ENCLOSURE 1

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

REPORT NO.: 50-62/06-92-01

FACILITY DOCKET NO.: 50-62

FACILITY LICENSE NO.: R-66

FACILITY: University of Virginia (UVAR)

EXAMINATION DATES: 7/13 - 16/92

EXAMINER: Frank Collins, Chief Examiner

SUBMITTED BY: for James L. Caldwell 7/28/92
Frank Collins, Chief Examiner Date

APPROVED BY: James L. Caldwell 7/28/92
James L. Caldwell, Chief Date
Non-Power Reactor Section
Operator Licensing Branch
Division of Licensee Performance
and Quality Evaluation, NRR

SUMMARY:

Initial operator licensing examinations were conducted at the University of Virginia Reactor (UVAR) on July 13-16, 1992. The examinations were administered by the Mr. Frank Collins, Chief Examiner, and Mr. Donald Draper, an NRC contract examiner. Written and operating examinations were administered for two Reactor Operator (RO) applicants. An operating examination was also administered for one Senior Reactor Operator, Upgrade (SRO-U) applicant. All applicants passed their respective operating examinations. Both RO applicants failed the written examination.

REPORT DETAILS

1. Examiner: Frank Collins

2. Results:

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

3. Written Examination:

The written examination was administered on Monday, July 13, 1992 for the RO applicants. Both applicants completed the examination within the allotted three hours. A copy of the examination was concurrently provided to facility management for review and comment. No clarifications were requested by the applicants during the examination.

Facility comments were received within one week following the examination in accordance with the provisions of Examiner Standard ES-201 and are included as an attachment to this report. All comments have been accepted.

4. Operating Examinations:

Operating examinations were administered on Tuesday and Wednesday, July 14-15, 1992. The RO applicants were given examinations that included pre-startup checkouts and reactor operations consisting of startup to criticality and power escalation in both manual and automatic modes. A facility licensed SRO was present for and supervised all reactor operations. At no time was the licensed SRO required to intervene in the operations. The SRO-U applicant was not required to demonstrate reactor operations.

The average time spent for an operating examination, including required discussions of administrative topics, tours of facility equipment, and the pre-startup and operations activities was approximately four hours per applicant, which is consistent with the guidance contained in Examiner Standard ES-304.C.3.f.

5. Exit Meeting:

The exit meeting was conducted by the Chief Examiner on May 27, 1992. The facility was represented by Mr. Robert Mulder, Director, Mr. Preston Farrar, Reactor Supervisor, and Mr. Donald Krause, SRO. The Chief Examiner, Frank Collins, represented the NRC. The Chief Examiner thanked the facility for support during the examination, discussed the conduct of the written and operating examinations, and reviewed two generic concerns. Specific examination results were not yet available, pending incorporation or resolution of formally submitted facility

comments on the written examination and grading of the operating examinations.

All three applicants experienced difficulty describing the procedures and administrative controls associated with securing and tagging equipment out of service. All applicants knew that danger and caution tags were available and used at the facility. Specific guidance for this task is not provided in the facility procedures.

The Chief Examiner expressed a concern over the condition of the facility. Both examiners noted an accumulation of obsolete experimental facilities, uncovered solid radioactive waste receptacles, widely scattered maintenance debris including wire and insulation clippings from instrumentation connections, and unsecured instrument cable runs that lie across areas of normal and frequent passage .

- Workers are required to routinely pass beneath a radiation area rope boundary to enter the heat exchanger room on the ground floor of the facility. No walkway area is provided.

- The floor on all levels of the facility, including the control room and the reactor bridge, is littered with terminal connectors, pieces of wire, and insulation clippings left over from instrument installation and maintenance.

- Cable runs and bundles for controls, instrumentation, and experimental facilities are draped loosely over walkways, structural members, and other components with neither support nor protection. An unsupported signal cable and the drive chain for the source range detector routinely drags across an edge of the core spray test tank lid during instrument withdrawal, sometimes jamming the detector drive motor or, at other times, lifting and then dropping the hinged lid.

These observations were discussed as typical of an overall need for enhancement of the "housekeeping" and material condition of the facility to minimize the potential for inadvertent contamination of the facility with resulting personnel contamination or damage to facility equipment.

ENCLOSURE 2

FACILITY COMMENTS AND NRC RESOLUTION OF COMMENTS

SCHOOL OF
ENGINEERING & APPLIED SCIENCE

NUCLEAR REACTOR FACILITY
Department of Mechanical,
Aerospace & Nuclear Engineering
University of Virginia
Charlottesville, VA 22903-2442
804-982-5440 FAX: 804-982-5473

Question A: 20

Which one of the following would result from adding the graphite reflector to the UVAR reactor?

a. thermal flux distribution flattens and power density increases

b. thermal flux distribution flattens and power density decreases

c. thermal flux distribution skews and power density increases

d. thermal flux distribution skews and power density decreases

Since it was not indicated that the graphite reflector would be added symmetrically around the core the possibility that exists that an un-symmetric reflector would be added. This reflector would skew the flux distribution towards the reflector and increase power density.

We ask that both answers a and c be taken as correct

Question B: 17

The reactor is operating at 2 MW. Power level as calculated by differential temperature across the core indicates 120 KW greater than Reactor Power level instrumentation. WHICH ONE of the following states the required immediate operator action?

a. adjust the chamber wells

b. calibrate differential temperature instrumentation

c. visually inspect top of core for foreign material

d. shutdown the reactor

By stating power level as calculated by differential temperature across the core indicates 120 kw greater than Reactor Power level instrumentation it is implied that this instrumentation is all instrumentation able to indicate reactor power not just level indication on THE power range meters. It follows that all

indications, except delta T, are indicating 2 MW and therefore delta T is in error. Since differential temperature is not a required instrument, immediate hutdown of the reactor is not mandated. Upon shutdown, investigation on why differential temperature was not functioning properly would begin and calibration may become necessary.

We ask this question be thrown out since no answer is correct.

RESOLUTION OF FACILITY COMMENTS

QUESTION A.20
WHICH ONE (1) of the following would result from adding the graphite reflector to the UVAR reactor?

a. thermal flux distribution flattens and power density increases
b. thermal flux distribution flattens and power density decreases
c. thermal flux distribution skews and power density increases
d. thermal flux distribution skews and power density decreases

ANSWER
a.

FACILITY COMMENT
The answer is correct based on core loadings discussed in the UVAR Design and Analysis Handbook. The stem of the question, however, does not specify that the graphite reflector will be placed entirely around the core and the present core loading at UVAR utilizes a graphite reflector on only one side. This configuration results in a skewed flux and an increased power density. Both a. and c. should be accepted as correct answers.

RESOLUTION
The comment is accepted. Both a. and c. will be accepted as correct answers.

QUESTION B.17
The reactor is operating at 2 MW. Power level as calculated by differential temperature across the core indicates 120 kW greater than Reactor Power level instrumentation. WHICH ONE (1) of the following states the required immediate operator action?

a. adjust the chamber wells
b. calibrate differential temperature instrumentation
c. visually inspect top of core for foreign material
d. shutdown the reactor

ANSWER
d.

FACILITY COMMENT
This question is intended to test the operators knowledge of required actions when the power level as calculated by differential temperature disagrees with the Power Range nuclear instrumentation system. The stem, however, refers to "Reactor Power level instrumentation". The question can be interpreted to mean all power level instruments, including Intermediate, Linear and Power Range. Failure of the differential temperature instruments would then be a reasonable and logical diagnosis. As there is no correct answer to this question, it should be deleted.

RESOLUTION
The comment is accepted. The question has been deleted.

ENCLOSURE 3

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

FACILITY: Univ. of Virginia

REACTOR TYPE: UVAR

DATE ADMINISTERED: 92/07/13

REGION: 2

CANDIDATE:

LICENSE APPLIED FOR:

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the exam page itself, or the answer sheet provided. Write answers one side ONLY. Attach any answer sheets to the examination. Points for each question are indicated in parentheses for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

CATEGORY VALUE	% OF TOTAL	CANDIDATE'S SCORE	% OF CATEGORY VALUE	CATEGORY
20.00	32.79			A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS
20.00	32.79			B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
21.00	34.43			C. PLANT AND RADIATION MONITORING SYSTEMS
61.00				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. Fill in the date on the cover sheet of the examination (if necessary).

7. Print your name in the upper right-hand corner of the first page of each section of your answer sheets.

8. Before you turn in your examination, consecutively number each answer sheet, including any additional pages inserted when writing your answers on the examination question page.

9. The point value for each question is indicated in parentheses after the question.

10. Partial credit will NOT be given.

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

12. 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)

The reactor is being started with a core which is near End of Life (EOL). WHICH ONE (1) of the following states the purpose of installing a secondary neutron source in the core?

a. to provide enough neutrons to start a chain reaction

b. to increase core neutron population to a detectable level during startup

c. to compensate for delayed neutrons that will not appear during startup

d. to compensate for those neutrons absorbed in burnable poison in the core

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

QUESTION: 002 (1.00)

WHICH ONE (1) of the following is the correct reason that delayed neutrons allow control of the reactor?

a. Delayed neutrons shorten the average period for a reactivity addition

b. Delayed neutrons increase the average neutron generation time

c. There are more delayed neutrons than prompt neutrons

d. Delayed neutrons are born at higher energies than prompt neutrons and take longer to thermalize

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

QUESTION: 003 (1.00)

Two reactors are identical with the exception that one has a beta fraction of .0072 and the second has a beta fraction of 0.0060. An equal amont of reactivity is inserted into both reactors. WHICH ONE (1) of the following will be the response of the reactor with the .0072 beta fraction?

a. The resulting power level will be lower.

b. The resulting power level will be higher.

c. The period will be shorter.

d. The resulting period will be longer.

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

QUESTION: 004 (1.00)

A reactor scram has resulted in the instantaneous insertion of .06 delta K/K of negative reactivity. WHICH ONE (1) of the following will be the stable reactor period resulting from the scram?

a. -45 seconds

b. -56 seconds

c. -80 seconds

d. -112 seconds

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

QUESTION: 005 (1.00)

WHICH ONE (1) of the following describes the power change caused by an increase in moderator temperature while critical?

a. Power will increase due to reduced buckling.

b. Power will increase due to a decrease in thermal neutron absorption in the moderator.

c. Power will decrease due to increased neutron leakage from the core.

d. Power will decrease due to increased reflection from the core.

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

QUESTION: 006 (1.00)

The UVAR has a moderator coefficient of reactivity equal to 2 EE-4 delta k/k/deg F with the reactor operating at 1 MW. WHICH ONE (1) of the following is the amount of regulating rod movement for a moderator temperature increase of 5 degrees F?

a. 1 inch

b. 2 inches

c. 5 inches

d. 10 inches

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

QUESTION: 007 (1.00)

The following data was obtained during a core loading:

Number of Fuel Elements	Count Rate (CPS) Rods In	Rods Out
0	20	20
4	25	27
6	29	32
8	35	40
10	43	53
12	55	79

WHICH ONE) of the following identifies the number of elements necessary to attain criticality?

a. 14

b. 16

c. 18

d. 20

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

QUESTION: 008 (1.00)

During reactor operation at 2 MW, one shim rod with a total worth of 2% loses electrical power and scrams into the reactor. WHICH ONE (1) of the following is the approximate power before assuming a stable period? Assume a beta fraction of .0077.

a. 28 KW

b. 57 KW

c. 284 KW

d. 567 KW

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

QUESTION: 009 (1.00)

The reactor has a Keff of 0.97. WHICH ONE (1) of the following identifies the reactivity that must be added to make the reactor prompt critical?

a. 0.031 Delta-K/K

b. 0.038 Delta-K/K

c. 0.007 Delta-K/K

d. 0.001 Delta-K/K

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

QUESTION: 010 (1.00)

WHICH ONE (1) of the following factors is affected most by moderator temperature changes in the UVAR?

a. thermal utilization

b. fast fission factor

c. resonance escape probability

d. fast neutron non-leakage probability

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

QUESTION: 011 (1.00)

Two identical reactors are operating at different power levels when they scram. Reactor A is at 100% power (2MW) while Reactor B is at 50% power (1MW). WHICH ONE (1) of the following describes the characteristics of xenon during the transients?

a. xenon peaks will be identical and occur simultaneously

b. xenon peaks will be identical, Reactor B will peak sooner

c. Reactor A will have a larger peak, peaks will occur simultaneously

d. Reactor A will have a larger peak, Reactor B will peak sooner

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

QUESTION: 012 (1.00)

Two different neutron sources were used during two reactor startups. One neutron source, which emits ten times as many neutrons as the second, was used in the first startup. Assume all other factors are the same for the second startup. WHICH ONE (1) of the following states the expected result at criticality?

a. power level will be higher for the first startup

b. power level will be higher for the second startup

c. the first startup will result in a higher rod position

d. the second startup will result in a higher rod position

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

QUESTION: 013 (1.00)

WHICH ONE (1) of the following explains the SHAPE of a differential rod worth graph?

a. It is dependent upon the boron concentration in the poison section of the rod

b. It is dependent upon the enrichment of the U-235 in the fuel following section of the rod

c. It is dependent upon reactor power

d. It is dependent upon the neutron flux in the vicinity of the rod

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

QUESTION: 014 (1.00)

The thermal utilization factor decreases due to the occurrence of "self shielding". WHICH ONE (1) of the following helps to minimize "self shielding" and increase the thermal utilization factor at UVAR?

a. only one regulating rod

b. light water as a moder tor

c. thin plates of fuel

d. maintaining the moderator at low temperature

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

QUESTION: 015 (1.00)

WHICH ONE (1) of the following scenarios will result in an Actual Critical Position (ACP) that is higher than the Estimated Critical Position (ECP)?

a. A Beam Tube is inadvertently filled after the ECP is calculated.

b. The reactor is restarted 10 hours after shutdown from full power instead of 2 hours after shutdown.

c. The ACP is taken at 100 W instead of 10 W with other parameters as calculated on ECP.

d. The primary pump is secured just prior to startup. Note: the reactor has been shutdown all weekend.

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

QUESTION: 016 (1.00)

WHICH ONE (1) of the following would cause the greatest increase in shutdown margin?

a. inserting 50 grams of a strong 1/v absorber into the thermal rabbit facility

b. inserting 50 grams of strong 1/v absorber into the epithermal rabbit facility

c. removing 50 grams of a strong 1/v absorber from the thermal rabbit facility

d. removing 50 grams of a strong 1/v absorber from the epithermal rabbit facility

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

QUESTION: 017 (1.00)

A fueled experiment using natural uranium is inserted into a radiation basket near the core. As moderator temperature increases, the core experiences a negative reactivity effect. WHICH ONE (1) of the following is most responsible for the change?

a. thermal utilization factor

b. neutron reproduction factor

c. fast fission factor

d. resonance escape probability

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

QUESTION: 018 (1.00)

After operating at 1 MW for three days, the UVAR reactor scrams. WHICH ONE (1) of the following states the power being produced by decay heat immediately following the scram?

a. 70 kW

b. 93 kW

c. 125 kW

d. 146 kW

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

QUESTION: 019 (1.00)

WHICH ONE (1) of the following cross sections is zero at low neutron energy levels insufficient to place the target nucleus in an excited state?

a. Elastic Scattering cross section

b. Inelastic Scattering cross section

c. Radiative Capture cross section

d. Fission cross section

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

QUESTION: 020 (1.00)

WHICH ONE (1) of the following would result from adding the graphite reflector to the UVAR reactor?

a. thermal flux distribution flattens and power density increases

b. thermal flux distribution flattens and power density decreases

c. thermal flux distribution skews and power density increases

d. thermal flux distribution skews and power density decreases

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

QUESTION: 001 (1.00)

A small experiment sample is in the reactor pool and is currently 1.0 foot under water. A radiation survey meter held at the surface of the water reads 200 mRem/hr. The reading taken one-half hour ago with the sample in the same position was 400 mRem/hr. WHICH ONE (1) of the following is the time required for the radiation level at the surface of the water to drop from 200 mRem/hr to 20 mRem/hr?

a. 1.4 minutes

b. 30 minutes

c. 50 minutes

d. 100 minutes

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

QUESTION: 002 (1.00)

In preparation to leave the step-down area of the UVAR reactor room controlled area, you perform a self survey. WHICH ONE (1) of the following states the standards set forth in UVAR radiation procedures for identifying the presence of contamination?

a. 200 dpm or greater above background

b. 2200 dpm or greater above background

c. 5,000 dpm or greater above background

d. 10,000 dpm or greater above background

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

QUESTION: 003 (1.00)

WHICH ONE (1) of the following states the minimum time performing licensed duties each calendar quarter necessary to satisfy 10 CFR 55 requirements for maintaining an active NRC license?

a. 4 hours

b. 8 hours

c. 24 hours

d. 40 hours

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

QUESTION: 004 (1.00)

An experiment is removed from the hydraulic rabbit facility after irradiation. It is stopped two feet below the surface of the pool water and measured at 15 mr/hr using a portable instrument. WHICH ONE (1) of the following is the expected dose rate at one foot when the experiment is removed from the pool?

a. 30 mr/hr

b. 60 mr/hr

c. 300 mr/hr

d. 600 mr/hr

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

QUESTION: 005 (1.00)

WHICH ONE (1) of the following statements is correct concerning the approval process for Irradiation Request Forms (IRF)?

a. All fueled experiments to be irradiated must be reviewed and approved by the Reactor Safety Committee.

b. An Irradiation Request Form is not required for experiments the Reactor Supervisor identifies as "routine".

c. If the Reactor Supervisor is the experimenter, he may review and approve his own request.

d. More than one sample of similar materials may be irradiated using the same Irradiation Request Form for a period of one year.

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

QUESTION: 006 (1.00)

WHICH ONE (1) of the following is a responsibility of the Emergency Director which can be delegated to the Reactor Operator?

a. Notification of an event to the Charlottesville Fire Department.

b. Personnel accountability.

c. Direction of facility reentry efforts to aid injured personnel.

d. Disseminating information to the news media.

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

QUESTION: 007 (1.00)

According to the immediate actions section of the abnormal procedure, WHICH ONE (1) of the following may be used to confirm the validity of an actuation of the Fuel Storage Room Criticality Alarm?

a. a dose rate of 20 mr/hr near the fuel storage room

b. an automatic reactor scram

c. actuation of the Hot Cell alarm in the UVAR control room

d. actuation of airborne effluent monitor alarms

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

QUESTION: 009 (1.00)

WHICH ONE (1) of the following tasks could be accomplished while the reactor is declared "SECURED" based on the definition given in Technical Specification?

a. removing an experiment from the rabbit

b. tightening the allen head screws on a rod drive mechanism

c. attaching the Core Spray system remote couplers

d. repositioning a grid plate plug

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

QUESTION: 009 (1.00)

WHICH ONE (1) of the following approves individuals to perform neutron radiography at the UVAR?

a. Reactor Director

b. Health Physicist

c. Reactor Safety Committee

d. Radiation Safety Committee

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

QUESTION: 010 (1.00)

WHICH ONE (1) of the following conditions would require Airborne Effluent monitoring in service by Technical Specifications?

a. reactor operation with either neutron beamport drained

b. reactor operation with fueled experiments whose power generation exceeds 1W

c. reactor operation above 100 kW in the Forced Convection mode

d. reactor operation with an "unsecured" experiment

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

QUESTION: 011 (1.00)

Technical Specification 3.1 prohibits reactor operation in excess of 1 kW unless all experiments with a reactivity worth greater than 0.45% delta k/k are secured. WHICH ONE (1) of the following is the basis for this requirement?

a. a safety limit will not be exceeded if reactor power increases on a 3 second period to the limiting safety system setting (LSSS)

b. a "nondestructive" period will result from a simultaneous failure of the two experiments with the highest reactivity worth

c. a restriction used to place a "reasonable" upper limit on the worth of unsecured experiments

d. ensures the reactor core will be similar in configuration to the core analyzed in the Safety Analyses Report

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

QUESTION: 012 (1.00)

WHICH ONE (1) of the following is a reportable occurrence as defined by Technical Specifications?

a. during shutdown, a slight increase in Co-60 concentrations (to 4 x 10 to -5 uCi/ml) is noted in the reactor pool

b. during operation, movement of an unsecured experiment results in an unanticipated decrease in reactivity of 0.008 delta k/k

c. during a surveillance with the reactor shutdown, the scram setpoint for pool level is found at 19' 1" and readjusted to 19"3"

d. a reactor shutdown is immediately initiated due to a loss of nuclear instrumentation which rendered the regulating rod immobile

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

QUESTION: 013 (1.00)

The safety limit for reactor coolant flow in the Forced Convection mode is conservative due to the inclusion of various tolerances. WHICH ONE (1) of the following tolerances has the greatest effect on the flow rate safety limit?

a. Variations in length of the fuel plates.

b. Variations in fuel loading concentrations.

c. Variations in width of uranium in the plates.

d. Restrictions caused by the lifting handle on the element.

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

QUESTION: 014 (1.00)

Emergency personnel are entering a potentially contaminated area for an eight hour task. The Emergency Plan states they must record their dosimeter reading on the Emergency Personnel Radiological Exposure Record form. WHICH ONE (1) of the following indicates when this reading is required?

a. at least hourly

b. upon exiting the affected area

c. as directed by the Health Physicist

d. at the conclusion of an assigned shift

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

QUESTION: 015 (1.00)

A Site Area Emergency has been declared by the Emergency Director. WHICH ONE (1) of the following would be the Emergency Control Center based on criteria in the UVAR Emergency Plan?

LOCATION	LOCAL READING
a. Office #102 (front office at Reactor Facility)	200 mr/hr
b. Health Physics Office on mezzanine level	125 mr/hr
c. an available first floor office	75 mr/hr
d. area outside the Reactor Facility building	2 mr/hr

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

QUESTION: 016 (1.00)

Contents of the #2 Waste Holdup Tank must be released into Meadow Creek. WHICH ONE (1) of the following identifies the sampling requirements for Tritium analysis?

a. One sample is valid until another transfer of liquid from Tank 1.

b. Samples within 24 hours of discharge and during discharge.

c. Sample within the last 30 days, sample within the last 2 weeks and sample 24 hours prior to release.

d. Sample at the beginning, during and after each release.

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

QUESTION: 017 (1.00) DELETED JTC

The reactor is operating at 2 MW. Power level as calculated by differential temperature across the core indicates 120 kW greater than Reactor Power level instrumentation. WHICH ONE (1) of the following states the required immediate operator action?

a. adjust the chamber wells

b. calibrate differential temperature instrumentation

c. visually inspect top of core for foreign material

d. shutdown the reactor

DELETED

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

QUESTION: 018 (1.00)

Excess reactivity in the UVAR reactor is limited to 5% delta k/k. WHICH ONE (1) of the following states the basis for this requirement?

a. ensures the reactor configuration is similar to the core analyzed in the Safety Analysis Report

b. ensures the ability to override the buildup of samarium at full power operation

c. ensures the ability to overcome the effects of failure of the total allowed worth of experiments

d. ensures the low count rate rod block can be overcome

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

QUESTION: 019 (1.00)

WHICH ONE (1) of the following radiation monitors must be in service to continue reactor operation for three more days?

a. Bridge radiation monitor.

b. Reactor room constant air monitor.

c. Core gamma monitor.

d. Reac. r face monitor.

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

QUESTION: 020 (1.00)

An alarm at the UVAR console indicates an abnormally high radiation level in the UVAR Demineralizer Room. WHICH ONE (1) of the following is an acceptable method to validate the alarm?

a. Verify an automatic reactor scram occurred.

b. Check for an increase on the room Ar41 monitor.

c. Check for an increase on the Core Gamma monitor.

d. Survey just outside of the Demineralizer Room.

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

QUESTION: 001 (1.00)

Water chemistry is approaching the confines of normal bands. The demineralizer is placed in service and an addition of sulfuric acid is made to the Seconary coolant. WHICH ONE (1) of the following will result?

a. Primary and Seconary pH decrease

b. Primary and Seconary pH increase

c. Primary pH increase and Seconary pH decrease

d. Primary pH decrease and Seconary pH increase

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

QUESTION: 002 (1.00)

WHICH ONE (1) of the following is the only element in the Power Range nuclear instrumentation common to both channels?

a. uncompensated ion chamber

b. detector power supply

c. +/- 25 volt DC power supply

d. 110 volt AC p[illegible]upply

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

QUESTION: 003 (1.00)

WHICH ONE (1) of the following conditions will result in an automatic reactor scram?

a. loss of power to Bridge Rad monitor in the Forced Convection mode

b. 109 degrees F pool temperature in the Natural Convection mode

c. 129 gpm reactor flow in the Natural Convection mode

d. 1 cps startup count rate in the Forced Convection mode

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

QUESTION: 004 (1.00)

WHICH ONE (1) of the following is the typical reactivity worth of a shim rod fully inserted into the reactor?

a. 0.5% delta k/k

b. 1.5% delta k/k

c. 3.0% delta k/k

d. 5.0% delta k/k

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

QUESTION: 005 (1.00)

During reactor operation at 2 MW, an individual opens the blockhouse door and breaks the light beam actuator inside the corridor, initiating a reactor scram. WHICH ONE (1) of the following identifies the beamport status indicating logic required to activate the light beam scram?

a. water detector on the vent tube signal

b. water detector on the top sight glass tube signal

c. BF3 radiation detector within the beamport signal

d. any two of the three signals above

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

QUESTION: 006 (1.00)

A total loss of electrical power to the facility occurs. WHICH ONE (1) of the following will continue to function during the event?

a. Primary Coolant Pump

b. Regulating Control Rod

c. Pool Makeup System

d. Constant Air Monitors

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

QUESTION: 007 (1.00)

WHICH ONE (1) of the following alarms will continue to function with the key switch off and the key removed?

a. Blockhouse door open

b. Demineralizer room door open

c. Heat exchanger room door open

d. Mezzanine Radiation light

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

QUESTION: 008 (1.00)

During operation at 1 MW with the regulating rod in automatic, a reactor scram occurs. WHICH ONE (1) of the following identifies the response of the regulating rod?

a. rod is driven into the core

b. rod responds to decreasing power and drives full out

c. rod is inhibited from outward motion

d. rod shifts to manual and maintains position

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

QUESTION: 009 (1.00)

WHICH ONE (1) of the following liquid waste effluents discharges through the 250 gallon underground retention tank to the pond?

a. leakage from pump packing glands

b. effluent from regeneration of the demineralizer

c. reactor pool drains

d. hot cell discharge

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

QUESTION: 010 (1.00)

The reactor bridge radiation monitor reads 30 mr/hr. WHICH ONE (1) of the following actions will NOT automatically occur as a result of this condition?

a. Reactor personnel door closes

b. Ventilation exhaust vent closes

c. Centrifugal blowers deenergize

d. Reactor scrams

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

QUESTION: 011 (1.00)

A simultaneous failure of both Solid State Relays in the Scram Logic Drawer will prevent a successful reactor scram from most inputs. WHICH ONE (1) of the following will initiate a scram even if both Solid State Relays are shorted out?

a. Fire alarm

b. Evacuation alarm

c. Manual pushbutton at the Reactor door

d. Manual pushbutton on the Reactor console

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

QUESTION: 012 (1.00)

WHICH ONE (1) of the following describes the flow path of Primary Cooling water from the pool?

a. tube side of heat exchanger, strainer, pump

b. shell side of heat exchanger, strainer, pump

c. strainer, pump, tube side of heat exchanger

d. strainer, pump, shell side of heat exchanger

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

QUESTION: 013 (1.00)

WHICH ONE (1) of the following describes the isotopic monitoring capability of the exhaust duct radiation monitor?

a. Monitors Argon only. Beta particle energy ranges for other gases are below the wall thickness of the GM tube.

b. Monitors Argon and fission product gases. Beta particle energy ranges are similar.

c. Monitors Argon only. Gamma ray energy ranges for other gases are below the wall thickness of the GM tube.

d. Monitors Argon and fission product gases. Gamma ray energy ranges are similar.

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

QUESTION: 014 (1.00)

WHICH ONE (1) of the following statements is correct concerning the Core Spray system?

a. operators must ensure makeup to the tanks for the first 30 minutes

b. the system will prevent fuel melting during a LOCA without a scram

c. both headers are required to adequately remove decay heat

d. each header is required to supply a minimum of 7.5 gpm for the first 15 minutes

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

QUESTION: 015 (1.00)

WHICH ONE (1) of the following parameters is NOT an input to the Mixer Driver relay?

a. Pool level

b. Period

c. Count Rate

d. Pool temperature

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

QUESTION: 016 (1.00)

An evacuation of the Reactor Facility has been initiated and the evacuation alarm has been actuated from the First Floor Hallway. WHICH ONE (1) of the following identifies the location(s) for resetting the alarm?

a. First Floor Hallway only

b. UVAR Control Room only

c. First Floor Hallway or UVAR Control Room

d. First Floor Hallway, UVAR Control Room or CAVALIER Control Room

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

QUESTION: 017 (1.00)

The reactor is operating at 2 MW with the regulating rod in automatic WHICH ONE (1) of the following will cause a failure of the Reactor Period scram logic trip?

a. failure of the Intermediate Range level amp

b. failure of the Source Range 800 volt power supply

c. failure of the Source and Intermediate Range 78 volt power supply

d. short circuit of Solid State Relay # 1

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

QUESTION: 018 (1.00)

The reactor is started up in the Forced Convection mode. At 50 kw the Primary Coolant return flow diverter fails, allowing return flow directly into the reactor side of the pool. WHICH ONE (1) of the following will be the first instrument to respond to the failure?

a. Source Range monitor

b. Linear Power Range monitor

c. Core Gamma monitor

d. N-16 monitor

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

QUESTION: 019 (1.00)

You have been asked to survey an experiment that was removed from the reactor this morning. A very high energy gamma field is expected. WHICH ONE (1) of the following instruments should be used?

a. Cutie Pie

b. Ion Chamber

c. G-M tube

d. Argon gas filled proportional counter

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

QUESTION: 020 (1.00)

A fueled experiment has failed and is releasing fission product gases to the Reactor Room. The radiation instrument that provides automatic closure of the Reactor Room has failed to function as designed. WHICH ONE (1) of the following is designed as a backup to sense fission product release and alert the operator in time to take manual corrective action?

a. N-16 monitor

b. Constant air monitor

c. Reactor face monitor

d. Core Gamma monitor

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

QUESTION: 021 (1.00)

WHICH ONE (1) of the following radiation monitors employs the use of a lead shielded GM tube?

a. Area Radiation monitor

b. Argon monitor

c. Constant Air monitor

d. Criticality monitor

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

ANSWER: 001 (1.00)

b.

REFERENCE:

SOP 5.4.2.A.2.A

ANSWER: 002 (1.00)

b.

REFERENCE:

UVa Reactor Theory for Reactor Training Program booklet, page 10, paragraph 3

ANSWER: 003 (1.00)

d.

REFERENCE:

Lamarsh Section 7.1, page 248

ANSWER: 004 (1.00)

c.

REFERENCE:

Lamarsh Section 7.5, page 255

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

ANSWER: 005 (1.00)

c.

REFERENCE:

Lamarsh, Sect. 7.3

ANSWER: 006 (1.00)

c.

REFERENCE:

UVAR Design and Analysis Handbook Table 3.1 pp 3-15

(2 EE-4 delta k/k/degree f) X 5 degrees F
.02% delta k/k per inch rod movement

ANSWER: 007 (1.00)

b.

REFERENCE:

UVAR Reactor Theory for Reactor Training Program handout, page 8

1/M = Co/Cf
Number of elements required: 1/Mo divided by 1/Mf = Ef divided by Eo

ANSWER: 008 (1.00)

d.

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

REFERENCE:

Lamarsh, Sect. 7.1

P=B(1-p)Po / (B-p)

=0.0077(1+0.02)x2 MW / (0.0077+0.02)

=0.567 MW

ANSWER: 009 (1.00)

b.

REFERENCE:

Lamarsh, pages 285-286

To go prompt critical, Keff must equal 1.0077.

0.97 + (delta k/k divided by Keff + delta k/k) = 1.0077

0.97 + (.038 divided by 1.008) = 1.0077

ANSWER: 010 (1.00)

d.

REFERENCE:

UVa Reactor Theory for Reactor Training Program booklet, page 23, paragraph 2

ANSWER: 011 (1.00)

d.

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

REFERENCE:

UVa Reactor Theory for Reactor Training Program booklet, page 27, paragraph 1

ANSWER: 012 (1.00)

a.

REFERENCE:

Lamarsh, pages 102-104

ANSWER: 013 (1.00)

d.

REFERENCE:

Lamarsh, page 270

ANSWER: 014 (1.00)

c.

REFERENCE:

UVa Reactor Theory For Reactor Training Program booklet, page 5, line 23

ANSWER: 015 (1.00)

b.

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

REFERENCE:

Lamarsh, pages 287, 288

ANSWER: 016 (1.00)

a.

REFERENCE:

Reactor Theory For Reactor Training Program booklet, page 2, paragraph 3

ANSWER: 017 (1.00)

d.

REFERENCE:

Reactor Theory For Reactor Training Program, page 19, paragraph 1

ANSWER: 018 (1.00)

a.

REFERENCE:

Lamarsh, page 350, paragraph 3

1000 kW x 7%

ANSWER: 019 (1.00)

b.

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

REFERENCE:

Lamarsh, page 53, paragraph 3

ANSWER: 020 (1.00)

a. or c

REFERENCE:

Lamarsh, page 256, paragraph 1; Design and Analysis Handbook, 3.3, paragraph 2.

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

ANSWER: 001 (1.00)

d.

REFERENCE:

Lamarsh, page 22

DR = DRo e EE -decay constant(T)

ANSWER: 002 (1.00)

d.

REFERENCE:

SOP 10.4.B.i

ANSWER: 003 (1.00)

a.

REFERENCE:

10 CFR 55.53, Conditions of licenses

ANSWER: 004 (1.00)

d.

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

REFERENCE:

Lamarsh, 9.11 and 10.11

24" of water equals one tenth thickness.

DR1/DR2 = distance2 squared/distance1 squared =>

DR2 = 10(DR1) / (distance 2 squared / distance 1 squared)

ANSWER: 005 (1.00)

c.

REFERENCE:

SOP 6.1.B 5

[illegible] 6 (1.00)

[illegible]

REFERENCE:

Emergency Plan 3.2(2)

ANSWER: 007 (1.00)

a.

REFERENCE:

SOP 11.L.B.2.d

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

ANSWER: 008 (1.00)

c.

REFERENCE:

SOP 4.4.B.3; Technical Specifications 1.0

ANSWER: 009 (1.00)

a.

REFERENCE:

SOP 6.6.A.2

ANSWER: 010 (1.00)

a.

REFERENCE:

Technical Specification 3.4.1

ANSWER: 011 (1.00)

a.

REFERENCE:

Technical Specification 3.1, Bases paragraph 5

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

ANSWER: 012 (1.00)

c.

REFERENCE:

Technical Specifications 1.0 and 6.4.2

ANSWER: 013 (1.00)

d.

REFERENCE:

SAR 9.A.11.A, paragraph 1; 9.A.11.C, paragraph 1; 9.A.11.D, paragraph 1

ANSWER: 014 (1.00)

a.

REFERENCE:

E PLAN 7.5(5)(a)1

ANSWER: 015 (1.00)

c.

REFERENCE:

EPIP-9, 4.B and C

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

ANSWER: 016 (1.00)

a.

REFERENCE:

SOP 10.5.B.2.d.1, paragraph 3

ANSWER: 017 (1.00)

d.

REFERENCE:

SOP 11.F.b

Deleted per JFC

ANSWER: 018 (1.00)

a.

REFERENCE:

Technical Specification 3.1, Bases paragraph 6

ANSWER: 019 (1.00)

a.

REFERENCE:

Technical Specifications, Table 3.2

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

ANSWER: 020 (1.00)

d.

REFERENCE:

SOP 11-S, Table 11.S.1, page 11-22

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

ANSWER: 001 (1.00)

c.

REFERENCE:

SOP 8.2 & 8.3

ANSWER: 002 (1.00)

d.

REFERENCE:

Design and Analysis Handbook 3.6.4

ANSWER: 003 (1.00)

b.

REFERENCE:

Technical Specification Table 3.1

ANSWER: 004 (1.00)

c.

REFERENCE:

Design and Analysis Handbook, Table 3.1

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

ANSWER: 005 (1.00)

b.

REFERENCE:

Design and Analysis Handbook 5.1, paragraph 3

ANSWER: 006 (1.00)

c.

REFERENCE:

Design and Analysis Handbook 4.2, paragraph 3

ANSWER: 007 (1.00)

a.

REFERENCE:

Design and Analysis Handbook 5.1, paragraph 3

ANSWER: 008 (1.00)

d.

REFERENCE:

Design an Analysis Handbook 3.8, paragraph 2, section 3.

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

ANSWER: 009 (1.00)

d.

REFERENCE:

Design and Analysis Handbook 4.8, paragraph 2

ANSWER: 010 (1.00)

c.

REFERENCE:

SOP 7.9.A.3; Design and Analysis Handbook, paragraph 2 footnote

ANSWER: 011 (1.00)

d.

REFERENCE:

Design and Analysis Handbook figure 3.15

ANSWER: 012 (1.00)

d.

REFERENCE:

Design and Analysis Handbook 4.3, paragraphs 2,3

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

ANSWER: 013 (1.00)

b.

REFERENCE:

Design and Analysis Handbook 4.9.4.2

ANSWER: 014 (1.00)

b.

REFERENCE:

Safety Analysis Report 9.A.21, paragraph 5, page 9-78

ANSWER: 015 (1.00)

c.

REFERENCE:

Design and Analysis Handbook, section 3.6.6

ANSWER: 016 (1.00)

a.

REFERENCE:

EPIP-14 Section 3, page 2

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

ANSWER: 017 (1.00)

a.

REFERENCE:

Design and Analysis Handbook 3.6.3, paragraph 2

ANSWER: 018 (1.00)

c.

REFERENCE:

Design and Analysis Handbook 3.6.1, paragraphs 7 and 8; 4.3, paragraph 3

ANSWER: 019 (1.00)

b.

REFERENCE:

Academic Program For Nuclear Power Plant Personnel, Vol 4, 2.21

ANSWER: 020 (1.00)

b.

REFERENCE:

Design and Analysis Handbook, page 5-6 footnote

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

ANSWER: 021 (1.00)

c.

REFERENCE:

Emergency Plan 7.2(2)(a)1.a

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

ANSWER KEY

MULTIPLE CHOICE

001 b

002 b

003 d

004 c

005 c

006 c

007 b

008 d

009 b

010 d

011 d

012 a

013 d

014 c

015 b

016 a

017 d

018 a

019 b

020 a or C

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

ANSWER KEY

MULTIPLE CHOICE

001 d

002 d

003 a

004 d

005 c

006 b

007 a

008 c

009 a

010 a

011 a

012 c

013 d

014 a

015 c

016 a

017 DELETED per

018 a

019 a

020 d

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

A N S W E R K E Y

MULTIPLE CHOICE

001 c

002 d

003 b

004 c

005 b

006 c

007 a

008 d

009 d

010 c

011 d

012 d

013 b

014 b

015 c

016 a

017 a

018

019 b

020 b

021 c

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

EQUATION SHEET

$\dot{Q} = \dot{m}\, c_p\, \Delta T$

$\dot{Q} = \dot{m}\, \Delta h$

$\dot{Q} = UA\, \Delta T$

$SUR = \dfrac{26.06\ (\lambda_{eff}\rho)}{(\beta - \rho)}$

$SUR = 26.06/\tau$

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

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

$P = \dfrac{\beta(1-\rho)}{\beta-\rho}\ P_0$

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

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

$\rho = \Delta Keff/Keff$

$\bar{\beta} = 0.0077$

$DR_1 D_1^2 = DR_2 D_2^2$

$\text{Cycle Efficiency} = \dfrac{\text{Net Work (out)}}{\text{Energy (in)}}$

$SCR = S/(1-Keff)$

$CR_1\ (1-Keff)_1 = CR_2\ (1-Keff)_2$

$M = \dfrac{(1-Keff)_0}{(1-Keff)_1}$

$M = 1/(1-Keff) = CR_1/CR_0$

$SDM = (1-Keff)/Keff$

$Pwr = W_f\, \dot{m}$

$\ell^* = 1 \times 10^{-5}$ seconds

$\tau = \ell^*/(\rho-\bar{\beta})$

$\lambda_{eff} = 0.1\ \text{seconds}^{-1}$

$T_{1/2} = \dfrac{0.693}{\lambda}$

$DR = DR_0 e^{-\lambda t}$

---

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5°C + 32

°C = 5/9 (°F - 32)

MASTER
ANSWER KEY

MULTIPLE CHOICE

001 b
002 b
003 d
004 c
005 c
006 c
007 b
008 d
009 b
010 d
011 d
012 a
013 d
014 c
015 b
016 a
017 d
018 a
019 b
020 a & c

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

ANSWER KEY

MULTIPLE CHOICE

001 d

002 d

003 a

004 d

005 c

006 b

007 a

008 c

009 a

010 a

011 a

012 c

013 d

014 a

015 c

016 a

~~017 d~~ question deleted DO

018 a

019 a

020 d

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

A N S W E R K E Y

MULTIPLE CHOICE

001 c
002 d
003 b
004 c
005 b
006 c
007 a
008 d
009 d
010 c
011 d
012 d
013 b
014 b
015 c
016 a
017 a
018 c
019 b
020 b
021 c

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