UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2016 – FORM A

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO EXAMINEE

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item. Each test item has equal point value. A score of at least 80 percent is required to pass this portion of the NRC operator licensing written examination. All examination materials will be collected 3 hours after the examination begins. This examination applies to a typical U.S. pressurized water reactor (PWR) nuclear power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 22		
REACTOR THEORY	23 - 36		
THERMODYNAMICS	37 - 50		
TOTALS	50		

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

_____

Examinee's Signature

RULES AND INSTRUCTIONS FOR THE
NRC GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

NOTE: The term "control rod" refers to the length of neutron absorber material that can be positioned by the operator to change core reactivity.

NOTE: Numerical answers are rounded to the nearest whole number unless otherwise indicated.

1. Print your name in the blank provided on the cover sheet of the examination.

2. Fill in your individual docket number.

3. Fill in the name of your facility.

4. Fill in your start and stop times at the appropriate times.

5. Two aids are provided for your use during the examination:

   (1) An Equations and Conversions Sheet contained within the examination copy, and

   (2) Steam tables and Mollier Diagram provided by your proctor.

6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.

7. Scrap paper will be provided for calculations.

8. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.

9. Restroom trips are limited. Only **one** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside the examination room.

10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination. Either pencil or pen may be used.

11. Turn in your examination materials, answer sheet on top, followed by the examination copy and the examination aids, e.g., steam tables, handouts, and scrap paper.

12. After turning in your examination materials, leave the examination area as defined by the proctor. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS SHEET

EQUATIONS

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

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

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

$\dot{Q} \propto \dot{m}^3_{\text{Nat Circ}}$

$\Delta T \propto \dot{m}^2_{\text{Nat Circ}}$

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

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

$SUR = 26.06/\tau$

$$\tau = \frac{\bar{\beta}_{eff} - \rho}{\lambda_{eff}\,\rho}$$

$$\rho = \frac{\ell^*}{\tau} + \frac{\bar{\beta}_{eff}}{1 + \lambda_{eff}\,\tau}$$

$\ell^* = 1.0 \times 10^{-4}$ sec

$\lambda_{eff} = 0.1\ \text{sec}^{-1}$ (for small positive ρ)

$DRW \propto \varphi^2_{tip} / \varphi^2_{avg}$

$P = P_o e^{t/\tau}$

$P = P_o 10^{SUR(t)}$

$A = A_o e^{-\lambda t}$

$N = S/(1 - K_{eff})$

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

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

$\dot{m} = \rho A\vec{v}$

$\dot{W}_{Pump} = \dot{m}\Delta P\upsilon$

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

$P_R = \sqrt{3}IE\sin\theta$

Thermal Efficiency = Net Work Out/Energy In

$$\frac{g(z_2 - z_1)}{g_c} + \frac{(\vec{v}_2^2 - \vec{v}_1^2)}{2g_c} + \upsilon(P_2 - P_1) + (u_2 - u_1) + (q - w) = 0$$

$g = 32.2\ \text{ft/sec}^2$

$g_c = 32.2$ lbm-ft/lbf-sec^2

CONVERSIONS

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1 MW $= 3.41 \times 10^6$ Btu/hr

1 hp $= 2.54 \times 10^3$ Btu/hr

1 Btu $= 778$ ft-lbf

$℃ = (5/9)(°F - 32)$

$°F = (9/5)(℃) + 32$

1 kg $= 2.21$ lbm

1 ft^3_{water} $= 7.48$ gal

1 gal_{water} $= 8.35$ lbm

1 Curie $= 3.7 \times 10^{10}$ dps

QUESTION: 1

Subcooled water is flowing through a throttle valve in an open system. The initial steady-state conditions for the throttle valve are as follows:

Inlet pressure = 60 psia
Outlet pressure = 44 psia
Flow rate = 800 gpm

After four hours, the current steady-state conditions for the throttle valve are as follows:

Inlet pressure = 58 psia
Outlet pressure = 46 psia
Flow rate = 1,000 gpm

Which one of the following could be responsible for the difference between the initial and current steady-state conditions for the throttle valve?

A. The throttle valve was closed more.

B. The throttle valve was opened more.

C. Another valve, located upstream of the throttle valve, was opened more.

D. Another valve, located downstream of the throttle valve, was opened more.

QUESTION: 2

During a local inspection of a manually operated 12-inch gate valve, the valve stem is observed to extend outward from the valve handwheel by 1 inch. The entire external valve stem is threaded, except for a 1-inch section that becomes smooth just before the valve stem enters the packing gland.

Which one of the following describes the position of the gate valve?

A. The valve is fully open or nearly fully open.

B. The valve is fully closed or nearly fully closed.

C. The valve may be in any position because it is a rising stem gate valve.

D. The valve may be in any position because it is a non-rising stem gate valve.

QUESTION: 3

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

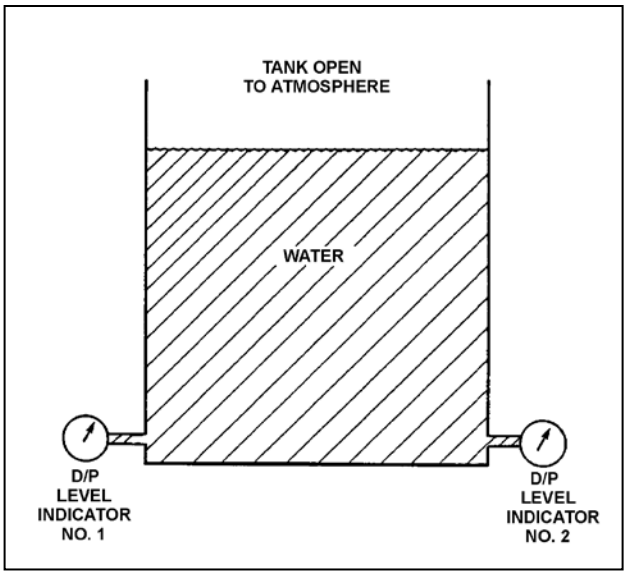
Indicator 1 was calibrated at 180°F and indicator 2 was calibrated at 120°F. If tank water temperature is 150°F, then indicator...

A. 1 will read greater than indicator 2, and greater than actual water level.

B. 1 will read greater than indicator 2, and less than actual water level.

C. 2 will read greater than indicator 1, and greater than actual water level.

D. 2 will read greater than indicator 1, and less than actual water level.



QUESTION: 4

When comparing a resistance temperature detector (RTD) to a thermocouple, the RTD is unique because only the RTD…

A. has a measuring junction made from two metals or alloys.

B. has a characteristic that varies almost linearly with temperature.

C. requires a power supply to produce a voltage that represents the measured temperature.

D. requires a known reference temperature to ensure accuracy of the temperature indication.

QUESTION: 5

Refer to the simplified drawing of a control rod position detector circuit (see figure below).

A magnet on the control rod extension (or drive) shaft sequentially closes individual reed switches mounted vertically adjacent to the control rod drive housing. A constant +5 DC volts is supplied to the input of the resistor network at resistor R_1.

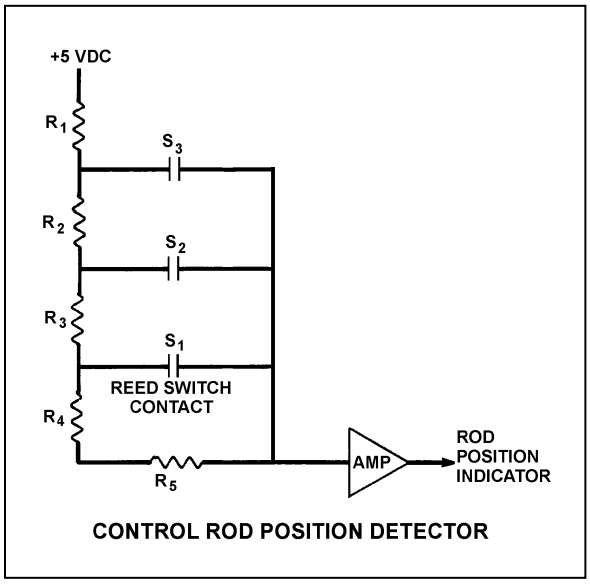
A control rod is initially fully inserted such that all reed switch contacts are open; then the rod is withdrawn until reed switch contact S_1 is closed. Compared to the initial circuit currents, the current through resistor R_5 after the rod withdrawal will be _____; and the output current of the resistor network to the amplifier will be _____.

A. lower; higher

B. lower; lower

C. higher; higher

D. higher; lower



CONTROL ROD POSITION DETECTOR

QUESTION: 6

A Geiger-Mueller detector with a "pancake" probe is being used to monitor workers leaving a radiologically controlled area for contamination. The probe is sensitive to alpha, beta, and gamma radiation. The background count rate is 20 cpm. As one worker's shoe is scanned, the count rate increases to 1,000 cpm.

Given the following separate actions:

- When a sheet of paper is placed between the probe and the shoe, the count rate decreases to 600 cpm.
- When a sheet of aluminum foil is placed between the probe and the shoe, the count rate decreases to 600 cpm.

Which one of the following describes the type(s) of radiation being emitted by the contamination?

A. Beta only

B. Alpha only

C. Beta and gamma

D. Alpha and gamma

QUESTION: 7

Refer to the drawing of a water storage tank and level control system (see figure below) that have just been returned to service following replacement of the drain valve actuator. Unfortunately, the original direct-acting actuator was mistakenly replaced with a reverse-acting actuator.

Given:

- The drain valve will now fail open if operating air pressure is lost.
- The level control system uses a direct-acting proportional-integral level controller with a setpoint of 15 feet.
- The level controller is currently in manual control, with an operator maintaining the tank water level at 14 feet.
- Tank inlet and outlet flow rates are currently equal with the drain valve 50 percent open.

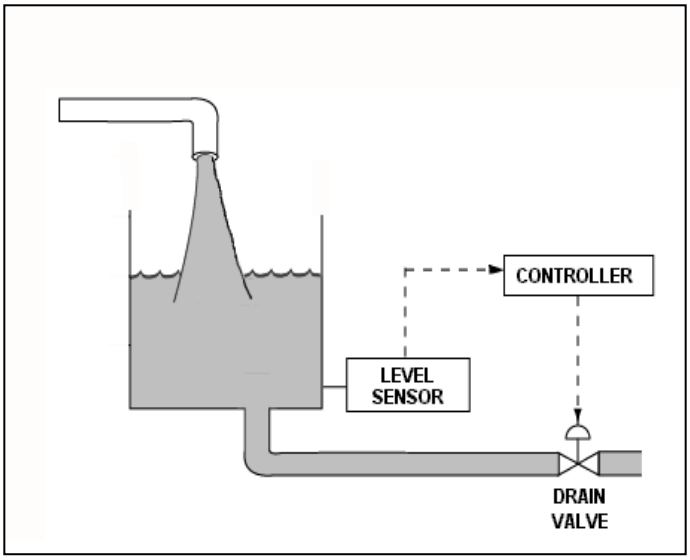
If the level controller is shifted to automatic control, the tank water level will…

A. increase and stabilize at 15 feet.

B. increase and stabilize slightly higher than 15 feet.

C. decrease until the tank nearly empties.

D. increase until the tank overflows.



QUESTION: 8

An outside water storage tank is equipped with submerged heaters. The heaters energize at minimum power when water temperature decreases to 48°F. If water temperature continues to decrease, heater power will increase directly with the temperature deviation from 48°F until maximum power is reached at 40°F. If water temperature decreases faster than 1°F/min, the heaters will reach maximum power at a higher water temperature.

Which one of the following types of control is used in the heater control circuit to produce these characteristics?

A. Proportional only

B. Proportional plus integral

C. Proportional plus derivative

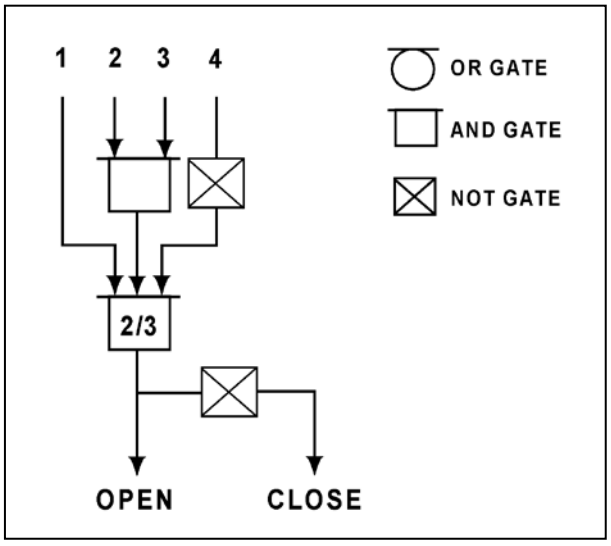
D. Proportional plus integral plus derivative

QUESTION: 9

Refer to the logic diagram for a valve controller (see figure below).

Which one of the following combinations of inputs will result in the valve receiving an OPEN signal?

	INPUTS			
	1	2	3	4
A.	Off	On	Off	Off
B.	Off	On	On	Off
C.	On	Off	Off	On
D.	On	Off	On	On



QUESTION: 10

Refer to the drawing of a centrifugal pump taking suction from the bottom of an open water storage tank (see figure below).

Given:

- The tank contains 60°F water.
- The eye of the pump impeller is located 50 feet above the bottom of the tank.
- The pump requires a minimum net positive suction head of 4 feet.

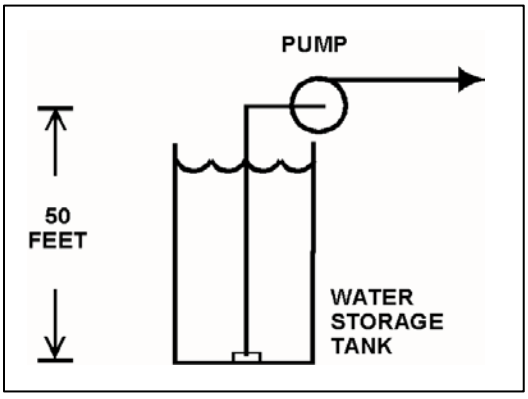
Which one of the following describes the effect on pump operation if tank water level is allowed to continuously decrease?

A. The pump will operate normally until tank water level decreases below approximately 20 feet, at which time the pump will cavitate.

B. The pump will operate normally until tank water level decreases below approximately 16 feet, at which time the pump will cavitate.

C. The pump will operate normally until the pump suction becomes uncovered, at which time the pump will cavitate.

D. The pump will operate normally until the pump suction becomes uncovered, at which time the pump will become air bound.



QUESTION: 11

A flow-limiting venturi in the discharge piping of a centrifugal pump decreases the potential for the pump to experience...

A. runout.

B. reverse flow.

C. shutoff head.

D. water hammer.

QUESTION: 12

Refer to the drawing showing two operating points for the same centrifugal pump (see figure below).

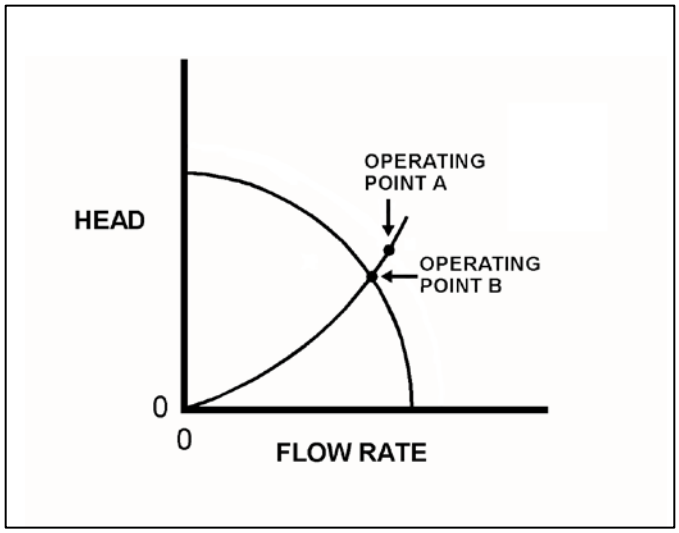
Operating point A was generated from pump performance data taken six months ago. Current pump performance data was used to generate operating point B. Which one of the following would cause the observed difference between operating points A and B?

A. The pump discharge valve was more open when data was collected for operating point A.

B. The pump discharge valve was more closed when data was collected for operating point A.

C. The pump internal components have worn since data was collected for operating point A.

D. The system piping head loss has increased since data was collected for operating point A.



QUESTION: 13

Refer to the drawing of operating curves for a positive displacement pump in a closed water system (see figure below).

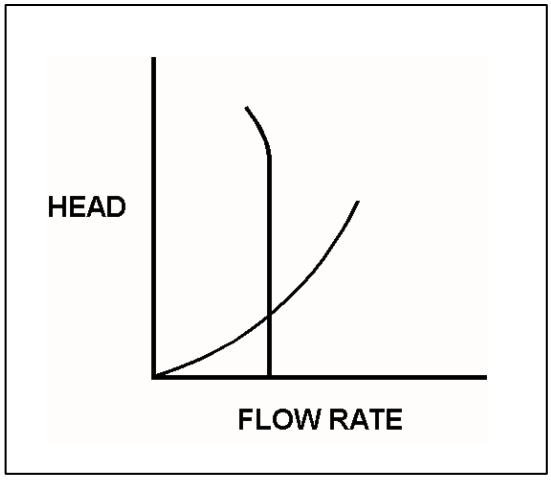
Which one of the following describes the value of the pump head where the two curves cross?

A. The amount of pump head produced at zero flow rate.

B. The amount of pump head required to avoid cavitation.

C. The amount of pump head needed to maintain the system flow rate.

D. The amount of pump head converted to kinetic energy in the pump.



QUESTION: 14

A radial-flow centrifugal cooling water pump is being powered by a 480 VAC induction motor. If the motor input voltage slowly decreases from 480 VAC to 450 VAC, the pump flow rate will _____; and the motor current will _____. (Assume the motor does not stall.)

A. decrease; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

QUESTION: 15

Which one of the following describes the relationship between the current drawn by an AC induction motor and the amount of heat generated in the motor windings?

A. Heat generation is directly proportional to the current.

B. Heat generation is proportional to the cube of the current.

C. Heat generation is proportional to the square of the current.

D. Heat generation is proportional to the square root of the current.

QUESTION: 16

A reactor is shut down with core decay heat being removed by the residual heat removal (RHR) system. Assume that only the RHR heat exchangers are removing heat from the reactor coolant system (RCS), and that the RHR system provides complete thermal mixing of the RCS. Also, assume that core decay heat is the only source of heat addition to the RCS.

Given the following information:

Reactor core rated thermal power	=	2,950 MW
Core decay heat rate	=	0.5% rated thermal power
RHR system heat removal rate	=	5.7×10^7 Btu/hr
RHR and reactor coolant c_p	=	1.05 Btu/lbm-°F
Combined RCS and RHR inventory	=	450,000 lbm

Which one of the following actions will establish a reactor cooldown rate between 20°F/hour and 30°F/hour?

A. Increase RHR heat exchanger flow rate to increase the cooldown rate by 10°F/hour.

B. Increase RHR heat exchanger flow rate to increase the cooldown rate by 20°F/hour.

C. Reduce RHR heat exchanger flow rate to decrease the cooldown rate by 10°F/hour.

D. Reduce RHR heat exchanger flow rate to decrease the cooldown rate by 20°F/hour.

QUESTION: 17

Refer to the drawing of an operating lube oil heat exchanger (see figure below).

The heat exchanger is operating with the following initial parameters:

Cooling water inlet temperature (T_{cw-in}) = 75°F
Cooling water outlet temperature (T_{cw-out}) = 95°F
Oil inlet temperature (T_{oil-in}) = 150°F
Oil outlet temperature ($T_{oil-out}$) = 110°F

Air leakage into the heat exchanger causes some of the heat exchanger tubes to become uncovered. As a result, T_{cw-out} decreases to 89°F. Assume the inlet temperatures, mass flow rates, and specific heats of both fluids do not change.

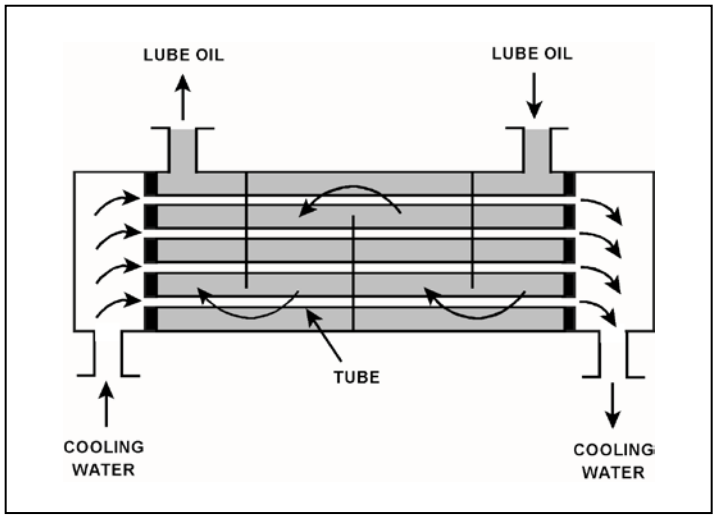
Which one of the following will be the resulting temperature of the lube oil exiting the heat exchanger ($T_{oil-out}$)?

A. 116°F

B. 122°F

C. 130°F

D. 138°F



QUESTION: 18

Mixed-bed demineralizer 1A was removed from service after it became saturated with sodium (Na^+) ions while processing condensate with 10 times the normal sodium concentration. Alternate mixed-bed demineralizer 1B has restored the condensate sodium concentration to normal. Demineralizer 1A has not been processed in any way since being removed from service.

If demineralizer 1A is returned to service to replace demineralizer 1B, the downstream condensate system sodium concentration will...

A. remain the same, because demineralizer 1A can no longer remove any anions from the condensate.

B. remain the same, because demineralizer 1A can no longer remove any cations from the condensate.

C. increase, only due to the water volume contained in demineralizer 1A mixing with the condensate influent.

D. increase, due to both the water volume contained in demineralizer 1A mixing with the condensate influent and the release of sodium ions from the resin.

QUESTION: 19

A nuclear power plant was operating at steady-state 100 percent power when the reactor coolant system experienced a large crud burst. After 20 minutes, the operators began to record parameters for the in-service reactor coolant purification ion exchanger.

Assuming no additional operator actions, what trend will the recorded parameters show during the next few hours?

A. Increasing ion exchanger inlet water conductivity.

B. Increasing ion exchanger outlet water conductivity.

C. Increasing flow rate through the ion exchanger.

D. Increasing pressure drop across the ion exchanger.

QUESTION: 20

Two identical 1,000 MW generators are operating in parallel, supplying the same isolated electrical bus. The generator output breakers provide identical protection for the generators. Generator A and B output indications are as follows:

Generator A	Generator B
22.5 KV	22.5 KV
60.2 Hertz	60.2 Hertz
750 MW	750 MW
25 MVAR (out)	50 MVAR (out)

A malfunction causes the voltage regulator setpoint for generator B to slowly and continuously increase. If no operator action is taken, which one of the following describes the electrical current indications for generator A?

A. Current will decrease continuously until the output breaker for generator A trips on reverse power.

B. Current will decrease continuously until the output breaker for generator B trips on reverse power.

C. Current will initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

D. Current will initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

QUESTION: 21

A 480 VAC motor control center supplies a load through a breaker and a manual disconnect switch. Which one of the following sequences will provide the greatest level of personnel safety when deenergizing the load for maintenance and when reenergizing the load after the maintenance?

	DEENERGIZING	REENERGIZING
A.	Open breaker first	Shut breaker first
B.	Open breaker first	Shut disconnect switch first
C.	Open disconnect switch first	Shut breaker first
D.	Open disconnect switch first	Shut disconnect switch first

QUESTION: 22

While remotely investigating the condition of a normally-open 480 VAC motor control center (MCC) feeder breaker, an operator observes the following indications:

Green breaker position indicating light is out.
Red breaker position indicating light is lit.
MCC voltmeter indicates 480 VAC.
MCC ammeter indicates zero amperes.

Based on these indications, the operator should report that the feeder breaker is _____ and racked _____.

A. open; in

B. closed; in

C. open; to an unknown position

D. closed; to an unknown position

QUESTION: 23

Delayed neutrons are fission neutrons that...

A. are released at the instant of fission.

B. are responsible for the majority of U-235 fissions.

C. have reached thermal equilibrium with the surrounding medium.

D. are expelled at a lower average kinetic energy than most other fission neutrons.

QUESTION: 24

A 1.5 MeV neutron is about to interact with a U-238 nucleus in an operating reactor. Which one of the following describes the most likely interaction and its effect on K_{eff}?

A. The neutron will be scattered, thereby leaving K_{eff} unchanged.

B. The neutron will be absorbed and the nucleus will fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and the nucleus will fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and the nucleus will decay to Pu-239, thereby increasing K_{eff}.

QUESTION: 25

Two identical reactors, A and B, with identical fuel compositions, are initially critical at 1.0×10^{-8} percent power. Then, suddenly and simultaneously, positive 0.001 $\Delta K/K$ is added to reactor A while negative 0.001 $\Delta K/K$ is added to reactor B.

One minute later, which reactor will have the shorter period, and why? (Note: λ_{eff} is the effective delayed neutron precursor decay constant.)

A. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is positive.

B. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is positive.

C. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is negative.

D. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is negative.

QUESTION: 26

Which one of the following describes a situation where an increase in moderator temperature can add positive reactivity?

A. At low moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

B. At low moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

C. At high moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

D. At high moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

QUESTION: 27

The following are the initial conditions for a nuclear power plant:

- Reactor power is 50 percent.
- Average reactor coolant temperature is 570°F.
- Reactor coolant boron concentration is 400 ppm.

After a power increase, the current plant conditions are as follows:

- Reactor power is 80 percent.
- Average reactor coolant temperature is 582°F.
- Reactor coolant boron concentration is 400 ppm.

Which one of the following describes the current differential boron worth (DBW) in ΔK/K/ppm compared to the initial DBW?

A. The current DBW is more negative because a 1°F increase in reactor coolant temperature will remove more boron-10 atoms from the core.

B. The current DBW is more negative because a 1 ppm increase in reactor coolant boron concentration will add more boron-10 atoms to the core.

C. The current DBW is less negative because a 1°F increase in reactor coolant temperature will remove fewer boron-10 atoms from the core.

D. The current DBW is less negative because a 1 ppm increase in reactor coolant boron concentration will add fewer boron-10 atoms to the core.

QUESTION: 28

A reactor has been operating at 100 percent power for three weeks shortly after a refueling outage. All control rods are fully withdrawn. Which one of the following describes why most of the power is being produced in the lower half of the core?

A. The fuel loading in the lower half of the core contains a higher U-235 enrichment.

B. Reactor coolant boron is adding more negative reactivity in the upper half of the core.

C. There is a greater concentration of Xe-135 in the upper half of the core.

D. The moderator temperature coefficient of reactivity is adding more negative reactivity in the upper half of the core.

QUESTION: 29

Why are control rod insertion limits established for power operation?

A. To minimize the worth of a dropped control rod.

B. To maintain a negative moderator temperature coefficient.

C. To provide adequate shutdown margin after a reactor trip.

D. To ensure sufficient positive reactivity is available to compensate for the existing power defect.

QUESTION: 30

A reactor is initially operating at 80 percent power with equilibrium xenon-135. Power is increased to 100 percent over a two-hour period and average reactor coolant temperature is adjusted to 585°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 24 hours after the power change is completed?

A. Less than 585°F and decreasing slowly.

B. Less than 585°F and increasing slowly.

C. Greater than 585°F and decreasing slowly.

D. Greater than 585°F and increasing slowly.

QUESTION: 31

A reactor trip occurred one hour ago following several months of operation at 100 percent power. Reactor coolant temperature is being maintained at 550°F and the source range count rate is currently 400 cps. If no additional operator action is taken, how will the source range count rate respond during the next 24 hours? (Assume a constant source neutron flux.)

A. The count rate will remain about the same.

B. The count rate will decrease for the entire period.

C. The count rate will initially decrease and then increase.

D. The count rate will initially increase and then decrease.

QUESTION: 32

Why are burnable poisons installed in a new reactor core instead of simply using a higher reactor coolant boron concentration for reactivity control?

A. To prevent boron precipitation during normal operation.

B. To establish a more negative moderator temperature coefficient.

C. To minimize the distortion of the neutron flux distribution caused by soluble boron.

D. To allow the loading of excessive reactivity in the form of higher fuel enrichment.

QUESTION: 33

A reactor startup is in progress with the reactor currently subcritical.

Which one of the following describes the change in source range count rate resulting from a short control rod withdrawal with K_{eff} at 0.95 compared to an identical control rod withdrawal with K_{eff} at 0.98? (Assume the reactivity additions are equal and the reactor remains subcritical.)

A. Both the prompt jump in count rate and the increase in stable count rate will be the same for both values of K_{eff}.

B. Both the prompt jump in count rate and the increase in stable count rate will be smaller with K_{eff} at 0.95.

C. The prompt jump in count rate will be smaller with K_{eff} at 0.95, but the increase in stable count rates will be the same.

D. The prompt jump in count rates will be the same, but the increase in stable count rate will be smaller with K_{eff} at 0.95.

QUESTION: 34

During a reactor startup, as K_{eff} increases toward 1.0 the value of 1/M...

A. increases toward 1.0.

B. increases toward infinity.

C. decreases toward 1.0.

D. decreases toward zero.

QUESTION: 35

A reactor is operating at steady-state 80 percent power near the end of a fuel cycle with a symmetrical axial power distribution peaked at the core midplane. Control rods are in manual control.

If the reactor coolant system (RCS) boron concentration is increased by 10 ppm, the axial power distribution will shift toward the _____ of the core. Then, if the control rods are repositioned to return RCS temperatures to normal for 80 percent power, the axial power distribution will shift toward the _____ of the core.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

QUESTION: 36

A nuclear power plant has been operating at 100 percent power for six months when a reactor trip occurs. Which one of the following describes the source(s) of core heat generation 1 minute after the reactor trip?

A. Fission product decay is the only heat source capable of increasing fuel temperature.

B. Delayed neutron-induced fission is the only heat source capable of increasing fuel temperature.

C. Both fission product decay and delayed neutron-induced fission are capable of increasing fuel temperature.

D. Neither fission product decay nor delayed neutron-induced fission are capable of increasing fuel temperature.

QUESTION: 37

Which one of the following is arranged from the lowest pressure to the highest pressure?

A. 2 psig, 12 inches Hg absolute, 8 psia

B. 2 psig, 18 inches Hg absolute, 8 psia

C. 12 psia, 20 inches Hg absolute, 2 psig

D. 12 psia, 30 inches Hg absolute, 2 psig

QUESTION: 38

Consider a saturated steam-water mixture with a quality of 99 percent. If pressure remains constant and heat is removed from the mixture, the temperature of the mixture will _____; and the quality of the mixture will _____. (Assume the mixture remains saturated.)

A. decrease; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

QUESTION: 39

A nuclear power plant has been operating at full power for six months when a sustained station blackout occurs, resulting in a reactor trip and a complete loss of forced reactor coolant circulation. All means of reactor coolant injection and steam generator heat removal are unavailable. Reactor coolant system (RCS) pressure is being maintained at approximately 2,100 psia by operation of the pressurizer relief valves.

The following conditions exist five minutes after the reactor trip:

RCS pressure	= 2,100 psia
Core exit thermocouple (CET) temperature	= 550°F

With RCS pressure constant at 2,100 psia, which one of the following describes the future response of the CET temperature indication?

A. CET indication will remain stable at approximately 550°F until the core becomes uncovered; then, CET indication will become erratic.

B. CET indication will remain stable at approximately 550°F until the core becomes uncovered; then, CET indication will increase to approximately 643°F where it will become erratic.

C. CET indication will steadily increase to approximately 643°F and stabilize; then, as the core begins to uncover, CET indication will increase further until it becomes erratic.

D. CET indication will steadily increase until it becomes erratic.

QUESTION: 40

A nuclear power plant is operating at 100 percent power. Steam is escaping to atmosphere through a flange leak in a steam supply line to the low pressure section of the main turbine.

Given:

- Steam line pressure is 300 psia.
- Steam line steam temperature is 440°F.

What is the approximate temperature of the steam as it reaches standard atmospheric pressure?

A. 212°F

B. 268°F

C. 322°F

D. 358°F

QUESTION: 41

Which one of the following will be caused by a <u>decrease</u> in main condenser vacuum (higher absolute pressure) in a nuclear power plant operating at 100 percent power? (Assume that main steam and main condenser circulating water mass flow rates do <u>not</u> change.)

A. Decrease in the condensate temperature.

B. Decrease in the ideal steam cycle thermal efficiency.

C. Decrease in the condensate pump required net positive suction head.

D. Decrease in the mass of noncondensible gases in the condenser.

QUESTION: 42

A steam generator transient causes main steam pressure to increase although the actual mass flow rate of steam remains constant. If the main steam flow instrument is <u>not</u> density compensated, the increased main steam pressure will cause indicated steam mass flow rate to...

A. increase, due to a higher steam velocity.

B. increase, due to a greater steam density.

C. decrease, due to a lower steam velocity.

D. decrease, due to a reduced steam density.

QUESTION: 43

Refer to the drawing of an operating cooling water system (see figure below).

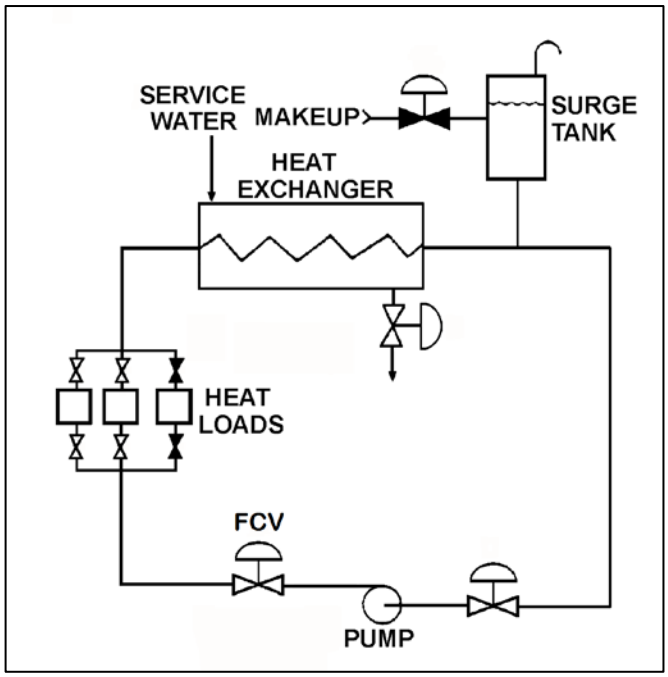
The pump is initially operating with the flow control valve (FCV) fully open. If the FCV is partially closed to decrease system flow rate, the pump differential pressure will _____; and the heat exchanger cooling water differential pressure will _____.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease



QUESTION: 44

A reactor is currently producing 200 MW of core thermal power. Reactor coolant pumps are adding an additional 10 MW of thermal power to the reactor coolant system. The core is rated at 1,330 MW.

Which one of the following is the current core thermal power output in percent?

A. 14.0 percent

B. 14.3 percent

C. 15.0 percent

D. 15.8 percent

QUESTION: 45

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel assembly if reactor coolant enters the fuel assembly as subcooled water and exits as superheated steam?

A. Increases continuously.

B. Increases, then decreases.

C. Decreases continuously.

D. Decreases, then increases.

QUESTION: 46

Which one of the following describes the heat transfer from a fuel rod experiencing departure from nucleate boiling? (Note: ΔT refers to the difference between the fuel rod surface temperature and the bulk coolant saturation temperature.)

A. Steam bubbles begin to blanket the fuel rod surface, causing a rapid increase in the ΔT for a given heat flux.

B. Steam bubbles completely blanket the fuel rod surface, causing a rapid decrease in the ΔT for a given heat flux.

C. Steam bubbles begin to form on the fuel rod surface, causing a rapid increase in the heat flux from the fuel rod for a given ΔT.

D. Steam bubbles completely blanket the fuel rod surface, causing a rapid increase in the heat flux from the fuel rod for a given ΔT.

QUESTION: 47

A nuclear power plant is operating with the following initial conditions:

- Reactor power is 45 percent in the middle of a fuel cycle.
- Axial and radial power distributions are peaked in the center of the core.

Which one of the following will decrease the steady-state departure from nucleate boiling ratio?

A. A reactor trip occurs and one control rod remains fully withdrawn from the core.

B. A pressurizer malfunction decreases reactor coolant system pressure by 20 psig.

C. The operator increases reactor coolant boron concentration by 5 ppm with no control rod motion.

D. Core xenon-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

QUESTION: 48

A nuclear power plant was operating at steady-state 100 percent power when a sustained loss of offsite power occurred, which caused a reactor trip and a complete loss of forced reactor coolant flow. Which one of the following combinations of reactor power history and post-trip steam generator pressure will result in the smallest stable natural circulation flow rate?

	Days At 100 Percent Power	Post-trip Steam Generator Pressure
A.	10	1,100 psia
B.	80	1,100 psia
C.	10	900 psia
D.	80	900 psia

QUESTION: 49

If fuel pellet densification occurs in a fuel rod producing a constant power output, the average linear power density in the fuel rod will _____ because pellet densification causes fuel pellets to _____.

A. decrease; swell

B. decrease; shrink

C. increase; swell

D. increase; shrink

QUESTION: 50

A reactor is shut down for refueling following 18 months of operation at an average power level of 85 percent. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The testing determined that the nil-ductility transition (NDT) temperature of the specimen increased from 42°F to 44°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is more susceptible to brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is less susceptible to brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the vessel NDT temperature would not increase during the described 18-month period of operation.

D. The test results are questionable because the vessel NDT temperature would increase by at least 10°F during the described 18-month period of operation.

***** FINAL ANSWER KEY *****

DECEMBER 2016 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

FORM A	FORM B	ANS.	FORM A	FORM B	ANS.
1	15	B	26	40	B
2	16	B	27	41	D
3	17	A	28	42	D
4	18	B or C	29	43	C
5	19	A	30	44	A
6	20	D	31	45	C
7	21	C	32	46	B
8	22	C	33	47	B
9	23	B	34	48	D
10	24	A	35	49	A
11	25	A	36	50	C
12	26	C	37	1	D
13	27	C	38	2	D
14	28	A	39	3	C
15	29	C	40	4	D
16	30	A	41	5	B
17	31	B	42	6	C
18	32	D	43	7	B
19	33	D	44	8	C
20	34	D	45	9	B
21	35	B	46	10	A
22	36	B	47	11	B
23	37	D	48	12	A
24	38	A	49	13	D
25	39	A	50	14	A