April 26, 2004

Mr. Robert Agasie
Reactor Director
Nuclear Engineering Laboratory
1513 University Avenue, Room 141ME
University of Wisconsin
Madison, WI 53706

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-156/OL-04-01, UNIVERSITY OF WISCONSIN

Dear Mr. Agasie:

During the week of March 15, 2004, the NRC administered an operator licensing examination at your University of Wisconsin 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 Agencywide Documents Access and Management 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 Mr. Paul Doyle at (301) 415-1058 or via internet e-mail 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. 50-156

Enclosures:
1. Initial Examination Report No. 50-156/OL-04-01
2. Facility comments with NRC resolution
3. Examination and answer key (RO/SRO)

cc w/encls.: Please see next page

cc:

Mayor of Madison
City Hall
Madison, WI 53705

Chairman, Public Service
Commission of Wisconsin
610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854

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

REPORT NO.: 50-156/OL-04-01

FACILITY DOCKET NO.: 50-156

FACILITY LICENSE NO.: R-74

FACILITY: University of Wisconsin

EXAMINATION DATES: March 15 – 18, 2004

SUBMITTED BY: ___________*/RA/*_______________ __4/2/2004_
Paul Doyle, Chief Examiner Date

SUMMARY:

During the week of March 15, 2004, the NRC administered operator licensing examinations to three Reactor Operator candidates and one Senior Reactor Operator (Instant) candidate. One Reactor Operator candidate failed all three sections of the written examination, and the operating test. All other candidates passed all portions of their respective examinations.

REPORT DETAILS

1. Examiners:
Paul Doyle, Chief Examiner
Phillip T. Young, Examiner Under Instruction

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	2/1	1/0	3/1
Operating Tests	2/1	1/0	3/1
Overall	2/1	1/0	3/1

3. Exit Meeting:
Paul Doyle, NRC, Examiner
Phillip T. Young, NRC, Examiner Under Instruction
Robert Agasie, Reactor Director, University of Wisconsin

During the exit meeting, the examiners commented on the fact that the candidates showed a universal reluctance to refer to administrative procedures during the examination. Conversely, all of the candidates demonstrated good use of operational procedures within the control room, with one being weak on the use of procedures outside the control room.

ENCLOSURE 1

Facility Comments Regarding NRC Exam Administered on March 15, 2004

Question A.19
Facility Comment: No answer was provided in the answer key. The correct answer should be C.
NRC Resolution: Agree with comment. The answer key has been modified to show C as the correct answer to question A.19.

Question B.4
Facility Comment: For Information Only. The procedure now identifiers the kit location as the Emergency Support Center (ESC).
NRC Resolution: Comment noted. Since the Emergency Support Center ***IS*** the Reactor Directors Office, no change is required to this question.

Question B.11
Facility Comment: To enhance the question. It is the role of management to ensure compliance with NRC regulations through the use of written procedures. I would not expect a RO to know what 10 CFR 55.53 says, rather, I would expect a RO to know what UWNR 004 says.
NRC Resolution: Comment noted.

Question B.18
Facility Comment: The answer key is incorrect. The correct answer is A
NRC Resolution: Agree with comment. Answer key modified to show A as answer to B.18.

Question C.2.
Facility Comment: To enhance the question. We teach that compensating voltage is necessary in order to regain the bottom 2-3 decades of range in a mixed neutron-gamma field. The square wave/pulse inhibit is set at 1kW. This means, an operator could level the reactor at 990 W prior to shifting into square wave. At this power level loss of compensating voltage would not result in upscale indication. Suggest the question specify the actual power level.
NRC Resolution: Agree with comment. Question has been modified to specify actual power level.

Question C.3
Facility Comment: To enhance the question. The question could be confusing without specifying the Panalarm Annunciator.
NRC Resolution: Agree with comment. Question modified to specify Panalarm Annunciator.

Question C.4
Facility Comment: There is no correct value in the list of answers. SAR page 4-3 estimates the value of 0.0007 %. It is suggested to eliminate this question. Furthermore, it is inappropriate to ask an operator to memorize a value of reactivity that is published in the console operator information handbook. These values of reactivity will vary based on core loading and other experiments and therefore no operator should attempt to memorize. The operator must know where to look for this information.
NRC Resolution: Agree with comment. This question has been deleted from examination. In addition a note was added to the question to specify that this answer may vary based on core loading, and is more appropriately tested on the operating test.

Question C.7

Facility Comment: ALL Answers are CORRECT. Answers A, B & D are used to prevent the build up of Ar^{41} concentrations (gaseous activity) and therefore are <u>not normal flow path used to prevent the spread of airborne particulate contamination</u>.

NRC Resolution: Agree with comment. This question has been deleted from examination.

Question C. 8

Facility Comment: There is no correct answer. Control element <u>position</u> is not an input to the automatic control system. Power level (servo error) and control element select are.

NRC Resolution: Agree with comment. This question has been deleted from examination.

Question C.9

Facility Comment: Comment to enhance the question. The power level should be indicated thereby implying the blade positions as well as the physical location within the beamport. At full power, and at the core end of the beamport, beam port #1 will have a higher flux.

NRC Resolution: Comment noted.

Question C.10

Facility Comment: For Information Only; these temperature rises are no longer seen with the new cooling system. No other comment.

NRC Resolution: Comment noted. No action required.

Question C.11

Facility Comment: The correct terminology should be used; secondary should be replaced with intermediate.

NRC Resolution: Agree with comment. Question modified for future use.

Question C.14

Facility Comment: The answer key is incorrect. The correct answer is C.

NRC Resolution: Agree with comment. Answer key modified to show C as answer to C.14.

Question C.16

Facility Comment: A, B & D are correct answers. A is correct because a reactor period of second or shorter will scram the reactor in manual mode. D is correct because the fuel temperature monitor will scram at 400°C.

NRC Resolution: Agree with comment. This question has been deleted from examination.

Question C.18.

Facility Comment: B & C are correct answers. There is an indicator in the reactor control room that a whale sample is in the reactor.

NRC Resolution: Agree with comment. The answer key has been modified to include both B & C as correct answers for question C.18.

UNIVERSITY OF WISCONSIN

WITH ANSWER KEY

UNITED STATES NUCLEAR REGULATORY COMMISSION

OPERATOR LICENSING EXAMINATION

March, 2004

ENCLOSURE 3

QUESTION A.01[1.0 point]
Which one of the following statements details the effect of fuel temperature on core operating characteristics? As fuel temperature …

a. increases, doppler peaks will become higher.

b. decreases, resonance escape probability will increase.

c. decreases, U^{238} and Erbium will absorb more neutrons.

d. increases, the fast non-leakage probability will decrease.

QUESTION A.02[1.0 point]
Which one of the following statements is the definition of "reactivity"?

a. A measure of the core's fuel depletion.

b. A measure of the core's deviation from criticality.

c. Equal to $.70 when the reactor is prompt critical.

d. Equal to 1.00 $\Delta K/K$ when the reactor is prompt critical.

QUESTION A.03[1.0 point]
Reactor period is at 26 seconds. How long will it take to increase power from 10 kilowatts to 100 kilowatts?

a. 10 seconds

b. 1 minute

c. 10 minutes

d. 1 hour

QUESTION A.04[1.0 point]
Which one of the following statements best describes the difference between a moderator and a reflector. A reflector …

a. increases the neutron production factor and a moderator increases the fast fission factor.

b. increases the neutron production factor and a moderator decreases the fast fission factor.

c. increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

d. decreases the fast non-leakage factor and a moderator increases the thermal utilization factor.

QUESTION A.05[1.0 point]
Which ONE of the following is an example of alpha (α) decay?

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

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

c. $_{35}Br^{87} \rightarrow {}_{34}Se^{86}$

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

QUESTION A.06[1.0 point]
Given a fuel temperature coefficient of -2×10^{-4} ΔK/K/°C and the INSERTION of a control rod 5 inches with an average worth of 0.1% ΔK/K/inch. After stabilization of reactor power what will be the new fuel temperature? (Assume no other reactivity changes.)

a. 2.5°C lower

b. 2.5°C higher

c. 25°C lower

d. 25°C higher

QUESTION A.07[1.0 point]
The first in a series of two pulses had a reactivity worth $2.00 and a peak power of 1050 Mw. If the second pulse had a reactivity worth $1.50, what was the peak power?

a. 263 Mw

b. 653 Mw

c. 525 Mw

d. 1485 Mw

QUESTION A.08[1.0 point]
Given the following conditions which one of the following reactions has the highest probability of occurrence? A beam of thermal neutrons is aimed at a thin foil target made of 10% copper and 90% aluminum.

σ_a Cu = 3.79 barns σ_a Al = 0.23 barns
σ_s Cu = 7.90 barns σ_s Al = 1.49 barns

a. A neutron absorption in copper

b. A neutron absorption in aluminum

c. A neutron scattering reaction with copper

d. A neutron scattering reaction with aluminum

QUESTION A.09[1.0 point]
K_{eff} for the reactor is 0.95. What is the shutdown margin for this condition? (I am NOT looking for Technical Specification definition)

a. 5.00% ΔK/K

b. 5.26% ΔK/K

c. 5.00¢

d. 5.26¢

QUESTION A.10[1.0 point]
The number of neutrons passing through a one square centimeter of target material per second is the definition of which one of the following?

a. Neutron Population (np)

b. Neutron Impact Potential (nip)

c. Neutron Flux (nv)

d. Neutron Density (nd)

QUESTION A.11[1.0 point]
β and β_{eff} both describe the total fraction of delayed neutrons. The difference between the two is that β_{eff} is …

a. smaller than β since delayed neutrons are born at lower energy levels than prompt neutrons.

b. larger than β since delayed neutrons are born at lower energy levels than prompt neutrons.

c. smaller than β since delayed neutrons are born at higher energy levels than prompt neutrons.

d. larger than β since delayed neutrons are born at higher energy levels than prompt neutrons.

QUESTION A.12[1.0 point]
The reactor had a shutdown margin of 1.75% Δk/k, and a source range count rate of 15 counts per minute. After placing samples in the reactor the count rate increased to 30 counts per minute. What is the worth of the sample?

a. -0.44%Δk/k

b. +0.44%Δk/k

c. -0.88%Δk/k

d. +0.88%Δk/k

QUESTION A.13[1.0 point]
The main source of heat in the reactor one hour after shutdown is due to …

a. Decay of fission products

b. Fission due to delayed neutrons

c. Spontaneous fission within the core

d. Decay of radioactive structural materials

QUESTION A.14[1.0 point]
For U^{235}, the thermal fission cross-section is 582 barns, and the capture cross-section is 99 barns. When a thermal neutron is absorbed by U^{235}, the probability that a fission will occur is:

a. 0.146

b. 0.170

c. 0.830

d. 0.855

QUESTION A.15[1.0 point]
With the reactor on a constant period, which of the following changes in reactor power would take the LONGEST time?

a. 5% — from 1% to 6%

b. 15% — from 20% to 35%

c. 20% — from 40% to 60%

d. 25% — from 75% to 100%

QUESTION A.16[1.0 point]
Which ONE of the following isotopes has the largest microscopic cross-section for absorption for thermal neutrons?

a. Sm^{149}

b. U^{235}

c. Xe^{135}

d. B^{10}

QUESTION A.17[1.0 point]
Which ONE of the following factors is the most significant in determining the differential worth of a control rod?

a. The rod speed.

b. Reactor power.

c. The flux shape.

d. The amount of fuel in the core.

QUESTION A.18[1.0 point]
Using the Integral Rod Worth Curve provided identify which ONE of the following represents "***<u>Excess Reactivity</u>***"?

a. Area under curve "B"

b. ρ_C

c. ρ_{max} - ρ_C

d. Area under curves "A" and "B"

QUESTION A.19[1.0 point]
When performing rod calibrations, many facilities pull the rod out a given increment, then measure the time for reactor power to double (doubling time), then calculate the reactor period. If the doubling time is 42 seconds, what is the reactor period?

a. 29 sec

b. 42 sec

c. 61 sec

d. 84 sec

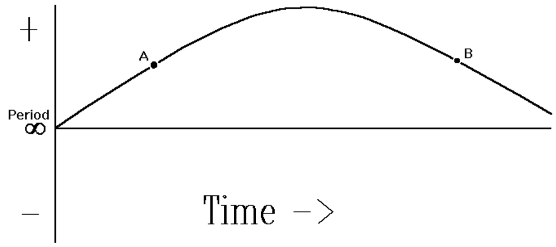
QUESTION A.20[1.0 point]
Shown below is a trace of reactor period as a function of time. Between points A and B reactor power is:

a. continually increasing.

b. continually decreasing.

c. increasing, then decreasing.

d. constant.



Question B.01 [1.0 point]
During an emergency, the lowest level of staff, by title, who may authorize receipt of radiation exposures, including delegation of responsibility if applicable, in excess of 10 CFR 20 occupational limits (according to the Emergency Plan) is the …

a. Reactor Director.

b. Reactor Supervisor.

c. most senior Senior Operator licensed individual present.

d. most senior Operator licensed individual present.

Question B.02 [1.0 point, 0.25 each]
Identify the PRIMARY source (irradiation of **air**, irradiation of **water**, or **fission** product) of **<u>EACH</u>** of the radioisotopes listed.

a. ${}_{1}H^{3}$

b. ${}_{18}Ar^{41}$

c. ${}_{7}N^{16}$

d. ${}_{54}Xe^{135}$

Question B.03 [1.0 point]
Which ONE of the following operations require the presence of a licensed SENIOR reactor operator?

a. operation for a planned shutdown.

b. any time a key is in the key switch.

c. recovery from an unplanned shutdown.

d. irradiation of an approved modified routine experiment.

Question B.04 [1.0 point]
The Emergency Response Kit is located in the …

a. Reactor Control Room

b. Reactor Directors Office

c. Police and Security dispatch center

d. Engineering Research Building Room B-130

Question B.05 [1.0 point]
Which ONE of the following correctly defines a Safety Limit?

a. The lowest functional capability of performance levels of equipment required for safe operation of the facility.

b. The limiting availability of systems, including their associated input and actuation circuits, which are designed to protect the reactor to guard against the uncontrolled release of radioactivity.

c. The limit(s) on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

d. The lowest initiating settings for automatic protective systems, related to those variables having significant safety functions, to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

Question B.06 [2.0 points, ½ each]
Match the values from column B for the Technical Specification limits listed in column A. (Values in Column B may be used more than once or not at all. Each limit in section A should have only one answer. Record the matching number on the answer key.)

Column A	Column B
a. Minimum Shutdown margin provided by control rods shall be greater than _____ with the highest worth non-secured experiment in its most reactive state, the highest worth control rod and the regulating rod (if not scrammable) fully withdrawn and the reactor in the cold condition without xenon	1. 0.20% $\Delta k/k$ 2. 0.70% $\Delta k/k$ 3. 0.80% $\Delta k/k$
b. Non-secured experiments shall have reactivity worths less than ____ .	4. 1.10% $\Delta k/k$ 5. 1.40% $\Delta k/k$
c. The reactivity worth of any single experiment shall be less than ____ .	6. 1.65% $\Delta k/k$
d. The reactivity inserted for pulse operation will not exceed _____ .	7. 6.00% $\Delta k/k$ 8. 14.00% $\Delta k/k$

Question B.07 [1.0 point]
A radiation survey instrument was used to measure an irradiated experiment. The results were 100 mrem/hr with the window open and 60 mrem/hr with the window closed. What was the beta dose rate?

a. 40 mrem/hr

b. 60 mrem/hr

c. 100 mrem/hr

d. 140 mrem/hr

Question B.08 [1.0 point]
A channel check is ....

a. a qualitative verification of actual performance by observation of behavior.

b. the injection of a signal into a channel to check the continuity of the channel circuits.

c. a visual verification of capability of automatic protective device(s) to perform their intended function(s)

d. an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures.

Question B.09 [1.0 point]
Which ONE of the following is the definition for “Annual Limit on Intake (ALI)”?

a. The concentration of a radio-nuclide in air which, if inhaled by an adult worker for a year, results in a total effective dose equivalent of 100 millirem.

b. 10CFR20 derived limit, based on a Committed Effective Dose Equivalent of 5 Rems whole body or 50 Rems to any individual organ, for the amount of radioactive material inhaled or ingested in a year by an adult worker.

c. The effluent concentration of a radio-nuclide in air which, if inhaled continuously over a year, would result in a total effective dose equivalent of 50 millirem for noble gases.

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

Question B.10 [1.0 point]
Given the following radiation information for a room you are about to enter:
5 millirad Beta 15 millirad gamma 5 millirad neutron
What is the dose rate in the room?

a. 25 mrem/hr

b. 70 mrem/hr

c. 115 mrem/hr

d. 120 mrem/hr

Question B.11 [1.0 point] Question changed for future use, per facility comment.
You are currently the licensed operator at the control of the reactor. Which ONE of the following **violates** ~~10 CFR Part 55.53 "Conditions of licenses"~~ "UNWR 004 "University of Wisconsin Nuclear Reactor Operator Proficiency Maintenance Program"?

a. Last license medical examination was 25 months ago.

b. Last Requalification operating test was 11 months ago.

c. Last quarter you were the Licensed operator for 6 hours.

d. Last Requalification written examination was 11 months ago.

Question B.12 [1.0 point]
Which ONE of the following conditions is an Abnormal Occurrence per the Technical Specification definitions?

a. Reactor Operation with a reactor power level scram set at 1.2 MW.

b. Reactor Operation with one fuel element temperature channel operable.

c. Operation with a pool level scram set-point of 18.5 ft. above the top of the core.

d. Reactor Operation with the time required for the scrammable control elements to be fully inserted measured at 1.95 seconds.

Question B.13 [1.0 point]
Which of the following correctly identifies the level of authorization required for the type of experiment identified in the statement?

a. Routine experiments may be performed at the discretion of the reactor operator responsible for operation without further review or approval.

b. Modified routine experiments may be performed at the discretion of the senior operator responsible for operation, without further review or approval provided he/she makes a determination that the experiment hazards are neither nor significantly different from the corresponding routine experiment.

c. Modified routine experiments require a review and concurrence by the Reactor Supervisor, for determination that the experiment hazards are neither nor significantly different from the corresponding routine experiment, followed by final approval by the senior operator responsible for operation.

d. Special experiments require a review, by the Reactor Supervisor, to determine the effect on consequences of failure, including chemical reactions, physical integrity, cooling, and reactivity effects. The Reactor Safety Committee will review all favorable evaluations but does not have to approve performance of the experiment.

Question B.14 [1.0 point]
Which ONE of the following is the **MAXIMUM** amount of explosive materials allowed to be irradiated per Technical Specifications?

a. 2.5 milligrams

b. 5 milligrams

c. 25 milligrams

d. 2.5 grams

Question B.15 [1.0 point]
Which ONE of the following statements concerning emergency exposure limits is correct?

a. the volunteers over age 55 can receive a 50 Rem one time emergency exposure dose.

b. an individual may be authorized to receive up to 25 REM to deal with situations which are likely to lead to life-threatening situations.

c. an individual can be authorized to receive up to 25 REM to deal with situations which are **not** life-threatening **nor** are likely to lead to life-threatening situations.

d. the volunteers over age 60 can receive a 75 Rem one time emergency exposure dose, if they have a life time dose less than 15 Rem and have adequate records of their radiation exposure history.

Question B.16 [1.0 point]
Technical Specification 5.5 “Fuel Storage” requires “all fuel elements shall be stored in a geometrical array where the value of K_{eff} is less than ___ for all conditions of moderation.

a. 0.80

b. 0.85

c. 0.90

d. 0.95

Question: B.17 [1.00 point]
Which statement accurately describes the stated mode of operation and its associated conditions/restrictions?

a. In the manual mode, the selected rod can be used to control power as long as actual power is within 5% of scheduled power.

b. In square wave mode the transient rod can be fired if power level is greater than 1kW. The transient rod returns to its pre-fire position 20 seconds after being fired.

c. In automatic mode, power is automatically controlled by the servo amplifier driving the selected blade or rod as long as the period, supplied from the Log N-period channel, is less than a pre-selected value.

d. In pulse mode, the transient rod can be fired from any position and will remain in its final position. The high level pulsing channel is connected to readout peak power of the pulse on a fast digital recorder. This channel also provides input to the safety channels because high voltage is removed from all other neutron monitoring channels.

Question B.18 [1.00 point]

Argon-41 is produced by neutron absorption of argon-40. Argon-41 decays by:

a. a 1.3 Mev gamma with a half-life of 1.8 hours.

b. a 6.1 Mev gamma with a half-life of 7 seconds.

c. neutron emission with a half-life of 1.8 hours.

d. a 1.3 Mev beta with a half-life of 7 seconds.

Question B.19 [1.0 point]
A small experiment sample reads 200 mR/hr with the sample 1 foot under water and the meter at the surface of the water. A reading taken ½ hour ago with both the sample and the meter in the same positions was 400 mR/hr. Approximately how long will it take for the reading to drop to 20 mR/hr with the sample and the meter in the same positions?

a. 40 minutes

b. 70 minutes

c. 100 minutes

d. 130 minutes

Question: C.01 [1.00 point]
Why are holes drilled into the suction and discharge piping, in the pool, of the primary coolant system are designed to ______________ ?

a. prevent scum buildup on the pool surface.

b. delay N^{16} isotope rise to the surface of the pool.

c. prevent a loss of pool inventory upon a primary loop pipe break.

d. provide a homogeneous mixture for circulation through the heat exchanger.

Question: C.02 [1.00 point] Clarification to stem added per facility comment.
Just prior to the plant shifting to Square-Wave Mode operation (at 300 watts), compensating voltage to the Safety Channel compensated ion chambers was lost. What was the plant response to this event?

a. The reactor scrammed due to high flux greater than 125%.

b. Reactor power was reduced by the automatic control mode.

c. The peak power read out on the fast digital recorder was lost.

d. An interlock prevented switching from auto mode to the square-wave mode.

Question: C.03 [2.00 point, 0.5 points each] Clarification to stem added per facility comment.
Match the following abnormal alarm condition with the appropriate alarm status on the Panalarm Annunciator.

	Alarm Condition		Alarm Status
a.	condition initiates	1.	annunciator extinguished
b.	condition acknowledged	2.	annunciator, slow flash
c.	condition corrected	3.	annunciator, flashes rapidly
d.	condition reset	4.	audible signal silences

Question: C.04 [1.00 point] Question Deleted per facility comment The answer to this question varies based on core loading, and is therefore more appropriately tested on the operating test.
~~If the beam ports and pneumatic tube were to flood while the reactor is operating at full power, what is the worth of the assumed step reactivity addition?~~

~~a. 0.077 % ΔK/K~~

~~b. 0.2 % ΔK/K~~

~~c. 0.7 % ΔK/K~~

~~d. 1.4 % ΔK/K~~

Question: C.05 [2.0 points, 0.5 each]
Match the reactor power instrumentation listed in column A with its corresponding detector type from column B. (Choices from column B may be used more than once or not at all.)

Column A	Column B
a. Log Count Rate	1. Gamma Ionization Chamber
b. Log N	2. Boron Lined Compensated Ionization Chamber
c. Picoammeter	3. Fission Chamber
d. Pulse Channel	4. Kanne Ionization Chamber

Question: C.06 [1.00 point]
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. Stack Gas Monitor

c. Stack Particulate Monitor

d. Bridge Area Monitor

Question: C.07 [1.00 point] Question Deleted per facility comment.
~~**WHICH ONE** of the following **does not** describe a normal air flow path used to prevent the spread of airborne particulate contamination.~~

~~a. The beam port shutter section drain lines each contain check valves and stop valves prior to the tie with the common line, this line has a normally closed drain into the hold tank floor drain.~~

~~b. The air flow is normally from Reactor Lab to beam ports, thermal column and liquid radwaste holdup tank to the stack.~~

~~c. The Room Exhaust Fan takes suction directly on the reactor control room.~~

~~d. The thermal column is sealed by weatherstripping when fully closed.~~

Question: C.08 [1.0 point] Question deleted per facility comment.
~~Which one of the following correctly identifies inputs into the Automatic Control System?~~

~~a. Position from the selected control blade/rod {servo error}.~~

~~b. Period signal from the Log Count Rate Circuit~~

~~c. Power level from the fuel element thermocouple.~~

~~d. Power/mode 1 kW interlock from the gamma-ray ion chamber~~

Question: C.09 [1.0 point] Per facility comment: This question should be modified to give more information as the flux in each of these positions will be affected by rod position.
A sample placed in which ONE of the following positions will have the greatest neutron flux exposure?

a. Beam Port #1

b. Beam Port #3

c. Pneumatic Tube

d. Thermal Column

Question: C.10 [1.0 point]
How much of a pool temperature rise, during reactor operation, will result in a one inch increase in pool level?

a. 10°F

b. 15°F

c. 20°F

d. 25°F

Question: C.11 [1.0 point] Question modified per facility comment.
During reactor operation, a leak develops in the primary to ~~secondary~~ intermediate heat exchanger. Which ONE of the following conditions correctly describes how the system will react?

a. Pool level will increase, the automatic level control will Pool maintain level within an 1 and ½ inches of normal.

b. Pool level will increase, an alarm will occur at the Security and Police Headquarters two inches above normal

c. Pool level will decrease, the reactor will scram if level decreases by two inches.

d. Pool level will decrease, the intermediate loop pump will trip due to low pressure.

Question: C.12 [1.0 point]
Which of the following is correct for the rules governing procedure use?

a. Operators are only required to adhere to the License and Technical Specifications.

b. Operating personnel shall know the immediate actions for emergency procedures.

c. The Senior Operator may make changes to any procedure step by initialing the change.

d. Entries into procedures requiring data entry, check-offs or initialing of steps can be completed at the end of the shift.

Question: C.13 [1.0 point]
Which of the following is the reason for an elevated ventilation release?

a. to maintain the Reactor Lab at a pressure lower than the atmosphere.

b. to allow the heavier particles and isotopes to be removed prior to release.

c. to reduce concentrations of radioactive materials, in non-restricted areas, compared to a ground release.

d. to provide a common collection point for all exhaust from the facility so that a composite effluent sample can be drawn.

Question: C.14 [1.00 point]
The Safety Channels (picoammeters):

a. supply a period signal for use in the Automatic mode.

b. provide a 1 kW inhibit for the pulse or square wave modes.

c. provide a zero output, fail safe, trip signal to scram the reactor.

d. provide a insertion inhibit signal to the fission counter drive circuit

Question: C.15 [1.00 point]
What do the thermocouples in each of the instrumented fuel elements measure?

a. The temperature of the fuel reflector end pieces.

b. The temperature of the fuel cladding.

c. The temperature of the fuel’s surface.

d. The temperature of the fuel’s interior.

Question: C.16 [1.00 point] Question deleted per facility comment.
~~Which ONE of the following situations will cause the reactor to automatically SCRAM?~~

~~a. Reactor period less than 2.0 seconds except in pulse mode.~~

~~b. Coolant temperature at core inlet above 130°F.~~

~~c. Any safety blade with magnets de-energized.~~

~~d. High fuel temperature 750°C.~~

Question: C.17 [1.00 point]
What type of detector does the Continuous Air Monitor particulate activity channel use to measure radiation?

a. Gamma scintillator.

b. Geiger-Mueller.

c. Ionization chamber.

d. Beta scintillator.

Question: C.18 [1.00 point]
There is an annunciator alarm or indicator light in the control room for which ONE of the following?

a. Manual control on.

b. Thermal Column door open.

c. Whale sample in reactor core.

d. Presence of water in any beam port.

A.01 b.
REF: NEEP 234, p.

A.02 b.
REF: NEEP 234, *Reactor Physics II*. p. 102

A.03 b.
REF: *Math and Physics,* p. 12

A.04 c.
REF: NEEP 234, p. 87.

A.05 a.
REF: NEEP 234, *Physics I,* p. 23

A.06 c.
REF: Inserting the rod 5 inches gives (-5 inches) x 0.1% ΔK/K/inch = -0.5% ΔK/K. Temperature coefficient = -2×10^{-4} ΔK/K/°C or -0.02% ΔK/K/°C. The temperature coefficient must compensate for the reactivity added by the rod movement. ∴ since the insertion of a rod added negative reactivity the fuel temperature must add positive reactivity (temperature decrease).
-0.02% ΔK/K/°C (-X°C) = 0.5% ΔK/K. -X°C = (0.5% ΔK/K) ÷ (-0.02% ΔK/K/°C) X°C = 25

A.07 a
REF: Peak power is proportional to $\Delta\$_{prompt}^2$. $P_1/\rho_2^2 = P_2/\rho_1^2$ $1050/0.5^2 = P_2/1^2$ $(1050/4) * 1 = P_2$
$262.5 = P_2$
REF: NEEP 234, *Reactor Pulsing* p. 144

A.08 d. $0.1 \times \sigma_{aCu} = 0.379$; $0.1 \times \sigma_{sCu} = 0.79$; $0.9 \times \sigma_{aAl} = .207$ **$0.9 \times \sigma_{sAl} = 1.341$**
REF: NEEP 234, p. 86

A.09 b. $SDM = (1 - K_{eff})/K_{eff} = (1 - 0.95)/0.95 = 0.05/0.95 = 0.0526$
REF: NEEP 234, *Reactor Physics II,* p. 102

A.10 c.
REF: NEEP 234, *Physics II (Objective 2)* p. 31

A.11 b.
REF: NEEP 234, *Reactor Physics II,* p. 101

A.12 d.
REF: SDM = 1.75% Δk/k = 0.0175 Δk/k $K_{eff} = 1/(1.0175) = 0.9828$
$1 - K_{eff2} = (1 - K_{eff1}) \times CR_1/CR_2 \rightarrow K_{eff2} = 1 - [(1 - K_{eff1})CR_1/CR_2]$
$K_{eff2} = 1 - [(1 - 0.9828) \times ½] = 1 - [0.0172 \times 0.5] = 1 - 0.0086 = 0.9914$
$\rho = (0.9828 - 0.9914)/(0.9828 \times 0.9914) = 0.008826$ Δk/k = +0.883% Δk/k

A.13 a.
REF: NEEP 234, *Reactor Physics III,* p. 113.

A.14 d.
REF: NEEP 234, p. 86 (Scope)

A.15 a.
REF: NEEP, *Math and Physics,* p. 12

A.16 c.
REF: NEEP 234, p. 86

A.17 c.
REF: Standard NRC Question.

A.18 c.
REF: NEEP 234, *Reactor Physics II,* pg. 102

A.19 c. Answer added per facility comment (TYPO).
REF: NEEP 234, *Reactor Physics III,* p. 103

A.20 a.
REF: NEEP 234, p.

B.01 d.
REF: UWNR 006 Section 3.1 & Table 1

B.02 a. Water; b. Air; c. Water; d. Fission
Reference: NEEP 234 pages 91 through 95.
NEEP 234 pages 249 through 251

B.03 c.
Reference: UWNR 001, page 1, items 1 & 2.

B.04 b.
REF: UWNR 006 - Section 8.0 par #1, page #6, and UWNR 150 Section E.4 page #3

B.05 c.
Reference: UWNR Technical Specifications, Section 1.0, Definitions

B.06 a. _1_ b. _2_ c. _5_ d. _5_
Reference: UWNR Technical Specifications: 1) Section 1.0, Definitions, 2) Section 3.6, Limitations of Experiments, and 3) Section 3.2 Pulse Mode Operation

B.07 a.
REF: Betas do not penetrate the closed window.

B.08 a.
REF: Technical Specification Definitions.

B.09 b
Reference: 10CFR20.1003

B.10 b.
Reference: 10CFR20.100x

Answer: B.11 a.
Reference: 10 CFR Part 55.53

Answer: B.12 c.
Reference: UWNR Technical Specifications 3.3.3 Table 1

Answer: B.13 b.
Reference: UWNR Technical Specifications, Administrative Controls, Section 6.8

Answer: B.14 c.
Reference: UWNR Technical Specifications, LCO 3.6.c

B.15 b.
REF: UWNR 006 Section 7 page 6. 10 CFR 20.1206, NEEP 234 Definitions (i) on page 33

B.16 a.
REF: UWNR Technical Specifications 5.5

B.17 c.
REF: SAR Section 7.3

B.18 ~~c.~~ a. Answer changed per facility comment (TYPO)
REF: Chart of the Nuclides

B.19 c.
REF: NEEP 234 Physics I page 24 $A = A_0 e^{-\lambda t}$
Solve for λ $200 = 400 e^{-\lambda 30min}$ ln (200/400) = -λ× 30minutes ln(½)/30 minutes = -λ = 0.0231
Next solve for time $20 = 200 e^{(-0.0231 \times time)}$ ln (1/10)/-0.0231 = time = 99.7 minutes ≈ 100 minutes

Answer: C.01 c.
REF: NEEP 234 pages 160 - 162 & SAR pages 5-1 to 5-5

Answer: C.02 a.
REF: NEEP 234 page 178, SAR 7.4

Answer: C.03 a. = 3 (0.5), b. = 4 (0.5), c. = 2 (0.5), d. = 1 (0.5)
REF: SAR 7.6 page 7-12

~~Answer: C.04 c.~~ Question deleted per facility comment.
~~REF: SAR 4.5 page 4-49~~

Answer: C.05 a, 3; b, 2; c, 2; d, 1
Reference: NEEP 234 pages 160 - 177, page 181 and 2000 SAR, § 7.2.3

Answer: C.06 a
Reference: SAR-2000, 11.1.1.1, page 11-2

~~Answer: C.07 c.~~ Question deleted per facility comment.
~~Reference: SAR-2000 page 6-1 and page 9-1, 2 and figure 9-1 0n page 9-4. NEEP 234 page 219 and 220~~

~~Answer: C.08 a.~~ Question deleted per facility comment.
~~Reference: NEEP 234 pages 169 through 179. SAR2000 pages 7-1 through 7-5~~

C.09 c
Reference: SAR § 4.1.2, page 4-3
Beam Port #1 & #3 8E11, Pneumatic Tube 5E12, Thermal Column 2E8

C.10 c
Reference: UWNR 105 CAUTION below step 1 on page 1

C.11 b.
Reference: UWNR Reactor Cooling System Description (from addemdum to 2003-2004 Annual Report) UWNR SAR2000 Section 7.6 Control Console and Display Instruments

C.12 b.
Reference: UWNR 001 steps 9 and 11.

C.13 c.
Reference: Technical Specification 5.6 Bases

C.14 ~~d.~~ c. Answer changed per facility comment (TYPO)
REF: NEEP 234, Controls and Instrumentation I & II figure 29 page 177.

C.15 d.
REF: SAR, 2.1 Reactor Core, page 2-6

~~C.16 b.~~ Question deleted per facility comment.
~~REF: SAR - 2000, 7.4 Reactor Protection System pages 7-10 through 7-13~~

C.17 b.
REF: NEEP 234 Controls and Instrumentation VI, page 203

C.18 b. or c. Second correct answer added per facility comment.
REF: SAR, Section 2.4.1 last, paragraph, SAR - 2000, Section 7.6 Control Console and Display Instrumentation pages 7-12 and 7-13