September 2, 2004

Mr. Tim DeBey, Reactor Supervisor
U.S. Geological Survey
Denver Federal Center
Building 15, MS-974
Denver, CO 80225

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-274/OL-04-01, U.S. GEOLOGICAL SURVEY

Dear Mr. DeBey:

During the week of August 16, 2004, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your United States Geological Survey reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Warren Eresian at 301-415-1833 or internet e-mail wje@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-274

Enclosures: 1. Initial Examination Report No. 50-274/OL-04-01
2. Examination and answer key

cc w/encl.:
Please see next page

cc:

Mayor
City Hall
Denver, CO 80202

Mr. Eugene W. Potter
State of Colorado
Radiation Management Program
HMWM-RM-B2
4300 Cherry Creek Drive South
Denver, CO 80246

Mr. Timothy DeBey
Reactor Director
U.S. Geological Survey
Box 25046 - Mail Stop 424
Denver Federal Center
Denver, CO 80225

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

September 2, 2004

Mr. Tim DeBey, Reactor Supervisor
U.S. Geological Survey
Denver Federal Center
Building 15, MS-974
Denver, CO 80225

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-274/OL-04-01, U.S. GEOLOGICAL SURVEY

Dear Mr. DeBey:

During the week of August 16, 2004, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your United States Geological Survey reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. At the conclusion of the examination, the examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosures will available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Warren Eresian at 301-415-1833 or internet e-mail wje@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-274
Enclosures: 1. Initial Examination Report No. 50-274/OL-04-01
2. Examination and answer key
cc w/encl.:
Please see next page

DISTRIBUTION w/encl.:
PUBLIC
AAdams
Facility File (EBarnhill)

DISTRIBUTION w/o encl.:
RNR\R&TR r/f
Eresian
PMadden

EXAMINATION PACKAGE ACCESSION NO.: ML041660334
EXAMINATION REPORT ACCESSION NO.: ML042390142 **TEMPLATE NO.: NRR-074**

OFFICE	**RNRP:CE**		**IROB:LA**		**RNRP:SC**	
NAME	**ERESIAN**		**EBarnhill**		**PMadden**	
DATE	**08/ 30 /2004**		**08/ 31 /2004**		**09/ 1 /2004**	

C = COVER **E = COVER & ENCLOSURE** **N = NO COPY**
OFFICIAL RECORD COPY

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

REPORT NO.:	50-274/OL-04-01
FACILITY DOCKET NO.:	50-274
FACILITY LICENSE NO.:	R-113
FACILITY:	United States Geological Survey
EXAMINATION DATES:	August 16-17, 2004
EXAMINERS:	Warren Eresian, Chief Examiner

SUBMITTED BY: **/RA/** 08/ 30 /2004
Warren Eresian, Chief Examiner Date

SUMMARY:

During the week of August 16, 2004, the NRC administered operator licensing examinations to one Reactor Operator candidate and one Senior Reactor (Upgrade) candidate. The Upgrade candidate passed the examination. The Reactor Operator candidate failed Category A of the written examination.

ENCLOSURE 1

REPORT DETAILS

1. Examiners: Warren Eresian, Chief Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	**0/1**	**N/A**	**0/1**
Operating Tests	**1/0**	**1/0**	**2/0**
Overall	**0/1**	**1/0**	**1/1**

3. Exit Meeting:

Mr. Tim DeBey, Reactor Supervisor
Warren Eresian, NRC Chief Examiner

The NRC thanked the facility staff for their cooperation during the examinations. The facility provided comments on the written examination. Question B4 was deleted due to inadequate information in the stem of the question. Question C4 was deleted due to inaccurate information in the material from which the question was created.

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

FACILITY: U.S. Geological Survey

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 08/16/04

REGION: 4

CANDIDATE:__________________________

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 category 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	36	______	______	A. REACTOR THEORY, THERMODYNAMICS, AND FACILITY OPERATING CHARACTERISTICS
17	33	______	______	B. NORMAL AND EMERGENCY OPERATING PROCEDURES AND RADIOLOGICAL CONTROLS
15	31	______	______	C. FACILITY AND RADIATION MONITORING SYSTEMS
52	100	______	______ FINAL GRADE%	

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

____
Candidate's Signature

ENCLOSURE 1

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

8. 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.

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

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

11. 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)

During the neutron cycle from one generation to the next, several processes occur that may increase or decrease the available number of neutrons. Which ONE of the following factors describes an INCREASE in the number of neutrons during the cycle?

a. Thermal utilization factor.

b. Resonance escape probability.

c. Thermal non-leakage probability.

d. Fast fission factor.

QUESTION: 002 (1.00)

A reactor is critical at 50% of rated power, with reactivity = zero. A control rod is withdrawn and the power increases to a higher steady-state value. The reactivity of the reactor at the higher power level is zero because:

a. the positive reactivity due to the fuel temperature decrease balances the negative reactivity due to the control rod withdrawal.

b. the negative reactivity due to the fuel temperature decrease equals the positive reactivity due to the control rod withdrawal.

c. the positive reactivity due to the fuel temperature increase balances the negative reactivity due to the control rod withdrawal.

d. the negative reactivity due to the fuel temperature increase equals the positive reactivity due to the control rod withdrawal.

QUESTION: 003 (1.00)

Which ONE of the following elements will slow down fast neutrons <u>least</u> quickly, i.e. produces the smallest energy loss per collision?

a. Oxygen-16

b. Uranium-238

c. Hydrogen-1

d. Boron-10

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

QUESTION: 004 (1.00)

Neutrons released by fission are called fast neutrons because they:

a. appear immediately following the fission.

b. are responsible for fast fissions.

c. decay rapidly to stable levels.

d. are at a high kinetic energy level.

QUESTION: 005 (1.00)

Which ONE of the following describes the relationship between thermal neutron flux and reactor power?

a. Power is proportional to the square of the thermal neutron flux.

b. Power is proportional to the square root of the thermal neutron flux.

c. Power is proportional to the thermal neutron flux.

d. Power and thermal neutron flux are independent of each other.

QUESTION: 006 (1.00)

A reactor is operating at a steady-state power level of 1.000 kW. Power is increased to a new steady-state value of 1.004 kW. At the higher power level, K_{eff} is:

a. 1.004

b. 1.000

c. 0.004

d. 0.000

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

QUESTION: 007 (1.00)

During the minutes following a reactor scram, reactor power decreases on a negative 80-second period, corresponding to the half-life of the longest-lived delayed neutron precursor, which is approximately:

a. 20 seconds.

b. 40 seconds.

c. 55 seconds.

d. 80 seconds.

QUESTION: 008 (1.00)

A reactor is slightly supercritical with the following values for each of the factors in the six-factor formula:

Fast fission factor =	1.03
Fast non-leakage probability =	0.84
Resonance escape probability =	0.96
Thermal non-leakage probability =	0.88
Thermal utilization factor =	0.70
Reproduction factor =	1.96

A control is inserted to bring the reactor back to critical. Assuming all other factors remain unchanged, the new value for the thermal utilization factor is:

a. 0.698
c. 0.704

b. 0.702
d. 0.708

QUESTION: 009 (1.00)

Reactor power is increasing by a factor of 10 every minute. The reactor period is:

a. 65 seconds.

b. 52 seconds.

c. 26 seconds.

d. 13 seconds.

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

QUESTION: 010 (1.00)

The neutron microscopic cross section for absorption, σ_a , generally:

a. increases as neutron energy increases.

b. decreases as neutron energy increases.

c. increases as the mass of the target nucleus decreases.

d. decreases as the mass of the target nucleus increases.

QUESTION: 011 (1.00)

Which factor in the six-factor formula is represented by the ratio:

$$\frac{\text{number of neutrons that reach thermal energy}}{\text{number of neutrons that start to slow down}}$$

a. Fast non-leakage probability.

b. Resonance escape probability.

c. Reproduction factor.

d. Thermal utilization factor.

QUESTION: 012 (1.00)

Which ONE of the following statements correctly describes the influence of delayed neutrons during the neutron life cycle?

a. Delayed neutrons are more likely to cause fission after they become thermalized because they thermalize more quickly than prompt neutrons.

b. Delayed neutrons take longer to thermalize because they are born at a higher average energy than prompt neutrons.

c. Delayed neutrons increase the average neutron generation time.

d. Delayed neutrons are produced some time after prompt neutrons and make up the majority of neutrons produced by fissions.

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

QUESTION: 013 (1.00)

Which ONE statement below describes a positive fuel temperature coefficient?

a. When fuel temperature increases, positive reactivity is added.

b. When fuel temperature decreases, positive reactivity is added.

c. When fuel temperature increases, negative reactivity is added.

d. When fuel temperature increases, reactor power decreases.

QUESTION: 014 (1.00)

Reactivity may be defined as a measure of:

a. the number of neutrons (both prompt and delayed) produced in the core.

b. the multiplication factor, K_{eff}.

c. heat energy produced by the reactor.

d. the fractional change in the neutron population per generation.

QUESTION: 015 (1.00)

Delayed neutron precursors decay by beta(-) decay. Which ONE reaction below is an example of beta(-) decay?

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

b. $_{35}Br^{87} \rightarrow {}_{36}Kr^{86}$

c. $_{35}Br^{87} \rightarrow {}_{35}Kr^{88}$

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

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

QUESTION: 016 (1.00)

A reactor is operating at a constant power level with equilibrium xenon. Reactor power is then doubled. The equilibrium xenon level at the higher power level will be:

a. higher than its value at the lower power level, but not twice as high.

b. twice as high.

c. more than twice as high.

d. the same as at the lower power level.

QUESTION: 017 (1.00)

Which ONE of the following statements correctly describes a characteristic of subcritical multiplication?

a. The number of neutrons gained per generation doubles for each succeeding generation.

b. A constant neutron population is achieved when the total number of neutrons produced in one generation is equal to the number of source neutrons added in the next generation.

c. For equal reactivity additions, it requires less time for the equilibrium neutron population to be reached.

d. When the indicated count rate doubles, the margin to criticality has been reduced by approximately one-half.

QUESTION: 018 (1.00)

The moderator temperature coefficient of reactivity is -1.25×10^{-3} delta k/k/deg.C. When a control rod with an average rod worth of 0.1% delta k/k/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher power level. At this point, the moderator temperature has:

a. increased by 8 deg. C.

b. decreased by 8 deg. C.

c. increased by 0.8 deg. C.

d. decreased by 0.8 deg. C.

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

QUESTION: 019 (1.00)

The term prompt critical refers to:

a. the instantaneous jump in power due to a rod withdrawal.

b. a reactor which is critical using only prompt neutrons.

c. a reactor which is critical using both prompt and delayed neutrons.

d. a reactivity insertion which is less then β_{eff}.

QUESTION: 020 (1.00)

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

a. Prompt gamma rays.

b. Fission fragments.

c. Prompt neutrons.

d. Delayed neutrons.

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

QUESTION: 001 (1.00)

In accordance with the Technical Specifications, given the control rod worths and excess reactivity below, calculate the minimum shutdown margin.

Shim rod = 1.8% delta k/k
Regulating rod = 2.5% delta k/k
Safety rod = 2.0% delta k/k
Transient rod = 2.1% delta k/k
Excess reactivity = 4% delta k/k

a. 1.8% delta k/k.

b. 1.9% delta k/k.

c. 4.4% delta k/k.

d. 8.4% delta k/k.

QUESTION: 002 (1.00)

In accordance with GSTR Procedure No. 2, "Reactor Power Calibration", a percent power indicating channel which is incorrect by more than 1.5% power is adjusted to agree with the true power by:

a. mechanically adjusting the pointers on the meters to give the proper indication.

b. adjusting the compensating voltage to the ion chamber to give the proper indication.

c. adjusting the high voltage to the ion chamber to give the proper indication.

d. changing its position to give the proper indication.

QUESTION: 003 (1.00)

In accordance with the Technical Specifications, which ONE situation below is permissible when the reactor is operating?

a. A pool water level of 17 feet.

b. A bulk pool temperature of 70 degrees C.

c. An excess reactivity of 4.5% delta k/k.

d. A pulse reactivity insertion of 2.9% delta k/k.

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

QUESTION: 004 (1.00) QUESTION DELETED

An irradiated sample (assume a point source) having a half-life of 3 minutes provides a dose rate of 200 mr/hour at 1 foot. The closest distance from the source that a “Caution - Radiation Area” sign can be posted is:

a. 1.4 feet.

b. 2.4 feet.

c. 4.5 feet.

d. 6.3 feet.

QUESTION: 005 (1.00)

In accordance with the Technical Specifications, there are limits on the amount of transverse bend and longitudinal elongation for a standard fuel element. If elements are found that exceed these limits:

a. the reactor shall not be operated.

b. the reactor shall only be operated at a power less than 100 kW.

c. the reactor shall not be operated in the pulse mode.

d. the reactor shall only be operated in the steady-state mode.

QUESTION: 006 (1.00)

In accordance with the Emergency Plan, “onsite” means:

a. the area within the site boundary.

b. the area within the operations boundary.

c. the reactor facility.

d. the protected area.

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

QUESTION: 007 (1.00)

In accordance with the Technical Specifications, the only mode in which the withdrawal of any control rod, except the pulse rod, is prevented is the:

a. Steady-State mode.

b. Auto mode.

c. Pulse mode.

d. Square-Wave mode.

QUESTION: 008 (1.00)

A group of visitors is going to enter the reactor bay. Dosimeters must be provided to:

a. each member of the group.

b. every third member of the group.

c. only one member of the group.

d. a few members of the group.

QUESTION: 009 (1.00)

In accordance with the Emergency Plan, "emergency procedures" are:

a. documented instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

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

c. conditions which call for immediate actions, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

d. specific instrument readings, observations, radiological dose or dose rates, etc., which may be used as thresholds for establishing emergency classes and initiating appropriate emergency measures.

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

QUESTION: 010 (1.00)

In order to comply with the Technical Specifications, a stack gas analysis is performed on a quarterly basis. The primary purpose of the analysis is to determine the release concentration of:

a. Nitrogen-16.

b. Argon-41.

c. Cobalt-60.

d. Iodine-135.

QUESTION: 011 (1.00)

In accordance with 10 CFR 20, the “Annual Limit on Intake (ALI)” refers to:

a. the amount of radioactive material taken into the body by inhalation or ingestion in one (1) year which would result in a committed effective dose equivalent of five (5) rems.

b. the dose equivalent to organs that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

c. limits on the release of effluents to an unrestricted environment.

d. the concentration of a given radionuclide in air which, if breathed for a working year of 2000 hours, would result in a committed effective dose equivalent of five (5) rems.

QUESTION: 012 (1.00)

A survey instrument with a window probe is used to measure the beta-gamma dose rate from an irradiated experiment. The dose rate with the window open is 100 mrem/hour, and the dose rate with the window closed is 60 mrem/hour. The beta dose rate is:

a. 40 mrem/hour.

b. 60 mrem/hour.

c. 100 mrem/hour.

d. 160 mrem/hour.

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

QUESTION: 013 (1.00)

An area radiation monitor is out of service while being repaired. As a result:

a. the reactor cannot be operated.

b. the reactor can continue to operate.

c. the reactor can continue to operate only if the alarm setpoints of other area radiation monitors are lowered.

d. the reactor can continue to operate only if the monitor is replaced by a portable gamma-sensitive ion chamber.

QUESTION: 014 (1.00)

Which ONE of the following would be a Class II experiment?

a. An experiment for which there exists adequate precedence for assurance of safety.

b. An experiment which represents less than that amount of reactivity worth necessary for prompt criticality.

c. An experiment in which any significant reactivity worth is stable and mechanically fixed.

d. An experiment which is dynamically coupled to the reactor core and together function as a system.

QUESTION: 015 (1.00)

Which ONE of the following statements is TRUE regarding experiments?

a. The reactivity worth of any incore-experiment shall be limited to $3.00.

b. Explosive materials in quantities greater than 25 milligrams shall not be irradiated in the reactor.

c. Experiments containing materials corrosive to reactor components shall not be irradiated in the reactor.

d. Explosive materials in quantities greater than 25 milligrams may be irradiated provided that the resulting pressure upon detonation does not exceed the design pressure of the reactor building.

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

QUESTION: 016 (1.00)

In order to maintain an active reactor or senior reactor operator license, the license-holder must perform the functions of his/her position for at least:

a. four hours per calendar quarter.

b. three hours per calendar quarter.

c. one hour per month.

d. sixteen hours per year.

QUESTION: 017 (1.00)

It is desired to remove a pneumatic system terminus from the core. When doing so:

a. the reactor must be shutdown.

b. the reactor may be critical, but at a power level less than 100 watts.

c. the reactor may be at any power level.

d. the reactor may be at any power level, but only if it has been operated for less than 12 hours.

QUESTION: 018 (1.00)

Match the condition in Column A with the appropriate emergency class in Column B. (Column B answers may be used once, more than once, or not at all.)

Column A	Column B
a. Sustained fire at the facility that does not involve reactor controls or radioactive materials.	1. Notification of Unusual Event
b. Continuous air monitor reading exceeds 10K cpm above background.	2. Alert
c. Fire that damages reactor controls.	3. Site Area Emergency
d. Report of tornado winds that could strike the facility.	

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

QUESTION: 001 (1.00)

An important design feature of the fuel-moderator elements is:

a. an enrichment of 90%, allowing for prolonged operations before refueling.

b. the inclusion of the burnable poison erbium.

c. the reduced neutron absorption provided by the zirconium cladding.

d. the prompt negative temperature coefficient of reactivity.

QUESTION: 002 (1.00)

Maximum fuel temperatures are expected to occur in the:

a. B-ring fuel elements.

b. D-ring fuel elements.

c. F-ring fuel elements.

d. G-ring fuel elements.

QUESTION: 003 (1.00)

Which ONE of the following conditions is NOT a requirement to enter the Square Wave mode of operation?

a. Power less than 1 kW.

b. Period greater than 26 seconds.

c. Reactor in Steady State mode.

d. All control rods and transient rod above the down limit.

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

QUESTION: 004 (1.00) QUESTION DELETED

Cooling system flow is measured by an orifice located at:

a. the inlet to the demineralizer.

b. the outlet of the heat exchanger.

c. the discharge of the pump.

d. the inlet to the heat exchanger.

QUESTION: 005 (1.00)

One of the differences between the transient control rod and the other control rods is that the transient control rod:

a. has 21 inches of borated graphite in the upper section while the other rods have 15 inches of borated graphite in the upper section.

b. contains an air void while the other rods do not.

c. is 43 inches long while the other rods are 37 inches long.

d. has a reactivity rod worth of about twice that of each of the other rods.

QUESTION: 006 (2.00)

Match the neutron measuring channel listed in Column A with the correct detector listed in Column B. Items listed in Column B may be used more than once or not at all.

	Column A		Column B
a.	Power safety channel #1	1.	Proportional counter
b.	Log power channel	2.	Fission chamber
c.	Linear channel	3.	Compensated Ion Chamber
d.	Power safety channel #2	4.	Uncompensated Ion Chamber

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

QUESTION: 007 (1.00)

Which ONE of the following will cause a HIGH conductivity reading at the inlet of the demineralizer?

a. Failure of cooling water heat exchanger.

b. Low pool water temperature.

c. High coolant pump flow.

d. Reactor water system pressure higher than secondary water pressure.

QUESTION: 008 (1.00)

Which ONE of the following radiation monitors is interlocked with the ventilation system?

a. Top of the reactor.

b. Entrance to reactor laboratory.

c. Reactor console.

d. CAM.

QUESTION: 009 (1.00)

Which ONE of the following will NOT automatically activate Building 15 evacuation alarm?

a. Fire alarm.

b. Continuous air monitor alarm.

c. Gaseous stack monitor.

d. Air particulate monitor.

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

QUESTION: 010   (1.00)

Neutron level input to the servo system is provided by the:

a. Power safety channel #2.

b. Log power channel.

c. Linear channel.

d. Power safety channel #1.

QUESTION: 011   (1.00)

The neutron source used in the reactor is a:

a. plutonium-beryllium source.

b. polonium-americium source.

c. polonium-beryllium source.

d. antimony-beryllium source.

QUESTION: 012 (1.00)

When the transient rod is used in the pulse mode, the amount of reactivity insertion is controlled by the:

a. pressure of the air supply.

b. position of the piston.

c. position of the cylinder.

d. position of the shock absorber.

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

QUESTION: 013 (1.00)

The inlet to the Purification system is taken from the:

a. outlet of the primary pump.

b. outlet of the flow meter.

c. inlet of the heat exchanger.

d. outlet of the heat exchanger.

QUESTION: 014 (1.00)

A three-way solenoid valve controls the air supplied to the pneumatic cylinder of the transient rod. De-energizing the solenoid causes the valve to shift to:

a. open, admitting air to the cylinder.

b. close, admitting air to the cylinder.

c. open, removing air from the cylinder.

d. close, removing air from the cylinder.

QUESTION: 015 (1.00)

The reactor is in the steady state mode with the transient rod shock absorber in the full down position and no air applied. The shock absorber is moved upward, and the operator then attempts to apply air to the transient rod. Which ONE of the following occurs?

a. The air solenoid blocks air to the transient rod.

b. The transient rod moves up until it reaches the shock absorber.

c. The shock absorber returns to its full down position.

d. The reactor scrams.

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

QUESTION: 016 (1.00)

Which ONE of the following describes the purpose of the Draw Tube in a control rod drive assembly?

a. Provides rod full out position indication.

b. Connects to the electromagnet to move the rod.

c. Actuates the rod down microswitch.

d. Automatically engages the control rod on a withdraw signal.

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

A. REACTOR THEORY, THERMODYNAMICS & FACILITY OPERATING CHARACTERISTICS

ANSWER: 001 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 188.

ANSWER: 002 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 327.

ANSWER: 003 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 164.

ANSWER: 004 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 13.

ANSWER: 005 (1.00)
C.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 82.

ANSWER: 006 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 149.

ANSWER: 007 (1.00)
C.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 111.

ANSWER: 008 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 189.

ANSWER: 009 (1.00)
C.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 234.
$P/P_o = 10 = e^{60/T}$; $60/T = \ln 10 = 2.303$; T = 26 seconds.

ANSWER: 010 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 89.

ANSWER: 011 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 169.

ANSWER: 012 (1.00)
C.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 239.

ANSWER: 013 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 262.

ANSWER: 014 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 231.

ANSWER: 015 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 11.

ANSWER: 016 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 254.

ANSWER: 017 (1.00)
D.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 191.

ANSWER: 018 (1.00)
A.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 262.
Reactivity added by control rod = 0.001 delta k/k/inch x 10 inches = 0.01 delta k/k.
(0.01 delta k/k)/1.25×10^{-3} delta k/k/deg.C = 8 deg. C. increase.

ANSWER: 019 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 248.

ANSWER: 020 (1.00)
B.
REFERENCE:
Glasstone & Sesonske, Nuclear Reactor Engineering, 3rd Edition, pg. 16.

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

ANSWER: 001 (2.00)
B.
REFERENCE:
Technical Specifications, Section E.5.
Shutdown margin + Excess reactivity = Rod worth (excluding the most reactive rod)

ANSWER: 002 (1.00)
D.
REFERENCE:
GSTR Procedure No. 2, pg. 2.

ANSWER: 003 (1.00)
C.
REFERENCE:
Technical Specifications, Section D.2.

ANSWER: 004 (1.00) QUESTION DELETED
C.
REFERENCE:
$DR_1D_1^2 = DR_2D_2^2$; $D_2 = [(200 \text{ mr/hr} \times 1 \text{ ft}^2)/100 \text{ mr/hr}]^{1/2}$ = 1.4 feet. 1 foot + 1.4 feet = 2.4 feet.

ANSWER: 005 (1.00)
C.
REFERENCE:
Technical Specifications, Section D.6.

ANSWER: 006 (1.00)
A.
REFERENCE:
USGS Emergency Plan, Definitions.

ANSWER: 007 (1.00)
C.
REFERENCE:
Technical Specifications, Table II.

ANSWER: 008 (1.00)
D.
REFERENCE:
Administrative Procedures, Section 4.3.5.

ANSWER: 009 (1.00)
A.
REFERENCE:
USGS Emergency Plan, Definitions.

ANSWER: 010 (1.00)
B.
REFERENCE:
Procedure for Stack Gas Analysis.

ANSWER: 011 (1.00)
A.
REFERENCE:
10 CFR 20.

ANSWER: 012 (1.00)
A.
REFERENCE:
With the window closed, no betas are measured. The beta dose rate is 40 mrem/hour.

ANSWER: 013 (1.00)
D.
REFERENCE:
Technical Specifications, Section F.1.

ANSWER: 014 (1.00)
D.
REFERENCE:
Hazards Summary Report, Section 9.2.4.

ANSWER: 015 (1.00)
A.
REFERENCE:
Technical Specifications, Section I.4.

ANSWER: 016 (1.00)
A.
REFERENCE:
10 CFR 55; USGS Requalification Program.

ANSWER: 017 (1.00)
A.
REFERENCE:
GSTR Procedure No. 6.

ANSWER: 018 (1.00)
A, 1; B, 1; C,2; D,1.
REFERENCE:
USGS Emergency Plan, Sections 4.2.1, 4.2.2.

C. FACILITY AND RADIATION MONITORING SYSTEMS

ANSWER: 001 (1.00)
D.
REFERENCE:
Hazards Summary Report, Section 5.1.

ANSWER: 002 (1.00)
A.
REFERENCE:
Hazards Summary Report, Section 7.3.3.

ANSWER: 003 (1.00)
D.
REFERENCE:
GA Control Console Operators Manual.

ANSWER: 004 (1.00) QUESTION DELETED
B.
REFERENCE:
Hazards Summary Report, Figure 5-12.

ANSWER: 005 (1.00)
B.
REFERENCE:
Hazards Summary Report, Section 5.3.1.

ANSWER: 006 (2.00)
A,3; B,2; C,2; D,3.
REFERENCE:
Control System Block Diagram.

ANSWER: 007 (1.00)
A.
REFERENCE:
GA TRIGA Maintenance and Operating Manual.

ANSWER: 008 (1.00)
D.
REFERENCE:
Hazards Summary Report, Section 9.3.1.

ANSWER: 009 (1.00)
C.
REFERENCE:
Emergency Procedures, Section 7.3.3.

ANSWER: 010 (1.00)
B or C.
REFERENCE:
Control System Block Diagram.

ANSWER: 011 (1.00)
C.
REFERENCE:
Hazards Summary Report, Section 5.6.

ANSWER: 012 (1.00)
C.
REFERENCE:
Hazards Summary Report, Section 5.4.2.

ANSWER: 013 (1.00)
D.
REFERENCE:
Hazards Summary Report, Figure 5-12.

ANSWER: 014 (1.00)
D.
REFERENCE:
Hazards Summary Report, Section 5.4.2.

ANSWER: 015 (1.00)
A.
REFERENCE:
Technical Specifications, Table II.

ANSWER: 016 (1.00)
B.
REFERENCE:
Hazards Summary Report, Section 5.4.1.

A. REACTOR THEORY, THERMODYNAMICS AND FACILITY OPERATING CHARACTERISTICS

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 ______

B. NORMAL/EMERGENCY PROCEDURES & RADIOLOGICAL CONTROLS

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 _____ QUESTION DELETED

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 _____

C. FACILITY AND RADIATION MONITORING SYSTEMS

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 ______ QUESTION DELETED

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 ______

EQUATION SHEET

$Q = m\ c_p\ \Delta T$

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

$SUR = 26.06/\tau$

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

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

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

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

$DR_1 D_1^2 = DR_2 D_2^2$

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

$DR = 6CiE/D^2$

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

1 Curie = 3.7×10^{10} dps

1 gallon water = 8.34 pounds

1 Btu = 778 ft-lbf

$^\circ F = 9/5^\circ C + 32$

1 Mw = 3.41×10^6 BTU/hr

$^\circ C = 5/9\ (^\circ F - 32)$