January 19, 2010

Mr. David Turner
Vallecitos and Morris Operations
Vallecitos Nuclear Center
General Electric Company
6705 Vallecitos Road
Sunol, CA 94586

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-073/OL-10-01, GENERAL ELECTRIC – HITACHI NUCLEAR TEST REACTOR

Dear Mr. Turner:

During the week of December 14, 2009, the Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your Nuclear Test Reactor facility. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Paul V. Doyle Jr. at (301) 415-1058 or via internet e-mail Paul.Doyle@nrc.gov.

Sincerely,

/RA/
Johnny H. Eads, Jr., Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-073

Enclosures:
1. Initial Examination Report No. 50-073/OL-10-01
2. Written examination with facility comments incorporated

cc w/o encl: See next page

January 19, 2010

Mr. David Turner
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General Electric Company
6705 Vallecitos Road
Sunol, CA 94586

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-073/OL-10-01, GENERAL ELECTRIC – HITACHI GENTR REACTOR

Dear Mr. Turner:

During the week of December 14, 2009, the Nuclear Regulatory Commission (NRC) administered operator licensing examinations at your General Electric – Hitachi GENTR reactor. The examinations were conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with Title 10 of the Code of Federal Regulations Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Paul V. Doyle Jr. at (301) 415-1058 or via internet e-mail Paul.Doyle@nrc.gov.

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Facility File (CRevelle) O-7 F-08

ADAMS ACCESSION #: ML100080075 **TEMPLATE #:NRR-074**

OFFICE	PRTB:CE		IOLB:LA	E	PRTB:SC	
NAME	PDoyle:mxc		CRevelle		JEads	
DATE	01/8/2010		01/14/2010		01/19/2010	

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

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

REPORT NO.: 50-073/OL-10-01

FACILITY DOCKET NO.: 50-073

FACILITY LICENSE NO.: R-33

FACILITY: GE-Hitachi GENTR Reactor

EXAMINATION DATES: December 15 – 16, 2009

SUBMITTED BY: _____ December 30, 2009
Paul V. Doyle Jr., Chief Examiner Date

SUMMARY:

On December 15 and 16, 2009, the NRC administered operating tests to one senior reactor operator (upgrade) candidates and one initial RO candidate. Both license candidates passed all portions of their respective examinations.

REPORT DETAILS

1. Examiners:

Paul V. Doyle Jr., Chief Examiner, NRC

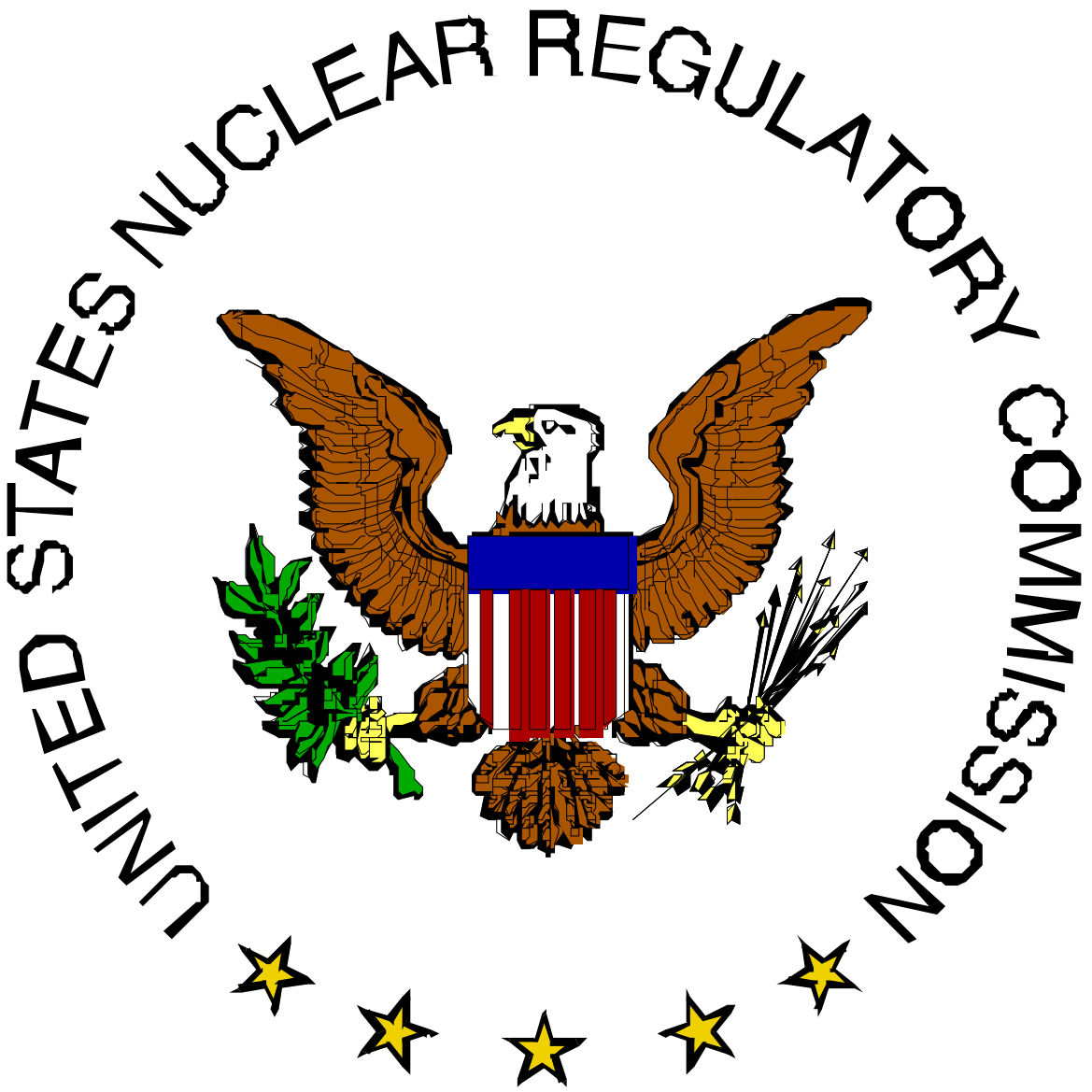
2. Results:

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

3. Exit Meeting:
Paul Doyle, Chief Examiner, NRC
Dan Thomas, Manager, Nuclear Test Reactor
Dave Turner, Manager, Vallecitos Nuclear Center

The examiner thanked the facility for their support in the administration of the examinations. In addition, the examiner pointed out one area of concern with respect to the operating tests. The facility provided comments on the written examination in an email which have been incorporated into the examination included as attachment 2 to this examination report.

U.S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING EXAMINATION
WITH ANSWER KEY



General Electric - Hitachi Nuclear Test Reactor
Week of December 14, 2009

Enclosure 2

QUESTION A.01 [1.0 point]

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 rod 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

b. 0.702

c. 0.704

d. 0.708

QUESTION A.02 [1.0 point]

During a reactor startup, the count rate is increasing linearly with time, with no rod motion. This means that:

a. the reactor is subcritical and the count rate increase is due to the buildup of delayed neutron precursors.

b. the reactor is critical and the count rate increase is due to source neutrons.

c. the reactor is subcritical and the count rate increase is due to source neutrons.

d. the reactor is critical and the count rate increase is due to the buildup of delayed neutron precursors.

QUESTION A.03 [1.0 point]

A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur with the same number of elements loaded as if there were no change in the initial count rate.

b. criticality will occur earlier (i.e., with fewer elements loaded.)

c. criticality will occur later (i.e., with more elements loaded.)

d. criticality will be completely unpredictable.

QUESTION A.04 [1.0 point]

For a β_{eff} = 0.0074, a reactivity insertion of 20 cents corresponds approximately to:

a. 0.0010 $\Delta k/k$.

b. 0.0015 $\Delta k/k$.

c. 0.0020 $\Delta k/k$.

d. 0.0074 $\Delta k/k$.

QUESTION A.05 [1.0 point]

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 A.06 [1.0 point]

Inelastic scattering can be described as a process whereby a neutron collides with a nucleus and:

a. reappears with a lower kinetic energy, with the nucleus emitting a gamma ray.

b. reappears with the same kinetic energy it had prior to the collision.

c. is absorbed by the nucleus, with the nucleus emitting a gamma ray.

d. reappears with a higher kinetic energy, with the nucleus absorbing a gamma ray.

QUESTION A.07 [1.0 point]

The infinite neutron multiplication factor K_{∞} differs from K_{eff} in that K_{eff} takes into account:

a. leakage from the core.

b. neutrons from fast fission.

c. the effect of poisons.

d. delayed neutrons.

QUESTION A.08 [1.0 point]

Which ONE of the following describes the response of the subcritical reactor to equal insertions of positive reactivity as the reactor approaches critical? Each reactivity insertion causes:

a. a SMALLER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

b. a SMALLER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

c. a LARGER increase in the neutron flux, resulting in a LONGER time to reach equilibrium.

d. a LARGER increase in the neutron flux, resulting in a SHORTER time to reach equilibrium.

QUESTION A.09 [1.0 point]

The moderator temperature coefficient of reactivity is -1.25×10^{-4} $\Delta k/k/°C$. When a control rod with an average rod worth of 0.1% Δ k/k/inch is withdrawn 1 inch, reactor power increases and becomes stable at a higher level. At this point, the moderator temperature has:

a. increased by 8 °C.

b. decreased by 8 °C.

c. increased by 0.8 °C.

d. decreased by 0.8 °C.

QUESTION A.10 [1.0 point]

The effective neutron multiplication factor, K_{eff}, is defined as:

a. absorption/(production + leakage)

b. (production + leakage)/absorption

c. (absorption + leakage)/production

d. production/(absorption + leakage)

QUESTION A.11 [1.0 point]

Xenon-135 (Xe^{135}) is produced in the reactor by two methods. One is directly from fission; the other is indirectly from the decay of:

a. Xe^{136}

b. Sm^{136}

c. Cs^{135}

d. I^{135}

QUESTION A.12 [2.0 points, ½ each]

Using the drawing of the Core Rod Position provided, identify each of the following reactivity worths.

a. Total Rod Worth

b. Actual Shutdown Margin

c. Technical Specification Shutdown Margin Limit

d. Excess Reactivity

1. B - A
2. C - A
3. C - B
4. D - C
5. E - C
6. E - D
7. E - A

QUESTION A.13 [1.0 point]

The term ***PROMPT JUMP*** refers to …

a. the instantaneous change in power due to raising a control rod.

b. a reactor which has attained criticality on prompt neutrons only.

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

d. a negative reactivity insertion which is greater than $\beta_{effective}$

QUESTION A.14 [1.0 point]

Which ONE of the following is the definition of effective multiplication factor (K_{eff})?

a. $\frac{\text{\# of neutrons produced from all fissions}}{\text{\# of neutrons in the previous generation.}}$

b. $\frac{\text{\# of neutrons produced from fast fissions}}{\text{\# of neutrons produced from thermal fission.}}$

c. $\frac{\text{\# of neutrons absorbed in the fuel}}{\text{\# of neutrons absorbed by fission products}}$

d. $\frac{\text{\# of neutrons in the present generation}}{\text{\# of neutrons in the previous generation.}}$

QUESTION A.15 [1.0 point]

You are performing a startup and the reactor is critical at a very low power level. If you establish a 26 second period, how long will it take to increase reactor power by a factor of 10,000?

a. 1 minute

b. 2 minutes

c. 3 minutes

d. 4 minutes

QUESTION B.01 [1.0 point]

Two centimeters of lead placed in a beam of gamma rays reduces the radiation level from 400 mR/hr to 200 mR/hr. Which ONE of the following is the total thickness of lead that would reduce the gamma radiation level from 400 mR/hr to 50 mR/hr.?

a. 4 cm.

b. 6 cm.

c. 7 cm.

d. 8 cm.

QUESTION B.02 [1.0 point]

The reactor is operating at full power over the weekend, during which time the Reactor Operator (RO) in the control room becomes ill and is taken to a hospital. Only a Senior Reactor Operator (SRO) and an operator trainee remain in the facility. In accordance with the Technical Specifications, reactor operations:

a. must be discontinued because both an RO and SRO must be present at the facility.

b. must be discontinued because there is only one licensed person at the facility.

c. may continue since the SRO can operate the facility with a second knowledgeable person available.

d. may continue until a replacement RO can arrive at the facility, up to a maximum of 30 minutes.

QUESTION B.03 [1.0 point]

A survey instrument with a window probe is used to measure low energy beta and gamma radiation. The measured dose rate is 100 mrem/hr with the window open and 60 mrem/hr with the window closed. The gamma dose rate is:

a. 100 mrem/hr.

b. 60 mrem/hr.

c. 40 mrem/hr.

d. 160 mrem/hr.

QUESTION B.04 [1.0 point]

In accordance with the Technical Specifications, which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. One control rod inoperable but fully inserted in the core.

b. Average scram time of four safety rods = 300 msec.

c. Excess reactivity = $1.00.

d. Positive temperature coefficient of reactivity of primary coolant when primary coolant temperature = 120°F.

QUESTION B.05 [1.0 point]

Which ONE of the following events does NOT require the presence of an SRO at the facility?

a. Recovery from an unscheduled shutdown.

b. Movement of reactor fuel.

c. An experiment change with a reactivity worth > $1.00.

d. Reactor power calibration.

QUESTION B.06 [1.0 point]

According to the Technical Specifications reactor operation shall not be permitted unless the core tank is filled with water. This limit is based on:

a. ensuring that there will be no reactivity insertions due to the sudden addition of water into the core tank.

b. providing adequate neutron and gamma shielding during operation.

c. providing sufficient suction head for the primary pump.

d. reducing the probability of aluminum corrosion.

QUESTION B.07 [2.0 points, ½ each]

Identify the time period for each of the 10 CFR Part 55 requirements listed below for an actively licensed operator. 1, 2, 4 or 6 years.

a. License Expiration

b. Medical Examination

c. Requalification Written Examination

d. Requalification Operating Test

QUESTION B.08 [1.0 point]

Two point sources have the same curie strength. Source A's gammas have an energy of 1 Mev, whereas Source B's gammas have an energy of 2 Mev. You obtain readings from the same GM tube and Ion Chamber at 10 feet from each source. Concerning the four readings, which ONE of the following statements is correct?

a. The reading from Source B is twice that of Source A for both meters.

b. The reading from Source B is twice that of Source A for the Ion chamber but the same for the GM tube.

c. The reading from Source B is half that of Source A for the GM tube, but the same for the Ion Chamber.

d. The reading from both sources are the same for both meters.

QUESTION B.09 [1.0 point]

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. twenty hours per year.

QUESTION B.10 [2.0 points, ⅓ each]

For the following terms (a through F) pick a definition (1 through 6) which most clearly describes the term.

a. Subcritical Multiplication	1. Substance used in a reactor to reduce the energy of neutrons to the energy at which there is a high probability of causing fissioning of the fuel.
b. Reactor Period	2. Different forms of the same chemical element which differ only by the number of neutrons in the nucleus.
c. Reactivity	3. The time required for neutron flux (power) to change by a factor of e (2.718).
d. Moderator	4. The multiplication of source neutrons resulting from reactivity addition.
e. Shutdown Margin	5. A measure of the deviation from critical.
f. Isotope	6. A measure of the reactivity which must be added to a shutdown reactor to make it just critical.

QUESTION B.11 [1.0 point, ¼ each]

Identify the **PRIMARY** source (irradiation of **air**, irradiation of **water**, or **fission** product) of EACH of the radioisotopes listed.

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

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

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

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

QUESTION B.12 [1.0 point]

Which ONE of the following correctly describes a Safety Limit?

a. Limits on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the uncontrolled release of radioactivity.

b. The Lowest functional capability of performance levels of equipment required for safe operation of the facility.

c. Settings for automatic protective devices related to those variables having significant safety functions.

d. a measuring or protective channel in the reactor safety system.

QUESTION B.13 [1.0 point]

So far this calendar year, you have received 3.3 Rem whole body dose. You must work on a control drive mechanism where there is an average dose of 250 mR/hr. Which ONE of the following times is closest to your stay time WITHOUT going over? (Assume you are over the age of 18.)

a. 3¼ hours.

b. 6½ hours.

c. 12¾ hours.

d. 19 hours.

QUESTION B.14 [1.0 point]

Which ONE of the following is the definition of a **CHANNEL TEST**?

a. the combination of sensor, line, amplifier, and output devices which are connected for the purpose of measuring the value of a parameter

b. an adjustment of the channel such that it output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, Including equipment actuation, alarm, or 'trip and shall be deemed to include a channel test

c. a qualitative verification of acceptable performance by observation of channel behavior.' This verification, where possible, shall Include comparison of the channel with other Independent channels or systems measuring the same variable.

d. the introduction of a signal into the channel for verification that It Is operable.

QUESTION B.15 [1.0 point] **Question changed per facility comment for future use.**

The ~~continuous air~~ Stack monitor is out of service. As a result:

a. the reactor cannot be operated.

b. the reactor can continue to operate below 100 watts.

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

d. the reactor can continue to operate only if the monitor is replaced by a portable monitor with a read-out and capable of alarming.

QUESTION C.01 [1.0 point]
One of the three picoammeters indicates a “Downscale” alarm. As a result:

a. control rods and safety rods cannot be withdrawn.

b. control rods can be withdrawn, but safety rods cannot be withdrawn.

c. safety rods can be withdrawn, but control rods cannot be withdrawn.

d. both control rods and safety rods can be withdrawn

QUESTION C.02 [1.0 point]
Primary coolant flow is regulated by:

a. throttling valve TV-101.

b. varying the speed of the primary pump.

c. throttling valve TV-103.

d. throttling valve V-204.

QUESTION C.03 [1.0 point]
Which ONE of the following is NOT a process scram?

a. Primary coolant high core outlet temperature at 100% power.

b. Low primary coolant flow at 100% power.

c. Positive pressure in reactor cell with respect to adjoining areas at 100% power.

d. Log N high power.

QUESTION C.04 [1.0 point]
The normal flow path for primary cooling water, starting at the reactor outlet, is:

a. hold-up tank, air trap, flow orifice, primary pump, reactor inlet.

b. primary pump, heat exchanger, flow orifice, air trap, reactor inlet.

c. flow orifice, heat exchanger, air trap, primary pump, reactor inlet.

d. flow orifice, hold-up tank, primary pump, heat exchanger, reactor inlet.

QUESTION C.05 [1.0 point]
Reactor cell pressure, with respect to surrounding areas, is maintained:

a. positive, by the Hoffman blower admitting outside air.

b. negative, by the Hoffman blower discharging through the furnace stack.

c. positive, by the ventilation fan admitting air from Building 105.

d. negative, by the ventilation fan discharging through the NTR stack.

QUESTION C.06 [1.0 point]
Which ONE of the following rod drive operations is possible with the reactor keylock switch in the “OFF” position?

a. Bypassing the “all-in” interlock.

b. Driving rod motors using the “IN” pushbutton.

c. Rod withdrawal using the rod test and interlock circuit.

d. Overriding the scram insert signal on one rod at a time.

QUESTION C.07 [1.0 point]
The secondary coolant solenoid cutoff valve SV-203 opens when:

a. inlet pressure at the heat exchanger exceeds 35 psig.

b. the reactor console power switch is ON.

c. the primary coolant high temperature relay energizes.

d. a high alarm level occurs in the fuel loading tank.

QUESTION C.08 [1.0 point]
The neutron source drive is identical to the rod drives in all respects, except:

a. the position indication reads out in percent withdrawn and rods must be “all-in” before the source can be withdrawn.

b. the position indication reads out in inches withdrawn and rods cannot be moved unless the source is “full-in.”

c. position indication is not provided and it is not necessary to pull any safety rods to with draw the source.

d. position indication is not provided and all safety rod magnets must be energized to withdraw the source.

QUESTION C.09 [1.0 point]

Which ONE of the following area radiation monitors is interlocked with the shutter and door controls to prevent inadvertent exposure to a radiation beam from the reactor?

a. Control room radiation monitor.

b. North room radiation monitor.

c. South cell radiation monitor.

d. Reactor cell radiation monitor (reactor operating).

QUESTION C.10 [1.0 point]

Operation with one picoammeter out of service is possible if:

a. power is less than 0.1 kW.

b. the coincidence logic unit is configured for 1-out-of-2 operation.

c. rods are not withdrawn beyond their present positions.

d. the other picoammeters are switched to the non-coincident logic unit.

QUESTION C.11 [1.0 point, $^1/_5$ each] Question changed for clarification per facility comment.

Match each of the Area Radiation Monitors in column A with the appropriate alarm set point in column B.

a.	North Room High Level	1.	5 mr/hr
b.	South Cell High Level	2.	10 mr/hr
c.	Reactor Cell High Level (~~Reactor Shutdown~~ Cell entry required)	3.	100 mr/hr
d.	Reactor Cell High Level (Reactor Operating)	4.	10^3 mr/hr
e.	Control Room High Level	5.	10^6 mr/hr

QUESTION C.12 [1.0 point]

Which ONE of the following experimental facilities produces the LEAST reactivity effects due to loading or unloading of experiments?

a. Vertical facility.

b. Horizontal facility.

c. Loading chute facility.

d. Face facility.

QUESTION C.13 [1.0 point]

An indication of a heat exchanger leak would be:

a. a high level alarm in the fuel loading tank.

b. a high level alarm in the core tank.

c. a reduction of secondary coolant flow.

d. a reduction of primary coolant flow.

QUESTION C.14 [2.0 points, ½ each]

Match the purification system conditions listed in column A with their respective causes listed in column B. Each choice is used only once.

Column A	Column B
a. High Radiation Level at demineralizer.	1. Channeling in demineralizer.
b. High Radiation Level downstream of demineralizer.	2. Fuel element failure.
c. High flow rate through demineralizer.	3. High temperature in demineralizer system
d. High pressure upstream of demineralizer.	4. Clogged demineralizer

QUESTION C.15 [1.0 point]

Which one of the following correctly describes the operation of a Thermocouple?

a. A bi-metallic strip which winds/unwinds due to different thermal expansion constants for the two metals, one end is fixed and the other moves a lever proportional to the temperature change.

b. a junction of two dissimilar metals, generating a potential (voltage) proportional to temperature changes.

c. a precision wound resistor, placed in a Wheatstone bridge, the resistance of the resistor varies proportionally to temperature changes.

d. a liquid filled container which expands and contracts proportional to temperature changes, one part of which is connected to a lever.

A.01 a
REF: Reactor Physics Training Manual, Section D, Neutron Multiplication Factors. In order to decrease K, thermal utilization must decrease.

A.02 b
REF: Reactor Physics Training Manual, Section H, Subcritical Multiplication.

A.03 a
REF: Reactor Physics Training Manual, Section H, Subcritical Multiplication.

A.04 b
REF: Reactor Physics Training Manual, Section I, Reactor Kinetics. $\Delta k/k$ = reactivity($) x β = 0.20 x 0.0074 = 0.00148 $\approx$ 0.0015

A.05 c 80 sec / ln (2) = 55.45
REF: Reactor Physics Training Manual, Section D, Neutron Multiplication Factors.

A.06 a
REF: Reactor Physics Training Manual, Section B, Types of Nuclear Reactions.

A.07 a
REF: Reactor Physics Training Manual, Section D, Neutron Multiplication Factors.

A.08 c
REF: Reactor Physics Training Manual, Section H, Subcritical Multiplication.

A.09 a (0.1% $\Delta k/k$/inch $\times$ 1 inches) / -1.25 $\times$ 10^{-4} $\Delta k/k/°C$ = (1 $\times$ 10^{-3} $\Delta k/k$) / -12.5 $\times$ 10^{-4} $\Delta k/k/°C$ = 8°C
REF: Reactor Physics Training Manual, Section A, basic Reactor Physics Definitions

A.10 d
REF: Reactor Physics Training Manual, Section D, Neutron Multiplication Factors.

A.11 d
REF:

A.12 a, 7; b, 2; c, 1; d, 5 answers were omitted from facility copy.
REF:

A.13 a
REF:

A.14 d
REF:

A.15 d
REF: $\ln(10{,}000) = (\text{time}_{\text{in seconds}})/26$ 9.210 = time/26 time = 26 × 9.210 = 239.467 or 4 minutes.

B.01 b 50/400 = 1/8 = $1/(2)^3$ implies 3 ½ thicknesses or 6 cm.
REF: Radiological Safety at Vallecitos Nuclear Center, Page 26.

B.02 c
REF: Technical Specifications Section 6.1.3.1.

B.03 b. With the window closed the dose rate is due to gamma radiation!!!
REF: Radiological Safety at Vallecitos Nuclear Center, Page 12.

B.04 d
REF: Technical Specifications Section 3.1.3.5.

B.05 d
REF: Technical Specifications, Section 6.1.3.2.

B.06 a
REF: Technical Specifications, Section 3.3.4.

B.07 a, 6; b, 2; c, 2; d, 1
REF: 10CFR55

B.08 b
REF: Radiological Safety at Vallecitos Nuclear Center, Page 11. GM tube cannot distinguish between energies.

B.09 a
REF: GENTR Requalification Plan.

B.10 a, 4; b, 3; c, 5; d, 1; e, 6; f, 2
REF:

B.11 a. = Water; b. = Water; c. = Air; d. = Fission
REF: Exam 4 Standard NRC Question.

B.12 a
REF:

B.13 b *5.0 - 3.3 = 1.7 Rem allowable. 1.7 Rem ÷ 0.25 Rem/hr = 6.8 ≈ 6½*
REF: 10CFR20.1201

B.14 d
REF: Technical Specifications § 1 Definitions

B.15 b, d 2nd answer only valid for this exam. With correction to body of question "b" will be only correct answer.
REF: T.S. 3.4.3.4

C.01 d
REF: SOP 2.4, Picoammeter Channels.

C.02 a
REF: SOP 1.1, Primary Cooling System.

C.03 C
REF: SOP 2.1, Safety Systems.

C.04 C.
REF: GE NTR Safety Analysis Report, Figure 5-1.

C.05 d
REF: GE NTR Safety Analysis Report, Section 6.7.

C.06 b
REF: GE NTR Safety Analysis Report, Section 8.5 and Figure 8.3.

C.07 b
REF: GE NTR Safety Analysis Report, Section 5.3; SOP 1.6, steps 5.9 and 5.11.

C.08 c
REF: GE NTR Safety Analysis Report, Section 8.8.

C.09 c
REF: GE NTR Safety Analysis Report, Section 8.6.

C.10 b
REF:

C.11 a, 3; b, 3; c, 3; d, 5; e, 1
REF:

C.12 d
REF: GE NTR Safety Analysis Report, Section 7.10.

C.13 a
REF: SOP 1.5, Secondary Cooling System.

C.14 a, 2; b, 3; c, 1; d, 4
Ref: Standard NRC cleanup loop question

C.15 b
REF: Standard NRC question

U. S. NUCLEAR REGULATORY COMMISSION
RESEARCH AND TEST REACTOR INITIAL OPERATOR LICENSING EXAMINATION

FACILITY: GE-Hitachi Nuclear Test Reactor

REACTOR TYPE: NTR

DATE ADMINISTERED: 12/ 15 /2009
Circle one

CANDIDATE:

INSTRUCTIONS TO CANDIDATE:

Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets 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.

% of Category Value	% of Total	Candidates Score	Category Value	Category	
16.00	32.65	_____	____	A.	Reactor Theory, Thermodynamics and Facility Operating Characteristics
17.00	36.70	_____	____	B.	Normal and Emergency Operating Procedures and Radiological Controls
16.00	32.65	_____	____	C.	Facility and Radiation Monitoring Systems
49.00		_____	____% FINAL GRADE		TOTALS

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 neither received nor 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 and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

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. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

EQUATION SHEET

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

$$P_{\max} = \frac{(\rho - \beta)^2}{2\alpha(k)\ell}$$

$$\ell^* = 1 \times 10^{-4}\ seconds$$

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

$$SCR = \frac{S}{-\rho} \approx \frac{S}{1 - K_{eff}}$$

$$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$$

$$CR_1(-\rho_1) = CR_2(-\rho_2)$$

$$SUR = 26.06\left[\frac{\lambda_{eff}\,\rho}{\beta - \rho}\right]$$

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}}$$

$$M = \frac{1}{1 - K_{eff}} = \frac{CR_1}{CR_2}$$

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

$$P = P_0\, e^{\frac{t}{T}}$$

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

$$SDM = \frac{(1 - K_{eff})}{K_{eff}}$$

$$T = \frac{\ell^*}{\rho - \overline{\beta}}$$

$$T = \frac{\ell^*}{\rho} + \left[\frac{\overline{\beta} - \rho}{\lambda_{eff}\,\rho}\right]$$

$$\Delta\rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1}\, x\, K_{eff_2}}$$

$$T_{‰} = \frac{0.693}{\lambda}$$

$$\rho = \frac{(K_{eff} - 1)}{K_{eff}}$$

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

$$DR = \frac{6CiE(n)}{R^2}$$

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

DR – Rem, Ci – curies, E – Mev, R – feet

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

1 Curie = 3.7 x 10^{10} dis/sec

1 Horsepower = 2.54 x 10^{3} BTU/hr

1 BTU = 778 ft-lbf

1 gal (H_2O) ≈ 8 lbm

c_P = 1.0 BTU/hr/lbm/°F

1 kg = 2.21 lbm

1 Mw = 3.41 x 10^{6} BTU/hr

°F = 9/5 °C + 32

°C = 5/9 (°F - 32)

c_p = 1 cal/sec/gm/°C

A.01 a b c d ___

A.02 a b c d ___

A.03 a b c d ___

A.04 a b c d ___

A.05 a b c d ___

A.06 a b c d ___

A.07 a b c d ___

A.08 a b c d ___

A.09 a b c d ___

A.10 a b c d ___

A.11 a b c d ___

A.12a 1 2 3 4 5 6 7 ___

A.12b 1 2 3 4 5 6 7 ___

A.12c 1 2 3 4 5 6 7 ___

A.12d 1 2 3 4 5 6 7 ___

A.13 a b c d ___

A.14 a b c d ___

A.15 a b c d ___

B.01 a b c d ___

B.02 a b c d ___

B.03 a b c d ___

B.04 a b c d ___

B.05 a b c d ___

B.06 a b c d ___

B.07a 1 2 4 6 ___

B.07b 1 2 4 6 ___

B.07c 1 2 4 6 ___

B.07d 1 2 4 6 ___

B.08 a b c d ___

B.09 a b c d ___

B.10a 1 2 3 4 5 6 ___

B.10b 1 2 3 4 5 6 ___

B.10c 1 2 3 4 5 6 ___

B.10d 1 2 3 4 5 6 ___

B.10e 1 2 3 4 5 6 ___

B.10f 1 2 3 4 5 6 ___

B.11a air water fission ____

B.11b air water fission ____

B.11c air water fission ____

B.11d air water fission ____

B.12 a b c d ___

B.13 a b c d ___

B.14 a b c d ___

B.15 a b c d ___

C.01 a b c d ___

C.02 a b c d ___

C.03 a b c d ___

C.04 a b c d ___

C.05 a b c d ___

C.06 a b c d ___

C.07 a b c d ___

C.08 a b c d ___

C.09 a b c d ___

C.10 a b c d ___

C.11a 1 2 3 4 5 ___

C.11b 1 2 3 d 5 ___

C.11c 1 2 3 4 5 ___

C.11d 1 2 3 4 5 ___

C.11e 1 2 3 4 5 ___

C.12 a b c d ___

C.13 a b c d ___

C.14a 1 2 3 4 ___

C.14b 1 2 3 4 ___

C.14c 1 2 3 4 ___

C.14d 1 2 3 4 ___

C.15 a b c d ___

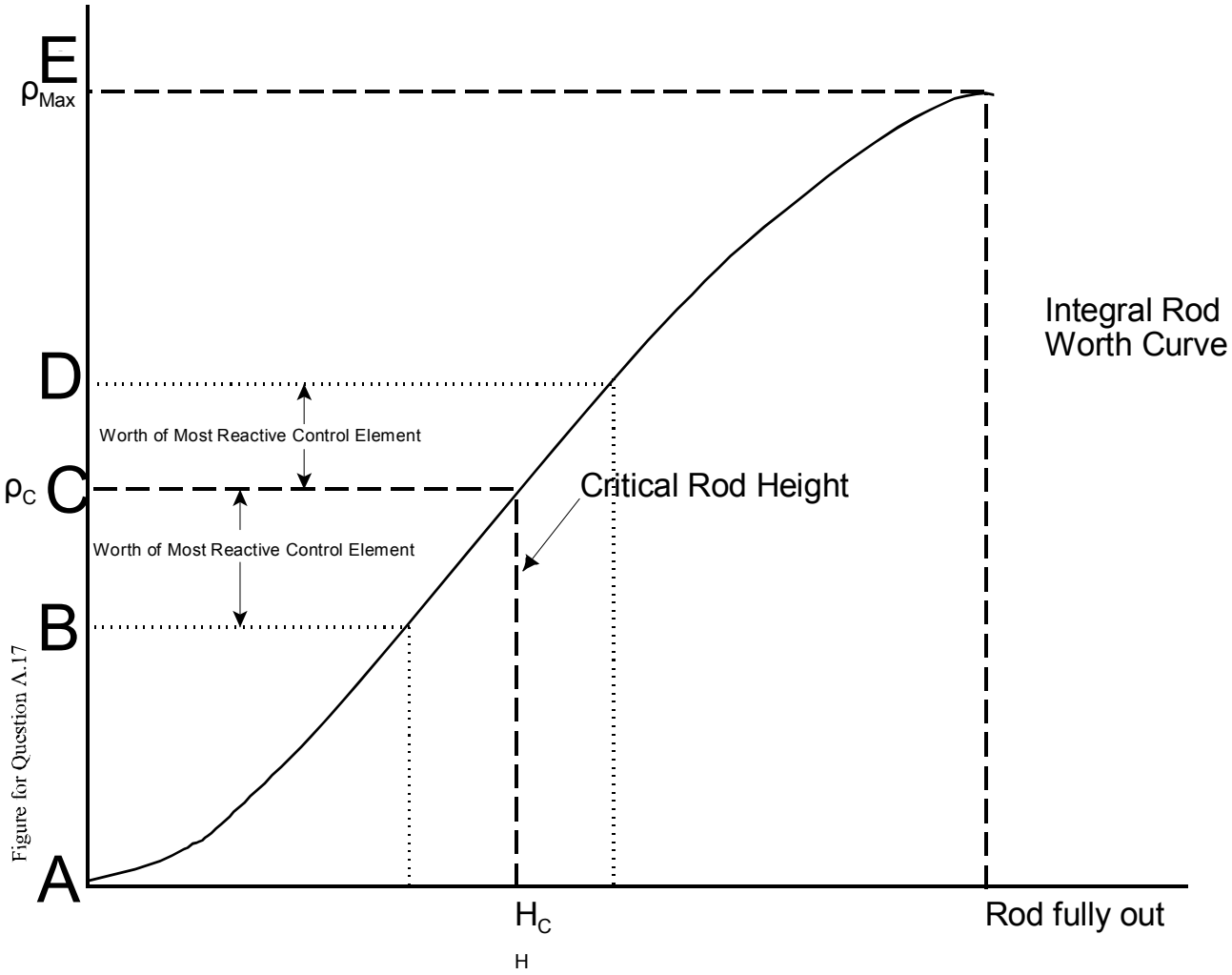


Figure for Question A.17

Total rod worth is the reactivity from A to E (7)
Actual Shutdown Margin is the amount of negative reactivity removed from the reactor = A to C (2)
T.S. Shutdown Margin is Actual SDM less the worth of the most reactive rod = A to B (1)
Core Excess is the amount of Negative Reactivity worth still in the reactor equal to C to E (5)