

**UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011--FORM A**

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

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.

Applicant's Signature

**RULES AND INSTRUCTIONS FOR THE NRC
GENERIC FUNDAMENTALS EXAMINATION**

During the administration of this examination the following rules apply:

NOTE: The generic 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 of 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 HANDOUT SHEET**

EQUATIONS

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

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

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

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

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

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

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

$$\text{SUR} = 26.06/\tau$$

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

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

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

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

$$\text{DRW} \propto \phi_{\text{tip}}^2 / \phi_{\text{avg}}^2$$

$$A = A_0 e^{-\lambda t}$$

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

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

$$\text{CR}_{\text{S/D}} = S/(1 - K_{\text{eff}})$$

$$\text{CR}_1(1 - K_{\text{eff}1}) = \text{CR}_2(1 - K_{\text{eff}2})$$

$$1/M = \text{CR}_1/\text{CR}_X$$

$$A = \pi r^2$$

$$F = PA$$

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

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

$$P = IE$$

$$P_A = \sqrt{3} IE$$

$$P_T = \sqrt{3} IE \text{ pf}$$

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

$$\text{Thermal Efficiency} = \text{Net Work Out}/\text{Energy In}$$

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

$$g_c = 32.2 \text{ lbm-ft/lbf-sec}^2$$

CONVERSIONS

$$1 \text{ Mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

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

$$1 \text{ Btu} = 778 \text{ ft-lbf}$$

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

$$^{\circ}\text{F} = (9/5)(^{\circ}\text{C}) + 32$$

$$1 \text{ kg} = 2.21 \text{ lbm}$$

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

$$1 \text{ gal}_{\text{water}} = 8.35 \text{ lbm}$$

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 1

A completely full water tank is being hydrostatically tested to 180 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 6 gpm. The tank is protected by two relief valves that discharge to the atmosphere. The relief valves have the following characteristics:

- Relief valve A opening setpoint is 180 psig with an accumulation of 5 percent.
- Relief valve B opening setpoint is 200 psig with an accumulation of 5 percent.
- Each relief valve has linear flow rate characteristics and a maximum flow rate of 4 gpm.

The PDP is inadvertently left running when tank pressure reaches 180 psig.

With the PDP still running, at what pressure will the tank stabilize?

- A. 190 psig
- B. 195 psig
- C. 205 psig
- D. 210 psig

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QUESTION: 2

In a comparison between butterfly valves and ball valves, _____ valves are generally more leak tight in high pressure applications; and _____ valves generally exhibit the lower system pressure drop when fully open.

- A. ball; ball
- B. ball; butterfly
- C. butterfly; ball
- D. butterfly; butterfly

QUESTION: 3

Subcooled water is flowing through each of the following devices. Which one of the devices will produce an outlet pressure that is greater than the inlet pressure?

- A. Convergent nozzle
- B. Divergent nozzle
- C. Orifice
- D. Flow restrictor

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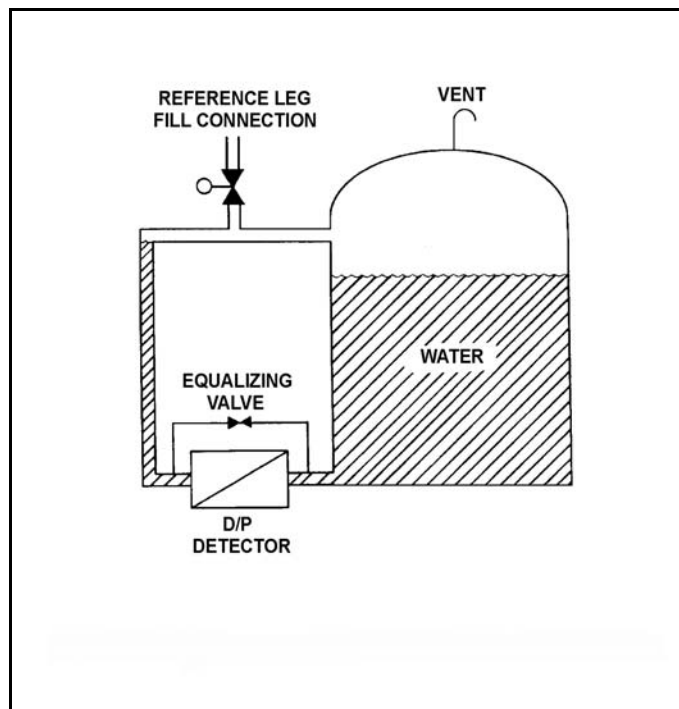
QUESTION: 4

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

Assume that the initial temperature of the reference leg and the water in the tank is 100°F, and that reference leg temperature does not change.

If the temperature of the water in the tank increases by 20°F, the D/P sensed by the detector will _____ if the _____ of the water in the tank is constant.

- A. decrease; level
- B. decrease; mass
- C. remain the same; level
- D. remain the same; mass



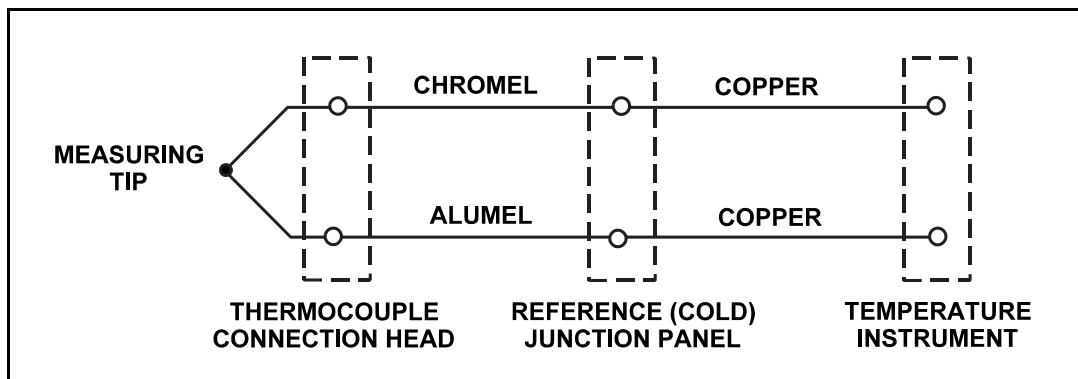
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QUESTION: 5

Refer to the drawing of a simple chromel-alumel thermocouple circuit (see figure below).

What is the effect on the thermocouple reference junctions if the chromel and alumel extension wires from the thermocouple connection head to the reference junction panel are replaced with copper wires?

- A. The reference junctions will be located in the thermocouple connection head.
- B. The reference junctions will still be located in the reference junction panel.
- C. The reference junctions will be located in the temperature instrument.
- D. There will no longer be any reference junctions.



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QUESTION: 6

Which one of the following describes a characteristic of a self-reading pocket dosimeter?

- A. Provides dose rate indication in mR/hr.
- B. More sensitive to gamma radiation than beta radiation.
- C. Contains crystals that luminesce when exposed to ionizing radiation.
- D. Can be stored as an accurate record of lifetime radiation exposure.

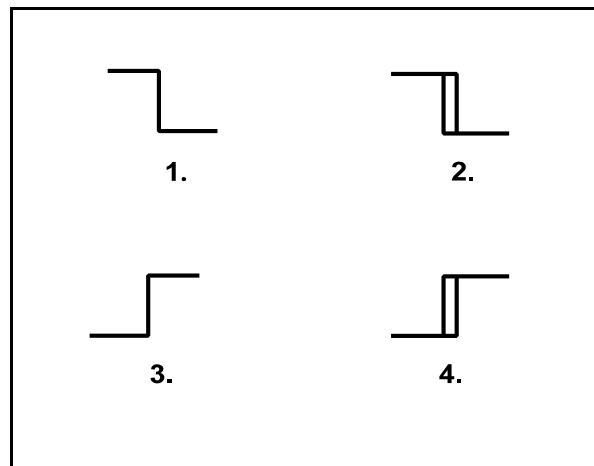
QUESTION: 7

Refer to the drawing of four bistable symbols (see figure below).

A temperature controller uses a bistable that turns on to actuate a warning light when the controlled temperature reaches a low setpoint. The bistable turns off to extinguish the warning light when the temperature increases to 5°F above the low setpoint.

Which one of the following bistable symbols indicates the characteristics of the bistable?

- A. 1.
- B. 2.
- C. 3.
- D. 4.



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QUESTION: 8

A diesel generator (DG) is supplying an isolated electrical bus with the DG governor operating in the speed droop mode. Assuming the DG does not trip, if a large electrical bus load trips, bus frequency will initially...

- A. decrease, then increase and stabilize below the initial value.
- B. decrease, then increase and stabilize above the initial value.
- C. increase, then decrease and stabilize below the initial value.
- D. increase, then decrease and stabilize above the initial value.

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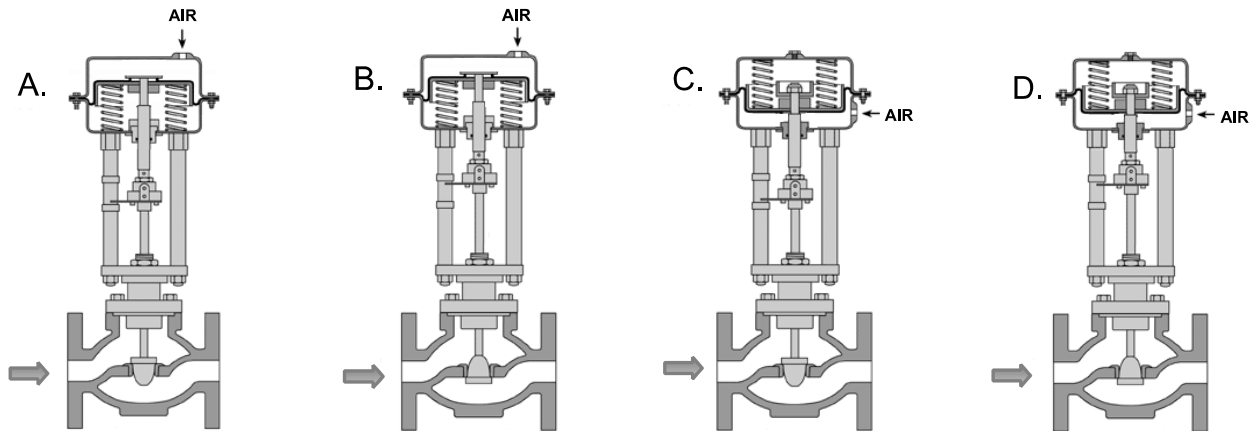
QUESTION: 9

Given:

- A reverse-acting proportional controller will be used to maintain level in a water storage tank by positioning an air-operated makeup water flow control valve.
- The controller input varies directly with water level.

Which of the following flow control valves will be compatible with the controller in this application?

- A. A and B
- B. B and C
- C. C and D
- D. D and A



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QUESTION: 10

By starting a centrifugal pump with the discharge valve throttled versus fully open, the possibility of pump runout is _____ , and the possibility of pump cavitation is _____ .

- A. increased; decreased
- B. increased; increased
- C. decreased; decreased
- D. decreased; increased

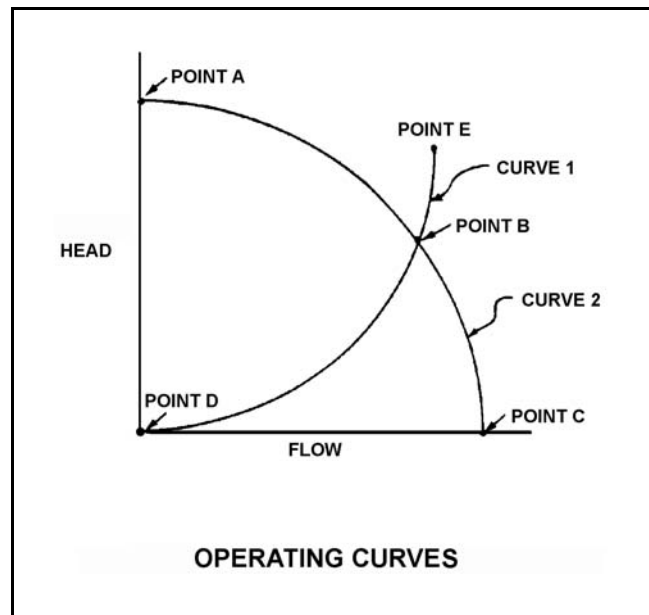
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QUESTION: 11

A centrifugal pump is located adjacent to the bottom of an open water storage tank. The pump is taking suction from a river and discharging to the bottom of the tank. Initially the tank was empty and the pump was operating at point B on the drawing below.

When tank water level reaches 30 feet, the new pump operating point will be located on curve _____, closer to point _____ . (Assume that no other changes occur in the system.)

- A. 1; D
- B. 2; A
- C. 1; E
- D. 2; C



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QUESTION: 12

A centrifugal firewater pump is operating to pressurize a fire main. The pump takes suction from a water reservoir. A fire hose connected to the fire main is being used to suppress an elevated fire.

Given:

- The eye of the pump impeller is located 5 feet above the reservoir water level.
- The pump has a design shutoff head of 120 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60°F.

At which one of the following elevations above the eye of the pump impeller will the fire hose spray nozzle first be unable to provide flow? (Disregard all sources of head loss.)

- A. 111 feet
- B. 116 feet
- C. 121 feet
- D. 126 feet

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QUESTION: 13

When starting a positive displacement pump, why must the pump discharge valve be fully open?

- A. Prevents pump cavitation.
- B. Reduces motor starting current.
- C. Minimizes the potential for water hammer.
- D. Ensures integrity of the pump and system piping.

QUESTION: 14

A nuclear power plant is operating normally at 80 percent power when a reactor coolant pump (RCP) shaft seizes. Which one of the following indications would not accompany the seized shaft?

- A. Reactor coolant system pressure transient.
- B. Decreased flow rate in the associated reactor coolant loop.
- C. Decreased flow rate in the remaining reactor coolant loop(s).
- D. Increased current to the affected RCP with possible breaker trip.

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QUESTION: 15

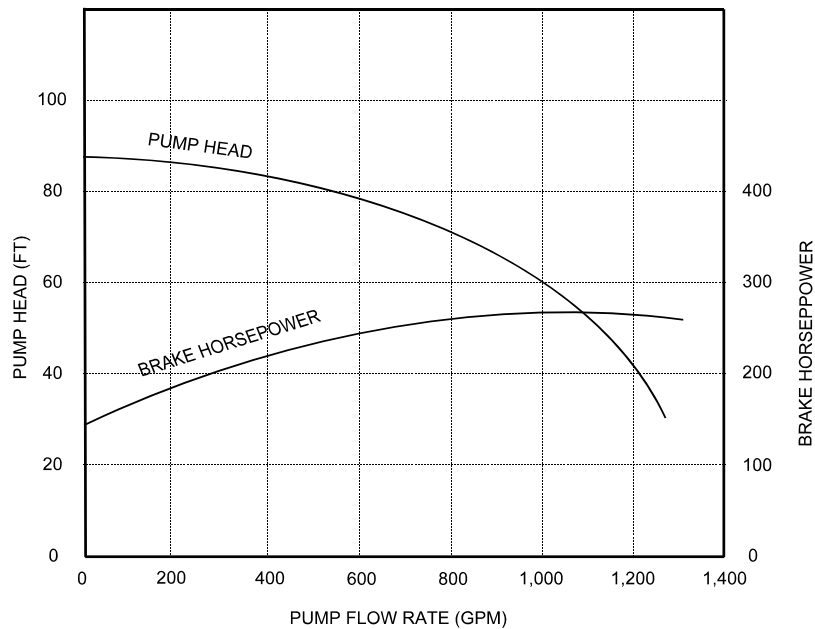
Refer to the pump performance curves for a centrifugal cooling water pump (see figure below). The pump is being driven by a single-speed ac induction motor. Pump flow rate is being controlled by a throttled discharge flow control valve.

The following initial pump conditions exist:

Pump motor current: 50 amps
Pump flow rate: 400 gpm

If the flow control valve is repositioned such that pump flow rate is now 800 gpm, what will be the approximate new pump motor current?

- A. Less than 100 amps
- B. 200 amps
- C. 400 amps
- D. More than 500 amps



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QUESTION: 16

A nuclear power plant 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.

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:	5.3×10^7 Btu/hr
Reactor coolant c_p :	1.05 Btu/lbm-°F
Combined RCS and RHR inventory:	425,000 lbm

Which one of the following actions will establish an RCS 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.

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QUESTION: 17

Steam has been admitted to a main condenser for 25 minutes with no cooling water flow. Initiating full cooling water flow rate at this time will...

- A. reduce the stress on the condenser shell by rapidly cooling the shell.
- B. reduce the stress on the condenser tubes by rapidly cooling the tubes.
- C. induce large thermal stresses on the condenser shell.
- D. induce large thermal stresses on the junctions between the condenser tubes and the tubesheet.

QUESTION: 18

Two indications of channeling through an operating demineralizer are a _____-than-normal demineralizer differential pressure and a _____-than-normal demineralization factor.

- A. higher; lower
- B. higher; higher
- C. lower; lower
- D. lower; higher

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QUESTION: 19

Reactor coolant is flowing through a mixed-bed ion exchanger. The ion exchanger is boron saturated. Which one of the following describes a condition that will result in the boron concentration of the ion exchanger outlet water being greater than the boron concentration of the inlet water?

- A. A decrease in the temperature of the inlet water will lower the relative affinity of the resin for the borate ions, which releases borate ions from the resin exchange sites.
- B. A decrease in the flow rate through the ion exchanger will lower the retention capacity of the resin, which releases borate ions from the resin exchange sites.
- C. An increase in reactor coolant suspended solids with greater mass than the borate ions will mechanically remove borate ions from the resin exchange sites.
- D. An increase in reactor coolant ionic impurities with higher relative affinities for the resin exchange sites will displace borate ions from the resin exchange sites.

QUESTION: 20

Which one of the following describes the local overcurrent trip flag indicators for a breaker?

- A. They actuate prior to breaker tripping to warn of imminent protective action.
- B. They indicate breaker overcurrent trip actuation during and after breaker trip actuation.
- C. When actuated, they indicate that the associated breaker has failed to trip open.
- D. When actuated, they indicate that the breaker overcurrent trip relay has been reset.

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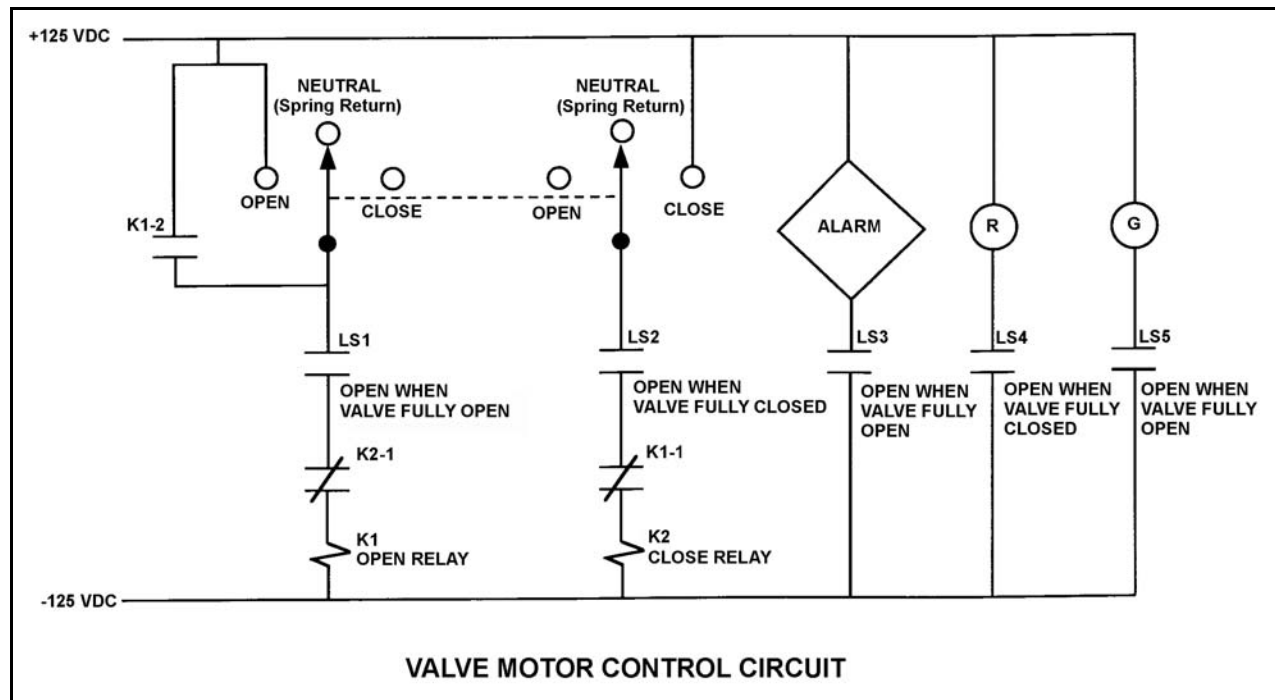
QUESTION: 21

Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully open and has a 10-second stroke time. Limit switch LS2 has failed open.

Note: Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts are shown open/closed according to the standard convention for control circuit drawings.

Which one of the following describes the valve response if the control switch is taken to the “Close” position for 2 seconds and then released?

- A. The valve will not move.
- B. The valve will close fully.
- C. The valve will begin to close and then stop moving.
- D. The valve will begin to close and then open fully.



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QUESTION: 22

The main generator output breaker is about to be closed to connect the main generator to the power grid via the main transformer. The main transformer voltage and frequency are as follows:

Voltage: 20,000 volts
Frequency: 60.0 Hz

Which combination of main generator voltage and frequency will ensure that the main generator will immediately supply real (MW) and reactive (MVAR) electrical power to the power grid when the main generator output breaker is closed?

- A. 19,950 volts; 59.9 Hz
- B. 19,950 volts; 60.1 Hz
- C. 20,050 volts; 59.9 Hz
- D. 20,050 volts; 60.1 Hz

QUESTION: 23

During a brief time interval in a typical commercial nuclear reactor operating near the beginning of a fuel cycle, 1.0×10^3 delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted during this same time interval?

- A. 1.5×10^5
- B. 6.5×10^6
- C. 1.5×10^7
- D. 6.5×10^8

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QUESTION: 24

A nuclear power plant is operating at 100 percent power with rod control in Manual. If no operator action is taken, then during the next two weeks of steady-state operation at 100 percent power, shutdown margin will...

- A. continuously increase.
- B. continuously decrease.
- C. initially increase, then return to the same value.
- D. initially decrease, then return to the same value.

QUESTION: 25

During a nuclear reactor startup, reactor power increases from 1.0×10^{-8} percent to 2.0×10^{-8} percent in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

- A. 173 seconds
- B. 235 seconds
- C. 300 seconds
- D. 399 seconds

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QUESTION: 26

Under which one of the following conditions is the nuclear reactor most likely to have a positive moderator temperature coefficient?

- A. High reactor coolant temperature at the beginning of a fuel cycle.
- B. High reactor coolant temperature at the end of a fuel cycle.
- C. Low reactor coolant temperature at the beginning of a fuel cycle.
- D. Low reactor coolant temperature at the end of a fuel cycle.

QUESTION: 27

A nuclear reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction caused a rod withdrawal that increased reactivity by $0.14\% \Delta K/K$.

Given:

- All control rod motion has stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals $-0.028\% \Delta K/K$ per % power.
- Core effective delayed neutron fraction equals 0.006.

Assuming the reactor does not trip, what is the approximate reactor power level increase required to offset the reactivity added by the control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

- A. 2.0 percent
- B. 5.0 percent
- C. 20 percent
- D. 50 percent

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QUESTION: 28

A nuclear reactor is initially critical below the point of adding heat with a constant reactor coolant temperature. If control rods are manually inserted for 5 seconds, reactor power will decrease...

- A. to a shutdown power level low in the source range.
- B. temporarily, then return to the original value due to the resulting decrease in moderator temperature.
- C. until inherent positive reactivity feedback causes the reactor to become critical at a lower neutron level.
- D. temporarily, then return to the original value due to subcritical multiplication.

QUESTION: 29

The purposes of using control rod bank overlap are to...

- A. provide a more uniform axial power distribution and to provide a more uniform differential rod worth.
- B. provide a more uniform differential rod worth and to provide a more uniform radial power distribution.
- C. provide a more uniform radial power distribution and to maintain individual and group rod position indicators within allowable tolerances.
- D. maintain individual and group rod position indicators within allowable tolerances and to provide a more uniform axial power distribution.

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QUESTION: 30

A nuclear reactor has been operating at full power for several weeks. Xenon-135 is being directly produced as a fission product in approximately _____ percent of all fissions.

- A. 0.3
- B. 3.0
- C. 30
- D. 100

QUESTION: 31

A nuclear reactor is initially operating at 80 percent power with equilibrium core xenon-135. Power is increased to 100 percent over a 2-hour period and average reactor coolant temperature is adjusted to 585°F using control rods. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core 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.

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QUESTION: 32

Which one of the following is not a function performed by burnable poisons in an operating nuclear reactor?

- A. Provide neutron flux shaping.
- B. Provide more uniform power density.
- C. Offset the effects of control rod burnout.
- D. Allow higher fuel enrichment of initial core load.

QUESTION: 33

Which one of the following describes the change in neutron count rate resulting from a short control rod withdrawal with K_{eff} at 0.95 as compared to an identical control rod withdrawal with K_{eff} at 0.99? (Assume the reactivity additions are equal, and the reactor remains subcritical.)

- A. The prompt jump in count rate will be the same, and the increase in count rate will be the same.
- B. The prompt jump in count rate will be greater with K_{eff} at 0.99, but the increase in count rate will be the same.
- C. The prompt jump in count rate will be the same, but the increase in count rate will be greater with K_{eff} at 0.99.
- D. The prompt jump in count rate will be greater, and the increase in count rate will be greater with K_{eff} at 0.99.

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QUESTION: 34

Nuclear reactors A and B are identical except that reactor A has an effective delayed neutron fraction of 0.007 and reactor B has an effective delayed neutron fraction of 0.006. Both reactors are initially critical at 1.0×10^{-8} percent of rated thermal power when $+0.1 \text{ \%}\Delta K/K$ is simultaneously added to both reactors.

Five minutes following the reactivity additions, reactor ____ will be at the higher power level; and reactor ____ will have the higher startup rate.

- A. A; A
- B. A; B
- C. B; A
- D. B; B

QUESTION: 35

A refueling outage has just been completed in which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to mark the beginning of the sixth fuel cycle and reactor power is being increased to 100 percent.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100 percent power?

- A. U-235 and U-238
- B. U-238 and Pu-239
- C. U-235 and Pu-239
- D. U-235 and Pu-241

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QUESTION: 36

After one month of operation at rated thermal power, the fraction of rated thermal power being produced from the decay of fission products in the operating nuclear reactor is...

- A. greater than 10 percent.
- B. greater than 5 percent, but less than 10 percent.
- C. greater than 1 percent, but less than 5 percent.
- D. less than 1 percent.

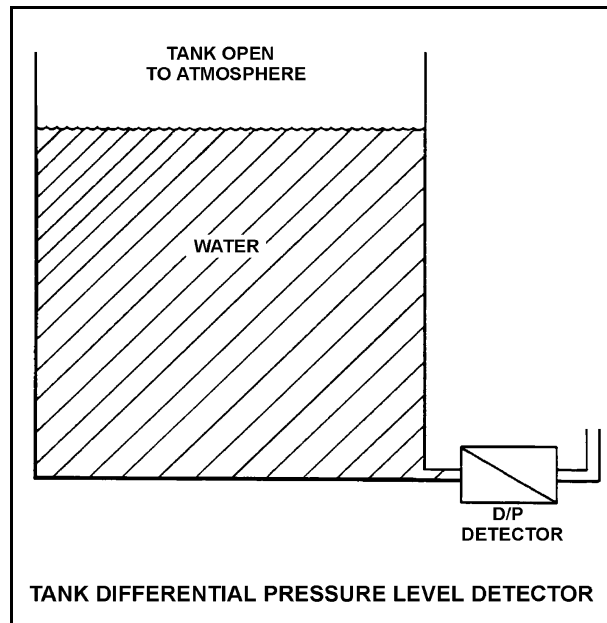
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QUESTION: 37

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

If the tank contains 30 feet of water at 60°F, what is the approximate D/P sensed by the detector?

- A. 7 psid
- B. 13 psid
- C. 20 psid
- D. 28 psid



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QUESTION: 38

A pressurizer is operating in a saturated condition at 636°F. If a sudden pressurizer level decrease of 10 percent occurs, pressurizer pressure will _____ and pressurizer temperature will _____.

- A. remain the same; decrease
- B. remain the same; remain the same
- C. decrease; decrease
- D. decrease; remain the same

QUESTION: 39

Given the following nuclear power plant conditions:

Core Thermal Power = 3,400 MW

RCS T_{ave} = 573.5°F

SG T_{stm} = 513.5°F

A nuclear power plant is shut down for maintenance, during which 5.0 percent of the total steam generator (SG) tubes are plugged. Upon completion of the maintenance, the plant is returned to 3,400 MW with RCS mass flow rate and RCS temperatures unchanged.

Which one of the following is the approximate new SG steam pressure with the plant at 3,400 MW?

- A. 711 psia
- B. 734 psia
- C. 747 psia
- D. 762 psia

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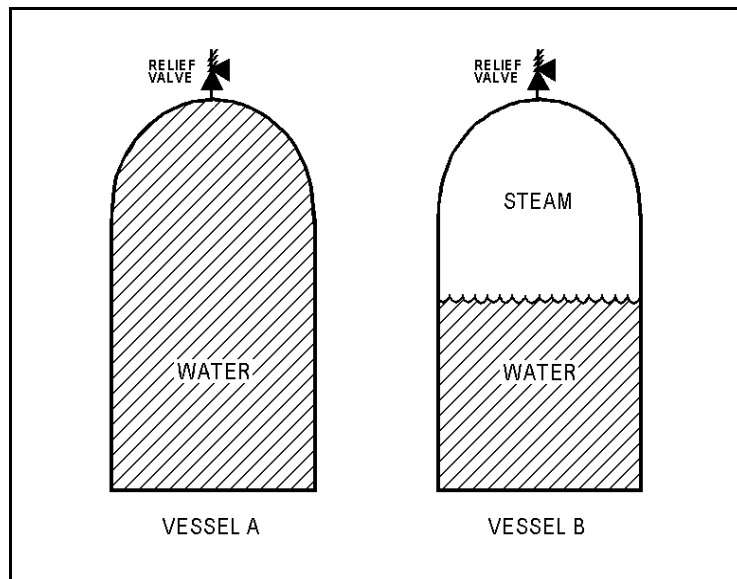
QUESTION: 40

Refer to the drawing of two 1,000 ft³ pressure vessels with installed relief valves (see figure below).

Both vessels are in saturated conditions at 281 °F and approximately 35 psig. Vessel A is completely filled with saturated water. Vessel B contains one-half saturated steam (100 percent quality) volume and one-half saturated water (0 percent quality) volume. Both vessels are protected by identical relief valves.

If both relief valves begin to leak at a rate of 0.1 percent of design flow, the higher temperature fluid will initially be leaving the relief valve of vessel _____. And, if 100 lbm of fluid is released through both relief valves, the larger pressure decrease will occur in vessel _____.

- A. A; A
- B. A; B
- C. B; A
- D. B; B



**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 41

Overall nuclear power plant thermal efficiency will decrease if...

- A. the temperature of the steam at the turbine exhaust increases.
- B. additional moisture is removed from the steam entering the turbine.
- C. the temperature of the feedwater entering the steam generator increases.
- D. the amount of condensate depression (subcooling) in the main condenser decreases.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 42

Refer to the drawing of two lengths of 16-inch diameter pipe, each containing an identical automatic isolation valve. The actual pipe lengths are proportional to their symbols in the drawing.

Water is flowing at 10,000 gpm through each pipe when both isolation valves instantly close.

Consider two cases:

Case 1: The water temperature upstream of both valves is 65°F.

Case 2: The water temperature is 85°F upstream of valve A, and 65°F upstream of valve B.

For which case(s), if any, will valve A experience a pressure spike that is greater than the pressure spike at valve B?

- A. Case 1 only
- B. Case 2 only
- C. Both cases
- D. Neither case



**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 43

A centrifugal pump is operating at a constant speed in an open system with the following initial parameters:

Suction pressure:	10 psig
Discharge pressure:	25 psig
Pump flow rate:	500 gpm

If the pump discharge flow control valve is throttled such that the pump discharge pressure increases to 40 psig, the change in pump flow rate is...

- A. directly proportional to the square of the change in pump differential pressure.
- B. directly proportional to the square root of the change in pump differential pressure.
- C. inversely proportional to the square root of the change in pump differential pressure.
- D. impossible to determine from the provided information.

QUESTION: 44

If excessive amounts of air are entrained/dissolved in the cooling water passing through a single-phase (liquid) heat exchanger, the overall heat transfer coefficient of the heat exchanger will decrease because the...

- A. laminar layer thickness will decrease.
- B. laminar layer thickness will increase.
- C. thermal conductivity of the cooling fluid will decrease.
- D. thermal conductivity of the cooling fluid will increase.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 45

Which one of the following describes why the core heat transfer rate increases when nucleate boiling begins on the surface of a fuel rod?

- A. Steam has a greater thermal conductivity than water.
- B. The formation of steam bubbles increases coolant flow rate along the fuel rod.
- C. Radiative heat transfer begins to supplement convective heat transfer.
- D. Heat transfer by steam bubble formation is more effective than through a liquid film.

QUESTION: 46

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 increase the steady state departure from nucleate boiling ratio?

- A. Core Xe-135 decays with no change in the axial and radial power distributions.
- B. A reactor trip occurs and one control rod remains fully withdrawn from the core.
- C. The operator decreases reactor coolant boron concentration by 5 ppm with no control rod motion.
- D. A pressurizer malfunction decreases reactor coolant system pressure by 20 psig with no control rod motion.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 47

A nuclear reactor had been operating at a constant power level for the last two weeks when a loss of all ac power occurred, thereby causing a reactor trip and a loss of forced reactor coolant flow. Natural circulation reactor coolant flow developed and stabilized 30 minutes after the trip.

Which one of the following combinations of initial reactor power and post-trip steam generator pressure will result in the highest stable natural circulation flow rate 30 minutes after the trip?

	<u>Initial Reactor Power</u>	<u>Post-trip Steam Generator Pressure</u>
A.	100 percent	1,100 psia
B.	25 percent	1,100 psia
C.	100 percent	1,000 psia
D.	25 percent	1,000 psia

QUESTION: 48

A reactor coolant system natural circulation cooldown is in progress using the steam generator (SG) atmospheric steam relief valves, operated in manual control. Assume feed flow rate, relief valve position, and decay heat level remain constant.

If SG tube high point voiding interrupts natural circulation, SG steam flow rate will _____ and core exit thermocouple temperature will _____.

- A. decrease; increase
- B. decrease; remain constant
- C. increase; increase
- D. increase; remain constant

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2011 PWR--FORM A**

QUESTION: 49

A nuclear reactor is operating at 80 percent power near the middle of a fuel cycle. All control rods are fully withdrawn and in manual control. Core axial power distribution is peaked below the core midplane.

Which one of the following will significantly decrease the core maximum axial peaking (or hot channel) factor? (Assume no subsequent operator action is taken and that main turbine load and core xenon distribution do not change unless stated.)

- A. One bank of control rods is inserted 10 percent.
- B. One control rod fully inserts into the core.
- C. Turbine load/reactor power is reduced by 20 percent.
- D. Reactor coolant system boron concentration is reduced by 50 ppm.

QUESTION: 50

Which one of the following comparisons will result in a higher probability of brittle fracture of the reactor vessel?

- A. A high reactor gamma flux rather than a high neutron flux.
- B. A high reactor vessel material strength rather than a high material ductility.
- C. A high reactor coolant oxygen content rather than a low oxygen content.
- D. A rapid 100°F reactor cooldown at a high temperature rather than a low temperature.

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

**MARCH 2011 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY**

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