d. Raleigh Community Hospital.

QUESTION B.10 [2.0 points, ½ each]

Match the evolution in Column A to the responsible person in Column B. (Answers in Column B may be used more than once)

COLUMN A

- a. approve checklists prior to reactor startup
- b. approve bypass of radiation alarms
- c. loading of unknown Δk value samples
- d. account for all fuel

COLUMN B

- 1. Reactor Supervisor
- 2. Designated SRO
- 3. RHP
- 4. CRM

QUESTION B.11 [1.0 point, ¼ each]

What is the minimum required operating crew with the reactor at 1.0 MW, steady state conditions? Indicate whether each individual must be **AT THE FACILITY** or **MAY BE ON CALL**.

- a. DSRO
- b. RO
- c. ROA
- d. RHP

QUESTION B.12 [1.0 point]

What is the reactivity worth limit for a pneumatic sample while operating in the Steady State Mode?

- a. 100 pcm
- b. 300 pcm
- c. 600 pcm
- d. 1000 pcm

QUESTION B.13 [2.0 points, ½ each]

10 CFR 55 contains requirements associated with your operator or senior operator license. Match each of the requirements listed in column A with its appropriate time period in column B. (Note: Periods from column B may be used more than once or not at all.)

<u>Column A (Requirements)</u>	<u>Column B (Years)</u>
a. License Expires	1
b. Pass a Requalification Written Examination	2
c. Pass a Requalification Operating Test	4
d. Medical Examination Required	6

QUESTION B.14 [1.0 point]

The CURIE content of a radioactive source is a measure of

- the number of radioactive atoms in the source.
- the amount of energy emitted per unit time by the source
- the amount of damage to soft body tissue per unit time.
- the number of nuclear disintegrations per unit time.

QUESTION B.15 [1.0 point]

Which one of the following are the Technical Specification limits for irradiated fuel storage?

- $K_{\text{eff}} < 0.80 \Delta k/k$
- $K_{\text{eff}} < 0.85 \Delta k/k$
- $K_{\text{eff}} < 0.90 \Delta k/k$
- $K_{\text{eff}} < 0.95 \Delta k/k$

QUESTION B.16 [1.0 point]

According to Section 2 of the PULSTAR Operations Manual, the Basement area ramp door and the Loading Dock Doors above the MER may be open for a maximum of ___ minutes while the reactor is operating. (Assume audible and visual indication IS available for the RO to verify door status.)

- one
- three
- five
- seven

QUESTION B.17 [2.0 points, ½ each]

Identify whether each of the listed Emergency Classes are credible (CRED) or not credible (NOT) at the NCSU PULSTAR reactor. (Note: Emergency classes are listed in alphabetical order NOT in order of severity.)

- a. Alert
- b. General Emergency
- c. Notification of Unusual Events
- d. Site Area Emergency

QUESTION C.1 [1.0 point]

The reactor has been secured for a week. You startup the reactor and raise power to 1 Megawatt thermal. You depress the AUTO button but the rod control system fails to go into AUTO. Which ONE of the following is the most likely reasons the rod control system would not go into Automatic control?

- a. Mode selector switch is in "steady State"
- b. Servo deviation is -0.35% of scale
- c. Regulating rod is at 11.5 inches
- d. The ganged drive switch is not being operated

QUESTION C.2 [1.0 point]

After losing commercial power, you attempt to start the Auxiliary Generator but the cranking limiter contact opens up. To restart the generator you must ...

- a. place the Start switch to stop than to start
- b. reset the cranking limiter at the Auxiliary Generator control panel
- c. place the Auxiliary Distribution Panel switch in the open position
- d. place the Run-Stop-Remote switch in the Run position

QUESTION C.3 [1.0 point]

The flow rate of the primary system is varied by which of the following methods?

- a. Adjusting the speed of the primary pump.
- b. Adjusting the orifice downstream of the flow straightening tubes.
- c. Adjusting the control signal from the flow transmitter.
- d. Adjusting the position of the primary pump discharge valve.

QUESTION C.4 [1.0 point]

Which ONE of the following signals will NOT cause an Evacuation signal?

- a. Remote manual switch in basement corridor
- b. West Wall monitor
- c. Control Room monitor
- d. Demineralizer monitor

QUESTION C.5 [1.0 point]

Which of the following methods is used to remove the gamma signal from the neutron signal in the Startup Channel?

- a. The outer chamber prevents gammas from ionizing the inner chamber.
- b. Inner chamber current cancels out gamma current in the outer chamber.
- c. A pulse height discriminator does not allow the gamma signals to be counted.
- d. Squaring the combined signal makes the gamma contribution insignificant.

QUESTION C.6 [1.0 point]

The Main Exhaust Fan directly takes a suction on the following components except:

- a. BP&TC Exhaust Fan
- b. Rx Bridge Glove Box
- c. Control Room louvers
- d. Rx Bay Hood

QUESTION C.7 [1.0 point]

Which ONE of the following conditions will prevent you from energizing the rod magnets prior to startup?

- a. Linear Power Scram relay is energized
- b. Over-the-Pool Radiation Monitor in alarm
- c. Air line to Pool level bubbler is isolated
- d. 42 48 VDC is present at SCRAM Logic circuit input Per facility staff, SCRAM logic uses 48 VDC.

QUESTION C.8 [1.0 point]

Which ONE of the following rods has the LOWEST worth?

- a. Regulating
- b. Safety #1
- c. Safety #2
- d. Pulse Rod

QUESTION C.9 [1.0 point]

The Stack Particulate radiation monitor uses a(n) ...

- a. Ion Chamber detector.
- b. Proportional Counter detector.
- c. Geiger Müller detector.
- d. Scintillation detector.

QUESTION C.10 [1.0 point]

N₂ is used as a purge gas in the pneumatic tube system specifically to minimize the production of ...

- a. H³
- b. N¹⁶
- c. O¹⁸
- d. Ar⁴¹

QUESTION C.11 [1.0 point]

TWO channels provide protection against exceeding the Safety Limit due to insufficient pool height, Pool Water Level and the ...

- a. Over-the-Pool Radiation Monitor
- b. Primary Coolant Flow
- c. Pool Water Temperature
- d. Flow Monitoring (Flapper)

QUESTION C.12 [2.0 points, ½ each]

Using the figure provided Identify each of the Nuclear Instrumentation channels on the “Reflected Core No. 4 and Pool Area” drawing.

- a. A 1. Fission Chamber
- b. B 2. Linear
- c. C 3. Log-N
- d. D 4. Safety

QUESTION C.13 [1.0 point]

Which ONE of the control rod blades cannot scram?

- a. Regulating
- b. Safety #1
- c. Safety #2
- d. Shim

QUESTION C.14 [1.0 point, ¼ each]

Identify whether the Reactor Air System supplies air to the listed process instrumentation (**YES**) or not (**NO**).

- a. Pool Level Measuring Channel
- b. Flow Measuring Channel
- c. Flow Monitoring Channel
- d. Temperature Measuring Channel

QUESTION C.15 [1.0 point]

The NCSU reactor cladding is made of ...

- a. aluminum
- b. silver-indium-cadmium alloy
- c. stainless steel
- d. zirconium alloy

QUESTION C.16 [1.0 point]

You may bypass the rod drive inhibits by depressing the Log N operative pushbutton if ...

- a. the startup channel is reading < 2 cps
- b. the Log N startup channel is reading > 2 watts
- c. the startup channel is reading $> 9 \times 10^4$ cps
- d. The Log N channel is reading > 4 watts

QUESTION C.17 [1.0 point, ¼ each]

Match the purification system functions in column A with the purification component listed in column B

Column A

- a. remove dissolved impurities
- b. remove suspended solids
- c. maintain pH
- d. Protect Purification Pump Impeller

Column B

- 1. Demineralizer (Ion Exchanger)
- 2. Filters
- 3. Wye Strainer

QUESTION C.18 [1.0 point]

Which ONE of the following primary parameters, if alarming, requires the operator to manually insert a scram?

- a. Low Pool Level
- b. Low Primary Flow
- c. High Temperature
- d. Safety Flapper Not Closed

- B.1 b
REF: NCS Reactor Operating Procedures Section 3 Sub 3.4.5.2 page 3-62
- B.2 d
REF: $2^{10} = 1024$, distractors: a = 2×10 ; b is bogus, c = 10^2
- B.3 b
REF: Technical Specifications § 3.6, 5th note.
- B.4 c
REF: Administrative Controls § 2, 2.9.4 page, 2-17 and NRC examination administered 1992.
- B.5 c
REF: HP 1, 4.3.4 Table on page 9.
- B.6 b
REF: HP 1, § 4.4.3, page 13.
- B.7 b
REF: NCS Tech Spec Section 3.5.a.ii note 2, page 20, and NRC administered Exam 1992.
- B.8 e b Changed per facility comment (typo)
REF: POM, § 3.4.6, p. 3-44, also complete rewrite NRC Exam question administered 1991.
- B.9 b
REF: NCSU, Emergency Procedure 1.0, § 4.3, p. 2, also NRC Exam administered 1986
- B.10 a. 2; b. 2 c. 1 d. 3 ~~e. 1~~
REF: **PULSTAR Ops. Manual, pp**, also minor rewrite of NRC exam administered 1988
- B.11 a, May be on call; b, At the facility; c, At the facility; d, May be on call
REF: PULSTAR Ops. Manual, § 2.3.2, p. 2-5 and Tech. Spec. 6.1.2, also Rewrite of NRC Exam question administered 1988
- B.12 b
REF: NCS Pulstar Operations Manual, Section 9, "Experimental Facilities", Page 9-19
- B.13 a, 6; b, 2; c, 1; d, 2
REF: 10CFR55
- B.14 d
REF: Standard Health Physics Definition.
- B.15 c
REF: NCS Tech Specs 5.3 page 35
- B.16 c
REF: POM § 2.5.1, 2nd ¶, p 2-11.
- B.17 a, CRED; b, NOT; c, CRED; d, NOT
REF: NCS Pulstar Emergency Plan Section 4.3.3 page 10

- C.1: c
REF: POM, Pg. 4-16 (7/20/1992)
- C.2: b
REF: POM Sect. 6.3 (7/20/1992)
- C.3 d
REF: NCSU, Ops Manual, Figure 5.1 (11/12/1991)
- C.4: d
REF: SAR Vol. II Sect. 5.2.2 (7/20/1992)
- C.5 c
REF: POM SEC. 4 (7/20/1992)
- C.6: c
REF: SAR Figure 5-1 (7/20/1992)
- C.7 c
REF: POM Sect. 4.2.3 / SAR Sect. 7.3 (7/20/1992)
- C.8 c
REF: Reactor Operator's Data Sect. II pg. 4
- C.9 d
REF: NCSU, Ops Manual, Table 7-1 (4/24/1986)
- C.10 d
REF: Pulstar Operations Manual § 9.2.4, Pneumatic Nitrogen Purge System
- C.11 a
REF: NCSU Tech. Specs. pg 20
- C.12 a, 4; b, 2; c, 3 d, 1
REF: NCSU PULSTAR Data Summary, Figure 1, page 2.
- C.13 d
REF: SAR § 7.3.7, p. 7-7.
- C.14 a, YES; b, YES; c, NO; d, NO
REF: SAR § 7.3.8, pp. 7-7 & 7-8.
- C.15 d
REF: SAR § 3.2. Reactor Design, Subsection 3.2.1, 7th ¶, p. 3-5.
- C.16 d
REF: POM, § 3.2.1.1, step 11, P. 3-3
- C.17 a, 1; b, 2; c, 1; d, 3
REF: SAR, Figure 4-1F.
- C.18 c
REF: Rewrite of examination question administered May 2002, rewrite based on facility comment.