ENCLOSURE 1

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

REPORT NO.: 50-243/OL-94-01

FACILITY DOCKET NO.: 50-243

FACILITY L ENSE NO.: R-160

FACILITY: Oregon State University

EXAMINATION DATES: January 31 - February 1, 1994

EXAMINER: Warren Eresian, Chief Examiner

SUBMITTED BY: Warren Eresian 2/14/94
Warren Eresian, Chief Examiner Date

APPROVED BY: Jose G. Ibarra 2/15/94
Jose G. Ibarra, Acting Chief Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Reactor Controls
and Human Factors
Office of Nuclear Reactor Regulation

SUMMARY:

The NRC administered an initial license examination to one Senicr Reactor Operator (Upgrade) applicant and one Reactor Operator candidate. Both applicants passed the examination.

REPORT DETAILS

1. Examiner:

   Warren Eresian, Chief Examiner

2. Results:

	RO (Pass/Fail)	SRO (Pass/Fail)	Total (Pass/Fail)
NRC Grading:	1/0	1/0	2/0

3. Written Examination:

   Each applicant passed the written examination.

4. Operating Test:

   Each applicant passed the operating test.

5. Exit Meeting:

   An exit meeting was held on February 2, 1994. Present were:

   Warren Eresian, NRC Chief Examiner
   Professor A. Johnson, Director
   Professor B. Dodd, Reactor Administrator
   T. V. Anderson, Reactor Supervisor

   The NRC thanked The Oregon State University staff for their assistance and cooperation during the examination. The NRC provided some observations concerning the examination. Professor Dodd indicated that the staff would send comments regarding the written examination. No generic weaknesses were noted.

RADIATION CENTER

ENCLOSURE 2

OREGON STATE UNIVERSITY
Radiation Center A100 Corvallis, Oregon 97331-5903
Telephone 503-737-2341 Fax 503-737-0480

February 2, 1994

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555
ATTN: James L. Caldwell, Mail Stop 10/D/22

Reference: Oregon State University TRIGA Reactor (OSTR), Docket No. 50-243, License No. R-106

Subject: Licensing Examination for Mr. S. P. Smith, and Mr. J. S. Bae.

Gentlemen:

In accordance with the procedures specified in your letter of November 3, 1993, we would like to take this opportunity to submit formal comments on the written examination conducted at our facility on January 31, 1994. Before addressing specific questions, we would first like to state that everyone involved in the exam felt that it was fair and reasonable. We would also like to thank the examiner, Mr. Eresian, for his effort to put the examinees at ease.

Our comments on specific questions are given below in the required format.

Question A.006

a. Answer b., 0.104 delta k/k ($13.33); Reference OSTR Training Manual Volume 3, page 11.

b. 0.104 delta k/k is the correct answer; however, the conversion to dollars is incorrect. Effective beta for the OSTR is 0.007, and therefore, 0.104 delta k/k is equivalent to $14.86. Consequently, there is no one completely correct answer. All of the other conversions to dollars are also incorrect.

   Our recommendation is to still accept b. as the most correct answer since the problem is set up in such a way that most people would obtain a result in delta k/k rather than dollars.

c. Reference for effective beta: OSTR Training Manual Vol. 3. page 30.

Question A.017

a. Answer a., Rate of power rise to 1 MW is slower than assumed by the procedure; Reference OSTROP 8.0, step 8.4.E.

b. This is the only poorly worded question in the examination. We feel that it is written in a very unclear and confusing manner. Each of the answers seems to assume that there is a distinction between measured values of a parameter and the values used in the calculation. In fact, they are the same. In other words, when a power calibration is performed readings are taken of the initial bulk water temperature, the final bulk water temperature, and the length of time at power. These values are then substituted into the equation to determine if the actual power level is above or below the indicated power. Therefore, to talk about, for example, the "actual time of power rise" and the "value used in the calculation" as two separate values is inappropriate and confusing. The same is true of the temperatures.

   Our recommendation is to delete this question from the examination.

c. Reference: OSTROP 8.4 describes the procedure for performing a power calibration, including taking the readings and substituting them into the equation given to determine the actual power level.

Question B.001

a. Answer c., 1000 degrees C; Reference Technical Specification 2.1, page 6.

b. While this reference is still in the Technical Specifications, the OSTR has not operated with any standard fuel elements since 1976 when the reactor was refueled with FLIP fuel. In addition, we do not have any standard fuel elements on site, and therefore do not have the possibility of even using a mixed core. It is for this reason that all of our training has related to FLIP fuel, and the FLIP safety limit is the one that we have emphasized because that is the one the operators need to know.

   Our recommendation is to delete this question from the examination as being irrelevant to the operation of the OSTR.

c. References for the non-availability of standard fuel elements include the Fuel Element History Log, and the Special Nuclear Material accountability log.

Question B.014

a. Answer a., Ventilation system inoperable; Reference Technical Specification 3.7.1, page 14.

b. This answer is incorrect. There are two correct answers, b. and c.

   Our recommendation is to accept either b. or c. as correct.

c. Reference for a. being incorrect: Technical Specification 3.7.1, page 14.

Reference for b. being correct: Technical Specification 5.2.d, page 25, which states that the reactor "shall not be operated at power levels exceeding 1 kW with a core lattice position vacant...". This clearly infers that at power levels less than or equal 1 kW it is acceptable to operate with a vacant core lattice position.

Reference for c. being correct: Technical Specification 3.8.g, page 16. This states that "the total inventory of iodine isotopes 131 through 135 in the experiment is no greater than 1.5 curies." Therefore, 1.5 curies is acceptable.

Question B.018

a. Answer b., "is required to be present at the complex only during the initial startup each day or at the initial startup of a new experiment.": Reference OSTROP 6.6.B.1, page IV.6.19.

b. While the wording in answer b. is a direct quotation from the referenced page, in practice there are at least two other times when the reactor supervisor is required to be present at the facility, which is contradictory to the "only" in answer b.

OSTROP 3 on page IV.3.1 states that the "senior reactor operator in charge will review the checklist form and affix his signature when the shutdown checks have been satisfactorily completed." The terms "senior reactor operator in charge" and "reactor supervisor" are synonymous in the OSTR procedures and have been used interchangeably over the years. Therefore, the reactor supervisor must also be present in the facility to sign off on the shutdown checklist and the console log book.

In addition, OSTROP 4.7.C on page IV.4.12 states that "Each and every time an unplanned scram occurs, the console operator will inform the Reactor Supervisor. The console operator will not restart the reactor without the permission of the Reactor Supervisor and will obtain his initials in the console log book." Therefore, this is another instance in which the reactor supervisor has to be present in the facility. OSTROP 1.2.c has a similar statement.

Our recommendation is that this question be deleted from the examination because there is no correct answer.

c. References giving other times the reactor supervisor must be present include: OSTROP 3, page IV.3.1, OSTROP 4.7.C on page IV.4.12 and OSTROP 1.2.c, page IV.1.2.

Question B.020

a. Answer a., Reactor Power; Reference OSTROP 4.2.18 page, IV.4.4.

b. The referenced procedure states correctly that "if the reactor is to be operated at a power of 100 kW or greater, turn on the primary and secondary cooling systems." However, the parameter which is practically used to determine whether the secondary water cooling systems are used or not is the bulk water temperature, i.e. answer b.

The bulk water temperature is the parameter which directly determines how much, if any, secondary cooling is necessary. Clearly, this is normally a function of the reactor power, but it is also a function of the ambient outside temperature. The operator watches the bulk water temperature and adjusts the cooling requirements accordingly. The procedure tells the operator to turn on cooling capacity if the reactor is to be operated above 100 kW because at those power levels it is usually necessary. However, there are various procedures, which allow the reactor to be operated without primary and/or secondary cooling (such as reactor power calibration), but in each case the primary limiting parameter is the bulk water temperature and not the reactor power. Further evidence for this is given in Technical Specification 3.7.2.b on page 14, which requires the water temperature not to exceed 49 degrees C.

Our recommendation is that answer b. be accepted as a correct answer in addition to answer a.

c. The reference for the primacy of water temperature is Technical Specification 3.7.2.b on page 14. OSTROP 8 is the power calibration procedure which is one example of when the power level exceeds 100 kW without the primary or secondary cooling system operating.

We appreciate the opportunity to submit these comments. Also let me once again emphasize that we do not want these comments to be regarded in any way as an indication of our dissatisfaction with the written examination. We merely wish to ensure that the examination is as fair as possible, by eliminating areas of possible ambiguity. Thank you for considering our recommendations.

Yours sincerely,

A. G. Johnson
Director

cc: Non-Power Reactor, Decommissioning, and Environmental Projects Directorate, USNRC, Washington, D. C. 20555 ATTN: Mr. Al Adams
Regional Administrator, USNRC, Region V, Walnut Creek, CA
Document Control Room, USNRC, Washington, D.C. 20555
Oregon Department of Energy, Salem, Oregon ATTN: Mr. D. Stewart-Smith
Prof. S. E. Binney, Chairman, Reactor Operations Committee
Prof. B. Dodd, Reactor Administrator
T. V. Anderson, Reactor Supervisor
S. P. Smith, Senior Reactor Operator trainee
J. Bae, Reactor Operator trainee

NRC RESOLUTION OF FACILITY COMMENTS

Question A006 **RESOLUTION**

Comment noted. A beta-effective value of 0.0078 was used in the conversions, rather than 0.007. The dollar conversions will be corrected in the question.

Question A017 **RESOLUTION**

Comment not accepted. Within the context of the question, which is designed to test understanding of how errors may arise in a calibration, there is every possibility that the "measured" value of a parameter (i.e., the one which is used in a calculation) can be different from the "actual" (or true) value of the parameter.

Question B001 **RESOLUTION**

Comment accepted. Question will be deleted.

Question B014 **RESOLUTION**

Comment accepted. Either "b" or "c" will be accepted.

Question B018 **RESOLUTION**

Comment accepted. Question will be deleted. For future reference, the word "only" will be removed from answer "b", thus making it the correct answer.

Question B020 **RESOLUTION**

Comment accepted. Either "a" or "b" will be accepted. However, some guidance should be provided to operators with regard to bulk coolant temperatures at which the primary and secondary systems should be started. Is 48 deg. C allowable?

ENCLOSURE 3

UNITED STATES NUCLEAR REGULATORY COMMISSION

OREGON STATE UNIVERSITY
01/31/94

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER REACTOR LICENSE EXAMINATION

FACILITY: Oregon State University

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 01/31/94

REGION: 5

CANDIDATE:______________________________

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheets provided. Attach all answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70 percent in each category is required to pass the examination.

Examinations will be picked up 3 hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE		CATEGORY
20	34.5	________	________	A.	REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
18	31.0	________	________	B.	NORMAL AND EMERGENCY PROCEDURES AND RADIOLOGICAL CONTROLS
20	34.5	________	________	C.	PLANT AND RADIATION MONITORING SYSTEMS
58	100.0	________	________		TOTALS
		FINAL GRADE	________%		

All work done on this examination is my own. I have neither given nor received aid.

____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have not received or given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil only to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet.

6. Print your name in the upper right-hand corner of the answer sheets.

7. Partial credit may be given. Therefore, ANSWER ALL PARTS OF THE QUESTION AND DO NOT LEAVE ANY ANSWER BLANK. NOTE: partial credit will NOT be given on multiple choice questions.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.

10. When you are done and have turned in your examination, leave the examination area as defined by the examiner. If you are found in this area while the examination is still in progress, your license may be denied or revoked.

QUESTION: 001 (1.00)

An Antimony-Beryllium (Sb-Be) type source is used to provide source neutrons. Which of the following describes how this type of source produces neutrons?

a. A neutron is emitted from Antimony following activation from gammas produced by the Beryllium.

b. A neutron is emitted from Beryllium following activation from gammas produced by the Antimony.

c. A neutron is emitted from Beryllium following activation from alphas produced by the Antimony.

d. A neutron is emitted from Antimony following activation from alphas produced by the Beryllium.

QUESTION: 002 (1.00)

A fully withdrawn control rod is being reinserted into the core. Select the term in the six factor formula that is mostly affected.

a. Resonance escape probability

b. Thermal non-leakage probability

c. Reproduction Factor

d. Thermal utilization factor

QUESTION: 003 (1.00)

A control rod is withdrawn from the core. Which of the following explains the reactivity addition from the rod?

a. Reactivity added will be equal for each inch of withdrawal.

b. Reactivity added will be dependent upon the neutron flux in the area rod is being withdrawn.

c. Reactivity addition will be greatest in the bottom third of the core.

d. Reactivity addition will be greatest in the top third of the core.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

The reactor was operated for 24 hours for an experiment. Subsequently a startup is performed 5 hours following the shutdown. It is desired to maintain constant power following the startup. Considering xenon effects, what will be the effect on critical rod position and rod movement following startup to achieve constant power?

a. Critical rod position will be higher and rods will be inserted following startup.

b. Critical rod position will be higher and rods will be withdrawn following startup.

c. Critical rod position will be lower and rods will be inserted following startup.

d. Critical rod position will be lower and rods will be withdrawn following startup.

QUESTION: 005 (1.00)

Which of the following conditions would increase shutdown margin?

a. Adding an experiment which added positive reactivity.

b. Depletion of the Erbium added to TRIGA FLIP fuel.

c. Depletion of uranium fuel.

d. Decreasing core moderator temperature.

QUESTION: 006 (1.00)

In a subcritical reactor, K_{eff} is increased from 0.861 to 0.946. Which ONE of the following is the amount of reactivity that was added to the reactor core?

a. 0.085 delta k/k

b. 0.104 delta k/k

c. 0.161 delta k/k

d. 0.218 delta k/k

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

Delayed neutrons are considered to be more "effective" than prompt neutrons because:

a. delayed neutrons have a higher reproduction factor.

b. delayed neutrons have a higher resonance escape probability.

c. delayed neutrons have a lower thermal utilization factor.

d. delayed neutrons have a higher thermal utilization factor.

QUESTION: 008 (1.00)

Reactor power increases from 40 to 60 watts in 20 seconds. What is the reactor period associated with this power increase?

a. 8.1 seconds

b. 4.93 seconds

c. 49.3 seconds

d. 81.1 seconds

QUESTION: 009 (1.00)

Which ONE of the following is true concerning the difference between prompt and delayed neutrons?

a. Prompt neutrons account for less than one percent of the neutron population while delayed neutrons account for approximately ninety-nine percent of the neutron population.

b. Prompt neutrons are released during fast fissions while delayed neutrons are released during thermal fissions.

c. Prompt neutrons are released during the fission process while delayed neutrons are released during the decay process.

d. Prompt neutrons are the dominating factor in determining the reactor period while delayed neutrons have little effect on the reactor period.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

The prompt negative temperature coefficient of reactivity is - $0.01/ degree C. When a control rod with an average rod worth of $0.10/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, neglecting all other changes, the fuel temperature has:

a. increased by 100 degree C

b. decreased by 100 degree C

c. increased by 10 degree C

d. decreased by 10 degree C

QUESTION: 011 (1.00)

Fuel is being loaded into the core. The operator is using a 1/M plot to monitor core loading. Which of the following conditions would result in a non-conservative prediction of core critical mass?

a. The detector is too far away from the source.

b. The detector is too close to the source.

c. Excessive time is allowed between fuel elements being loaded.

d. A fuel element is placed between the source and the detector.

QUESTION: 012 (1.00)

Control rods are being withdrawn for startup prior to the reactor being critical. The operator allows power to stabilize between each rod withdrawal. Assuming equal amounts of reactivity are added for each rod withdrawal, select the expected time for power to stabilize as criticality is approached and reason for the response of power.

a. Time to stabilize will be the same for each withdrawal because equal amounts of reactivity are being added.

b. Time to stabilize will decrease for each withdrawal because increased neutron flux.

c. Time to stabilize will be the same for each withdrawal because source strength is constant.

d. Time to stabilize will increase for each withdrawal because source strength is constant but larger changes in flux occur.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

The core is to be pulsed. The projected pulse will add TWICE as much prompt reactivity as the last pulse performed. In relation to the last pulse, select the expected values for the projected pulse.

a. Peak power will be 4 times larger and the energy released will be 4 times larger.

b. Peak power will be twice as large and the energy released will be 4 times larger.

c. Peak power will be 4 times larger and the energy released will be twice as large.

d. Peak power will be twice as large and the energy released will be twice as large.

QUESTION: 014 (1.00)

The amount of positive reactivity that must be added to make the reactor prompt critical equals:

a. the effective total delayed neutron fraction.

b. the amount to make K_{eff} equal to one.

c. the amount to make the reactor period infinite.

d. the amount needed to increase the mean neutron lifetime to 0.080 seconds.

QUESTION: 015 (1.00)

Which ONE of the following elements will slow down fast neutrons most quickly, i.e. results in the greatest energy loss per collision?

a. Oxygen-16.

b. Uranium-238.

c. Hydrogen-1.

d. Boron-10.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

You enter the control room and observe that the neutron instrumentation indicates a steady neutron level with no rods in motion. Which ONE condition below CANNOT be true?

a. The reactor is critical.

b. The reactor is subcritical.

c. The reactor is supercritical.

d. The neutron source is in the core.

QUESTION: 017 (1.00)

A reactor power calibration is performed. Which ONE of the following conditions would result in calculated power being LESS than actual power.

a. Rate of power rise to 1 MW is slower than assumed by the procedure.

b. The measured final temperature is greater than bulk temperature.

c. The measured initial temperature is less than bulk temperature.

d. Actual time of power rise is 2 minutes longer than the value used in the calculation.

QUESTION: 018 (1.00)

Which ONE of the following is the major source of the recoverable energy released during fission?

a. Kinetic energy of the fission fragments.

b. Kinetic energy of the fission neutrons.

c. Prompt gamma rays.

d. Fission product decay.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

The major contributor to the production of Xenon-135 in a reactor operating at full power is:

a. direct from the fission of Uranium-235.

b. from the radioactive decay of Iodine.

c. from the radioactive decay of Promethium.

d. direct from the fission of Uranium-238.

QUESTION: 020 (1.00)

Starting with a critical reactor at low power, a control rod is withdrawn from position X and reactor power starts to increase. Neglecting any temperature effects, in order to terminate the increase with the reactor again critical but at a higher power, the control rod must be:

a. inserted deeper than position X.

b. inserted, but not as far as position X.

c. inserted back to position X.

d. inserted, but exact position depends on power level

(***** END OF CATEGORY A *****)

QUESTION: 001 (1.00)

The safety limit for temperature in a standard TRIGA fuel element is:

a. 800 degrees C.

b. 950 degrees C.

c. 1000 degrees C.

d. 1150 degrees C.

QUESTION: 002 (1.00)

Which ONE of the following defines an "Channel Check?"

a. The introduction of a an input signal into the channel to verify that it is operable.

b. A combination of sensors, electronic circuits and output devices which measure and display the value of a parameter.

c. The qualitative verification of acceptable performance by observation of channel behavior.

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

QUESTION: 003 (1.00)

To limit the fuel temperature rise during a pulse transient, limitations are established during pulse operation on:

a. reactivity insertion value.

b. control rod scram time.

c. fuel element temperature indication.

d. reactor core configuration.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

Given the following conditions:

- Experimental facilities and experiments are in place and the highest worth non-secured experiment is in its most reactive state.
- The most reactive control rod is fully withdrawn.
- The reactor is in cold condition without xenon.

The shutdown margin provided by control rods shall be greater than:

a. $0.57

b. $1.00

c. $2.55

d. $3.00

QUESTION: 005 (1.00)

To maintain an active operator license, the functions of an operator must be actively performed for at least:

a. one hour per month.

b. three hours per calendar quarter.

c. four hours per calendar quarter.

d. sixteen hours per year.

QUESTION: 006 (1.00)

In accordance with the Technical Specifications, which ONE condition below is NOT permissible during reactor operation?

a. Scram time of a control rod = 2 seconds.

b. Bulk pool water temperature = 120 deg. F.

c. An experiment containing 20 milligrams of explosive.

d. Pool water level 13 feet above the core.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

A radioactive sample from an experiment results in a dose rate of 100 mR/hour at a distance of one foot from the sample. Lead sheets (each having a tenth-value thickness = 2.00 inches) are available for shielding. What is the minimum number of sheets required to lower the dose rate to 1 mR/hour at a distance of one foot?

a. 2

b. 5

c. 6

d. 10

QUESTION: 008 (1.00)

A pancake probe Geiger-Mueller (GM) detector would be used to measure which of the following?

a. Gamma dose rate.

b. Beta contamination.

c. Neutron dose rate.

d. Alpha contamination.

QUESTION: 009 (1.00)

In accordance with the Reactor Power Calibration, after power level is determined:

a. the pointers on the power meters and recorders are adjusted to give the proper indication.

b. the high voltages to the neutron detectors are adjusted to give the proper indication.

c. the compensating voltages of the compensated ion chambers are adjusted to give the proper indication.

d. the positions of the neutron detectors are adjusted to give the proper indication.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

An area in which a major portion of the whole body could receive a dose in excess of 100 millirem in 5 consecutive days would be posted with signs reading:

a. "CAUTION RADIATION RESTRICTED AREA."

b. "CAUTION RADIOACTIVE MATERIAL."

c. "CAUTION HIGH RADIATION AREA."

d. "CAUTION RADIATION AREA."

QUESTION: 011 (1.00)

Safety Channels which are required to be operable in all modes of operation are:

a. Fuel element temperature, Percent power level, High voltage

b. Console Scram Button, Safety power level, Log power level

c. Fuel element temperature, Console Scram Button, High Voltage

d. Fuel element temperature, Console Scram Button, Safety power level

QUESTION: 012 (1.00)

Which of the following alarms is an Emergency Action Level - Class 0?

a. Reactor Top Area High Radiation

b. Bulk Water High Temperature

c. Primary System Water High Activity

d. Reactor Tank Low Water Level

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

All of the following conditions covered by the Emergency Operating Procedures require a reactor scram EXCEPT:

a. Ventilation System Low Flow Alarm

b. Rotating Rack Off

c. Fuel Element Low Temperature Alarm

d. Reactivity Anomalies

QUESTION: 014 (1.00)

In accordance with the Technical Specifications, which ONE of the following conditions is allowable during reactor operation?

a. Ventilation System inoperable.

b. Operation at 500 watts with a core lattice position vacant.

c. An experiment containing 1.5 curies of I-135.

d. Continuous Air Particulate Radiation Monitor inoperable.

QUESTION: 015 (1.00)

If core operation is suspended by the Senior Health Physicist, then resumption of reactor operation must be concurred upon by the:

a. Reactor Administrator and Reactor Supervisor.

b. Reactor Supervisor and Senior Health Physicist.

c. Reactor Administrator, Reactor Supervisor, and Reactor Operator.

d. Reactor Administrator, Reactor Supervisor, and Senior Health Physicist.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

In the event of a major spill of radioactive material:

a. disposable gloves and remote handling tongs should be used to clean up the spill.

b. leave the room and lock the doors to prevent entry.

c. check the area around the spill with a GM survey meter.

d. immediately initiate decontamination procedures.

QUESTION: 017 (1.00)

A procedure change to an approved operating procedure may be made with the approval of the Reactor Supervisor ONLY if it is a change:

a. required for safe reactor shutdown.

b. required for safe operation of experiments and experiment facilities.

c. that does not change the original intent of the procedure.

d. that specifies corrective actions to be taken for specific foreseen malfunctions.

QUESTION: 018 (1.00)

With regard to staffing requirements for the Radiation Center complex, the Reactor Supervisor (SRO):

a. is one of the two persons required to be present in the complex while the reactor is operating.

b. is required to be present at the complex only during the initial startup each day or at the initial startup of a new experiment.

c. may be away from the complex at any time provided he remains within 10 miles of the facility.

d. may be away from the complex at any time provided he has a radio and can contact the facility within 10 minutes of receiving a message from the operator on duty.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

The Measuring Channel which is required to be operable in all modes of reactor operation is:

a. Fuel element temperature

b. Linear power level

c. Safety power level

d. Percent power level

QUESTION: 020 (1.00)

What parameter is used to determine whether the primary and secondary cooling systems are used during reactor operations?

a. Reactor Power

b. Bulk Water Temperature

c. Reactor Tank Water Level

d. Ambient Temperature

(***** END OF CATEGORY B *****)

QUESTION: 001 (1.00)

The "Source level interlock" is a Control Rod Drive Interlock. This interlock assures that:

a. start-up is not initiated unless a reliable indication of the neutron flux in the core is available.

b. the magnitude of the rod pull will not cause fuel element temperature safety limits to be exceeded.

c. the limit on reactivity insertion rate from the standard control rods is not exceeded.

d. the insertion of more than 2.55 dollars worth of reactivity is not inserted when count rate is less than 2 counts per second.

QUESTION: 002 (1.00)

The cadmium lined in-core irradiation tube (CLICIT) is designed tc irradiate samples. Select the type and energy of the "particles" used to accomplish the irradiation.

a. high energy gammas.

b. high energy betas.

c. neutrons with energies greater than the cadmium cut-off threshold.

d. neutrons from the alpha-neutron reaction with cadmium.

QUESTION: 003 (1.00)

Excessive radioactivity levels in the demineralizer are a result of:

a. low primary water conductivity.

b. a failure of the fuel element cladding.

c. demineralizer temperature in excess of 120 degrees F.

d. de-oxygenated water used for primary water make-up.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 004 (1.00)

For a control rod, the "UP" light is OFF, the "DOWN" light is OFF, and the "CONT/ON" light is ON. This indicates that:

a. the rod and drive are in contact, and are both full in.

b. the rod and drive are in contact, and are both full out.

c. the rod and drive are not in contact, and the rod and drive are somewhere between full in and full out.

d. the rod and drive are in contact, and are somewhere between full in and full out.

QUESTION: 005 (1.00)

When the stack gas high activity alarm sounds, which ONE of the following occurs?

a. The reactor scrams.

b. The evacuation alarm sounds.

c. The ventilation system shuts down.

d. There are no automatic actions.

QUESTION: 006 (1.00)

When a fission chamber is used for neutron detection at low power levels, how is the gamma flux accounted for?

a. Pulse height discrimination is used to eliminate the gamma flux.

b. The gamma flux is proportional to neutron flux and is counted with the neutrons.

c. The gamma flux is cancelled by creating an equal and opposite gamma current.

d. The gamma flux passes through the detector with no interaction because of detector design.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 007 (1.00)

Primary system flow rates are measured by a(n):

a. rotometer.

b. nutating disk flowmeter.

c. flow element.

d. resistance-temperature detector.

QUESTION: 008 (1.00)

For a control rod drive mechanism, in order to withdraw the rod, the armature is:

a. bolted to the draw tube.

b. threaded to accept the draw tube rack and pinion assembly.

c. connected to the draw tube with a connecting rod.

d. held by the draw tube using an electromagnet.

QUESTION: 009 (1.00)

With reference to Figure 1, attached, which positions of the valves (1, 2, 3, 4) in the Rabbit System will result in a sample being inserted into the reactor?

a. Valves 2 and 4 are open, valves 1 and 3 are closed.

b. Valves 1 and 2 are open, valves 3 and 4 are closed.

c. Valves 1 and 3 are open, valves 2 and 4 are closed.

d. Valves 1 and 4 are open, valves 2 and 3 are closed.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 010 (1.00)

In the automatic mode of operation, a period scram will occur at:

a. -30 seconds.

b. -3 seconds.

c. +3 seconds.

d. +10 seconds.

QUESTION: 011 (1.00)

When the mode selector switch is turned to the PULSE position, what type of reading is recorded by the log-N recorder (red) pen?

a. Peak power.

b. Fuel temperature.

c. Average power.

d. Log power.

QUESTION: 012 (1.00)

For a control rod, the "UP" light is ON, the "DOWN" light is OFF, and the "CONT/ON" light is OFF. This indicates that:

a. the rod and drive are not in contact, the rod is full out and the drive is full in.

b. the rod and drive are both full out.

c. the rod and drive are both full in.

d. the rod and drive are not in contact, the drive is full out and the rod is full in.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 013 (1.00)

Which ONE of the following conditions will NOT result in a reactor scram while operating in the Steady State mode?

a. Safety power level = 1.1 MW

b. Fuel element temperature = 600 deg. C.

c. Pool water level 10 feet above the core.

d. Loss of high voltage to neutron detectors.

QUESTION: 014 (1.00)

Which of the following controls the amount of reactivity that is inserted by the transient rod during pulse operations?

a. The timer setting that vents the pneumatic piston.

b. The pressure of the air applied to the pneumatic piston.

c. The position of the cylinder.

d. The initial power level of the reactor prior to firing the pulse.

QUESTION: 015 (1.00)

Thermocouples in the instrumented fuel element measure temperature at the:

a. interior surface of the cladding.

b. center of the zirconium rod.

c. outer surface of the fuel.

d. interior of the fuel.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 016 (1.00)

The purpose of the diffuser above the core during operation is to:

a. better distribute heat throughout the pool.

b. enhance heat transfer across all fuel elements in the core.

c. reduce dose rate at the pool surface from N-16.

d. ensure consistent water chemistry in the core.

QUESTION: 017 (1.00)

The demineralizer in the purification system performs which ONE of the following functions?

a. Removes charged impurities by ion exchange.

b. Maintains system pH.

c. Maintains system conductivity at greater than 20 micromho/cm^2.

d. Maintains water clarity by removal of insoluble particulates.

QUESTION: 018 (1.00)

Which ONE of the following describes operation in the Automatic mode:

a. The output from the Linear channel is compared to the DEMAND potentiometer.

b. The output from the Log-N channel is compared to the DEMAND potentiometer.

c. The period signal from the uncompensated ion chamber limits the period to approximately 10 seconds.

d. The regulating rod cannot be withdrawn if another rod is being withdrawn.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

QUESTION: 019 (1.00)

Pressure in the Reactor Bay is maintained less than atmospheric in order to ensure any leakage is inward.

Identify the method used to control this differential pressure.

a. The supply damper is modulated to control pressure.

b. The damper on the suction of the exhaust fan is modulated to control pressure.

c. The damper on the discharge of the exhaust fan is modulated to control pressure.

d. The speed of the exhaust fan is adjusted to control pressure.

QUESTION: 020 (1.00)

The operator is withdrawing the safety rod when the UP button is depressed for the transient rod. When both UP buttons are depressed:

a. Both rods will stop.

b. The safety rod will withdraw but the transient rod will not.

c. The transient rod will withdraw but the safety rod will not.

d. Both rods will withdraw.

(***** END OF CATEGORY C *****)

A. REACTOR THEORY, THERMO & FACILITY OPERATING CHARACTERISTICS

ANSWER: 001
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 1, page 30.

ANSWER: 002
D.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 8 and 16.

ANSWER: 003
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 17.

ANSWER: 004
A.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 25.

ANSWER: 005
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 29.

ANSWER: 006
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 11.
ρ_1 = (0.861 - 1)/0.861 = - 0.161 delta k/k
ρ_2 = (0.946 - 1)/0.946 = - 0.057 delta k/k
$\Delta\rho = \rho_2 - \rho_1$ = - 0.057 - (- 0.161) = + 0.104 delta k/k

ANSWER: 007
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 30.

ANSWER: 008
C.
REFERENCE
(T = t / Ln(N_0/N) = 20 sec / Ln(60/40) = 49.3 seconds.)
Oregon State Triga Reactor Training Manual Volume 3, page 35.

ANSWER: 009
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 30.

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

ANSWER: 010
A.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, pg 19.
Reactivity added by control rod = +($0.10/inch)(10 inches) = $1.00
Fuel temperature change = - Reactivity added by rod/temperature coefficient
Fuel temperature change = - ($1.00)/(- $0.01/deg.C) = + 100 deg. C.

ANSWER: 011
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, pages 46-49.

ANSWER: 012
D.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 53.

ANSWER: 013
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 89.

ANSWER: 014
A.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 34.

ANSWER: 015
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 12.

ANSWER: 016
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 53.

ANSWER: 017
A.
REFERENCE
OSTROP 8.0, Reactor Power Calibration Procedure, step 8.4.E.

ANSWER: 018
A.
REFERENCE
Nuclear Reactor Engineering, Glasstone & Sesonske; 6.27

(***** CATEGORY A CONTINUED ON NEXT PAGE *****)

ANSWER: 019
B.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 22.

ANSWER: 020
C.
REFERENCE
Oregon State Triga Reactor Training Manual Volume 3, page 49.

(***** END OF CATEGORY A *****)

B. NORMAL/EMERGENCY PROCEDURES AND RADIOLOGICAL CONTROLS

ANSWER: 001
C.
REFERENCE
Technical Specifications, Section 2.1, pg. 6.

ANSWER: 002
C.
REFERENCE
Technical Specifications Definitions, Section 1.31, page 5.

ANSWER: 003
A.
REFERENCE
Technical Specifications, Section 3.3, pg. 9.

ANSWER: 004
A.
REFERENCE
Technical Specifications, Section 3.2, pg. 8.

ANSWER: 005
C.
REFERENCE
OSTROP 14.0, Quarterly Surveillance and Maintenance Procedures, Section 14.12, pg. IV.14.6

ANSWER: 006
D.
REFERENCE
Technical Specifications, Section 3.7.2, pg. 14.

ANSWER: 007
A.
REFERENCE
OSTR Training Manual, Volume 5, Radiological Protection, pg. 54.

ANSWER: 008
B.
REFERENCE
OSTR Training Manual, Volume 5, Radiological Protection, pg. 37.

ANSWER: 009
D.
REFERENCE
OSTROP 8.0, Reactor Power Calibration Procedure, pg. IV.8.3

ANSWER: 010
D.
REFERENCE
OSTR Training Manual, Volume 5, Radiological Protection, pg. 11.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

B. NORMAL/EMERGENCY PROCEDURES AND RADIOLOGICAL CONTROLS

ANSWER: 011
C.
REFERENCE
Technical Specifications, Table I, pg. 12.

ANSWER: 012
A.
REFERENCE
OSTROP 1.0, Emergency Operating Procedures, (ERIP 3.0), Section 1.8, pg. IV.1.9.

ANSWER: 013
B.
REFERENCE
OSTROP 1.0, Emergency Operating Procedures, (ERIP 3.0), Section 1.17, pg. IV.1.15.

ANSWER: 014
B,C
REFERENCE
Technical Specifications, Section 3.7.1, pg. 14.

ANSWER: 015
D.
REFERENCE
OSTROP 6.0, Administrative and Personnel Procedures, Section 6.6.B.5., pg. IV.6.20.

ANSWER: 016
B.
REFERENCE
E-4-1, Emergency Procedures for Laboratories

ANSWER: 017
C.
REFERENCE
Technical Specifications, Section 6.5, pg. 33.
OSTROP 6.0, Administrative and Personnel Procedures, Figure 6.8.1, pg IV.6.28

ANSWER: 018
B.
REFERENCE
OSTROP 6.0, Administrative and Personnel Procedures, Section 6.6.B.1., pg. IV.6.19.

(***** CATEGORY B CONTINUED ON NEXT PAGE *****)

ANSWER: 019
A.
REFERENCE
Technical Specifications, Section 3.5.2, pg.10.

ANSWER: 020
A,B
REFERENCE
OSTROP 4.0, Reactor Operation Procedures, Section 4.2.18., pg. IV.4.4.

(***** END OF CATEGORY B *****)

C. PLANT AND RADIATION MONITORING SYSTEMS

ANSWER: 001
A.
REFERENCE
Tech Specs 3.5.3, Bases, pg. 11.
Volume 2, pg. 23.

ANSWER: 002
C.
REFERENCE
Volume 1, pg. 81.

ANSWER: 003
B.
REFERENCE
Volume 1, pg. 116.

ANSWER: 004
D.
REFERENCE
Volume 2, pg. 17.

ANSWER: 005
C.
REFERENCE
Volume 1, pg. 149.

ANSWER: 006
A.
REFERENCE
Volume 2, pg. 32.

ANSWER: 007
C.
REFERENCE
Volume 1, pg. 117.

ANSWER: 008
D.
REFERENCE
Volume 1, pg. 50.

ANSWER: 009
C.
REFERENCE
Volume 1, pg. 71.

ANSWER: 010
C.
REFERENCE
Volume 2, pg. 38.

(***** CATEGORY C CONTINUED ON NEXT PAGE *****)

C. PLANT AND RADIATION MONITORING SYSTEMS

ANSWER: 011
B.
REFERENCE
Volume 2, pg. 46.

ANSWER: 012
D.
REFERENCE
Volume 2, pg. 17.

ANSWER: 013
C.
REFERENCE
Technical Specifications, Table I, pg.12.

ANSWER: 014
C.
REFERENCE
Volume 1, pg. 56.

ANSWER: 015
D.
REFERENCE
Volume 1, pg. 35.

ANSWER: 016
C.
REFERENCE
Volume 1, pg. 106.

ANSWER: 017
A.
REFERENCE
Volume 1, pg. 116.

ANSWER: 018
A.
REFERENCE
Volume 1, pg. 44.

ANSWER: 019
B.
REFERENCE
Volume 1, pgs. 147 and 148.

ANSWER: 020
C.
REFERENCE
Volume 2, pg. 24.

(***** END OF CATEGORY C *****)

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ______

002 a b c d ______

003 a b c d ______

004 a b c d ______

005 a b c d ______

006 a b c d ______

007 a b c d ______

008 a b c d ______

009 a b c d ______

010 a b c d ______

011 a b c d ______

012 a b c d ______

013 a b c d ______

014 a b c d ______

015 a b c d ______

016 a b c d ______

017 a b c d ______

018 a b c d ______

019 a b c d ______

020 a b c d ______

(***** END OF CATEGORY A *****)

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ______

002 a b c d ______

003 a b c d ______

004 a b c d ______

005 a b c d ______

006 a b c d ______

007 a b c d ______

008 a b c d ______

009 a b c d ______

010 a b c d ______

011 a b c d ______

012 a b c d ______

013 a b c d ______

014 a b c d ______

015 a b c d ______

016 a b c d ______

017 a b c d ______

018 a b c d ______

019 a b c d ______

020 a b c d ______

(***** END OF CATEGORY B *****)

ANSWER SHEET

MULTIPLE CHOICE (Circle or X your choice)

If you change your answer, write your selection in the blank.

001 a b c d ______

002 a b c d ______

003 a b c d ______

004 a b c d ______

005 a b c d ______

006 a b c d ______

007 a b c d ______

008 a b c d ______

009 a b c d ______

010 a b c d ______

011 a b c d ______

012 a b c d ______

013 a b c d ______

014 a b c d ______

015 a b c d ______

016 a b c d ______

017 a b c d ______

018 a b c d ______

019 a b c d ______

020 a b c d ______

(***** END OF CATEGORY C *****)

EQUATION SHEET

$SUR = 26.06/\tau$

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

$P = P_0 \, e^{(t/\tau)}$

$\tau = (\ell^*/\rho) + [(\beta-\rho)/\lambda_{eff}\rho]$

$\lambda_{eff} = 0.08 \text{ seconds}^{-1}$

$DR_1D_1^2 = DR_2D_2^2$

$DR = DR_0e^{-\lambda t}$

$DR = 6CiE/D^2$

$\rho = (Keff-1)/Keff$

$R = N\sigma$

---

1 Curie = 3.7×10^{10} dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

°F = 9/5°C + 32

1 Mw = 3.41×10^6 BTU/hr

°C = 5/9 (°F - 32)