

**UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004--FORM A**

Please Print

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided. Each item has equal point value. A score of at least 80% is required to pass this portion of the written licensing examination. All examination papers will be collected 3.0 hours after the examination starts. This examination applies to a typical 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 done on this examination is my own. I have neither given nor received aid.

Applicant's Signature

**RULES AND GUIDELINES 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.

1. Print your name in the blank provided on the cover sheet of the examination.
2. Fill in the name of your facility.
3. Fill in your individual docket number.
4. Fill in your start and stop times at the appropriate time.
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 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.
11. Turn in your examination materials, answer sheet on top, followed by the examination booklet, then examination aids - steam table booklets, handouts, and scrap paper used during the examination.
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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

$$\text{Eff.} = \text{Net Work Out/Energy In}$$

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

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

CONVERSIONS

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

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

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

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

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

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

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

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

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

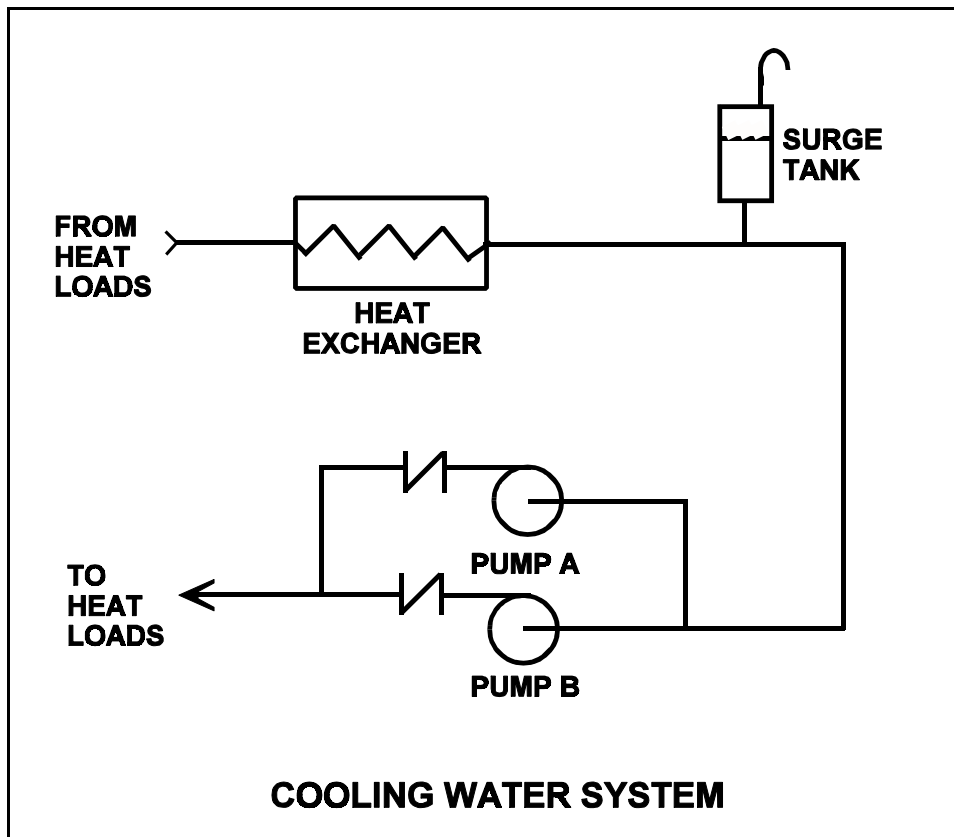
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QUESTION: 1

Refer to the drawing of a cooling water system in which both centrifugal pumps A and B are operating (see figure below).

An operator stops pump B, but the pump B check valve fails to close. In comparison to normal operation with only pump A running, operation with the failed pump B check valve will result in pump A flow rate being _____ than normal; and heat exchanger flow rate being _____ than normal.

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



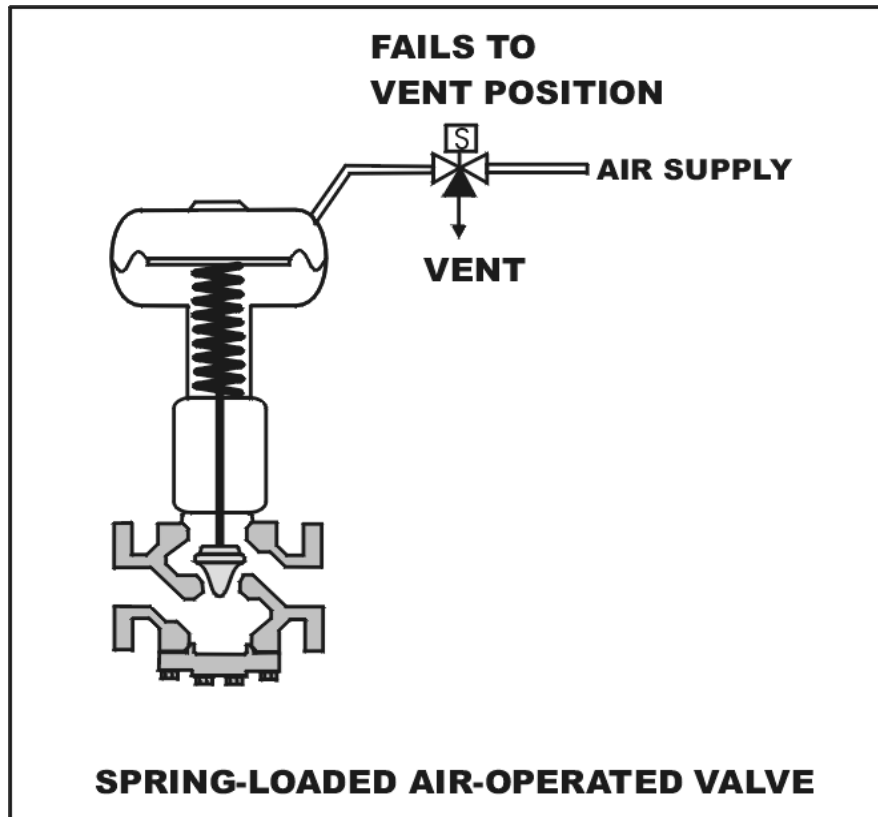
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QUESTION: 2

Refer to the drawing of a spring-loaded air-operated valve shown in a throttled position (see figure below).

The figure currently depicts normal air supply pressure and an energized solenoid. What will be the valve position following a loss of electrical power to the solenoid?

- A. As is
- B. More open
- C. More closed
- D. Varies with system flow



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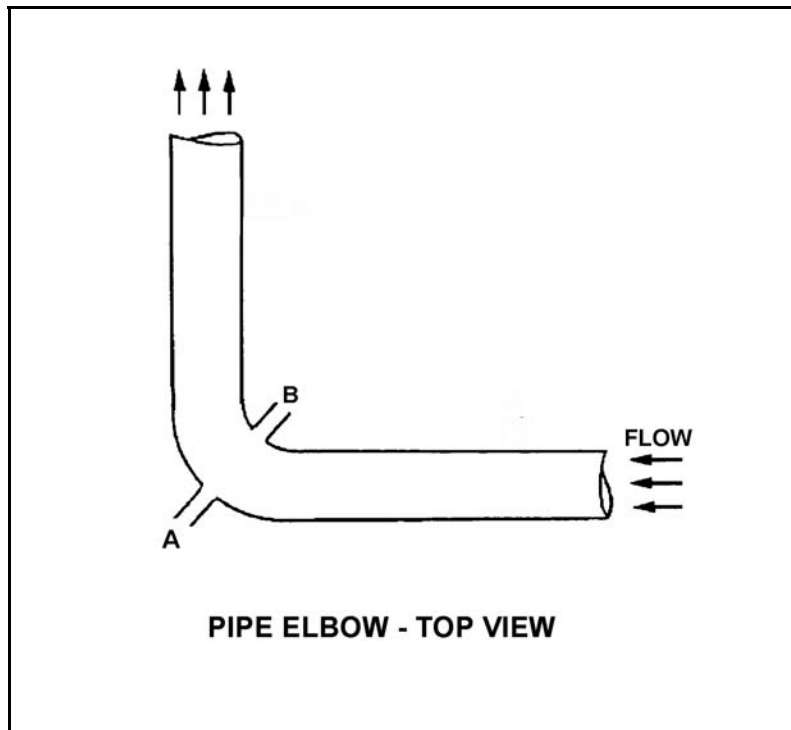
QUESTION: 3

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line A develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

- A. increase; larger
- B. increase; smaller
- C. decrease; larger
- D. decrease; smaller



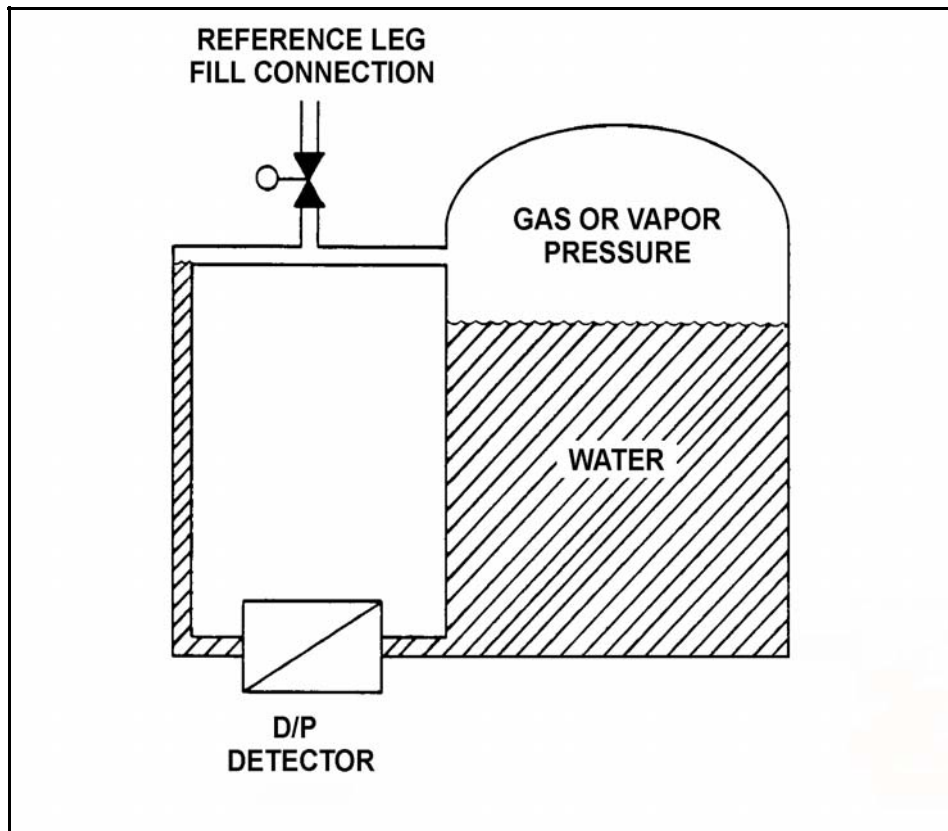
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QUESTION: 4

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

The level instrument has just been calibrated to read actual tank water level. If the reference leg subsequently experiences high ambient temperature, indicated level will...

- A. equal the actual level.
- B. read less than the actual level.
- C. read greater than the actual level.
- D. drift above and below the actual level.



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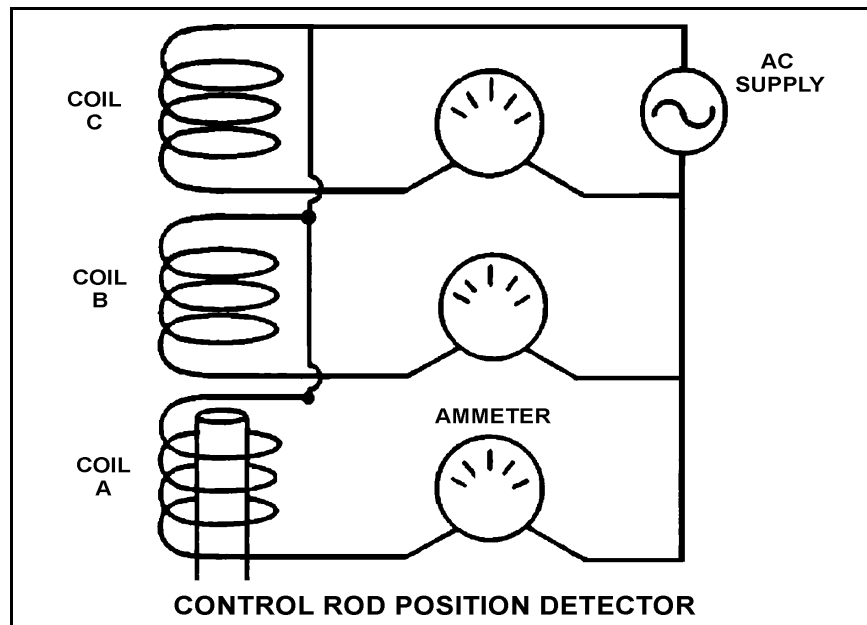
QUESTION: 5

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

Coils of wire connected to an ac power supply are being used to monitor the position of a control rod in a reactor. The coils are mounted in a column outside the reactor vessel head such that the steel control rod drive shaft passes upward through the coils as the control rod is withdrawn. Currently, the top of a control rod drive shaft is located between coils A and B as shown. The control rod is to be withdrawn until the top of the control rod drive shaft is located just below coil C.

Compared to the initial coil output currents, after the control rod is withdrawn the output current of coil A will be _____; and the output current of coil B will be _____.

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



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QUESTION: 6

A beta particle and an alpha particle enter and cause ionization in a gas-filled radiation detector operating in the Geiger-Mueller region. Which one of the following accurately compares the amplitude of the detector pulses caused by each type of radiation?

- A. The beta particle pulse will be larger in amplitude.
- B. The alpha particle pulse will be larger in amplitude.
- C. The pulses will be identical for both types of radiation.
- D. Cannot be determined without particle kinetic energy information.

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QUESTION: 7

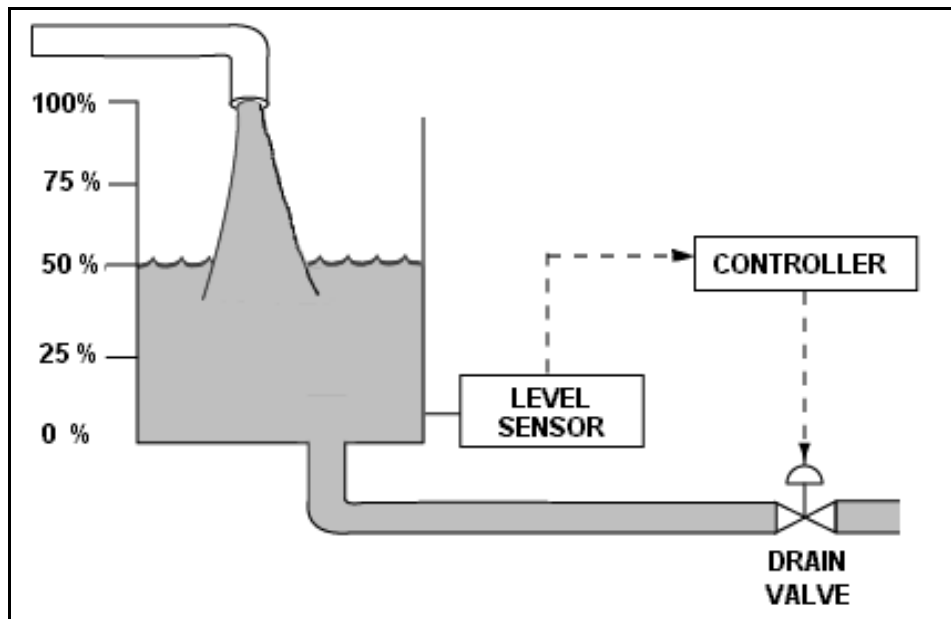
Refer to the drawing of a water storage tank with an automatic level control system (see figure below).

Given:

- The drain valve fails open on loss of controller output signal.
- The level sensor output signal changes directly with tank water level.

For proper automatic control of tank water level, the controller must be _____; and the control loop must be _____.

- A. direct-acting; open
- B. direct-acting; closed
- C. reverse-acting; open
- D. reverse-acting; closed



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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, DG frequency will...

- A. initially increase, then decrease and stabilize below the initial value.
- B. initially increase, then decrease and stabilize at the initial value.
- C. initially increase, then decrease and stabilize above the initial value.
- D. remain constant during and after the load trip.

QUESTION: 9

Which one of the following describes the response of a direct acting proportional-integral controller, operating in automatic mode, to an increase in the controlled parameter above the controller set point?

- A. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller set point, at which time the output signal becomes constant.
- B. The controller will develop an output signal that will remain directly proportional to the difference between the controlled parameter and the controller set point.
- C. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller set point, at which time the output signal becomes zero.
- D. The controller will develop an output signal that will remain directly proportional to the rate of change of the controlled parameter.

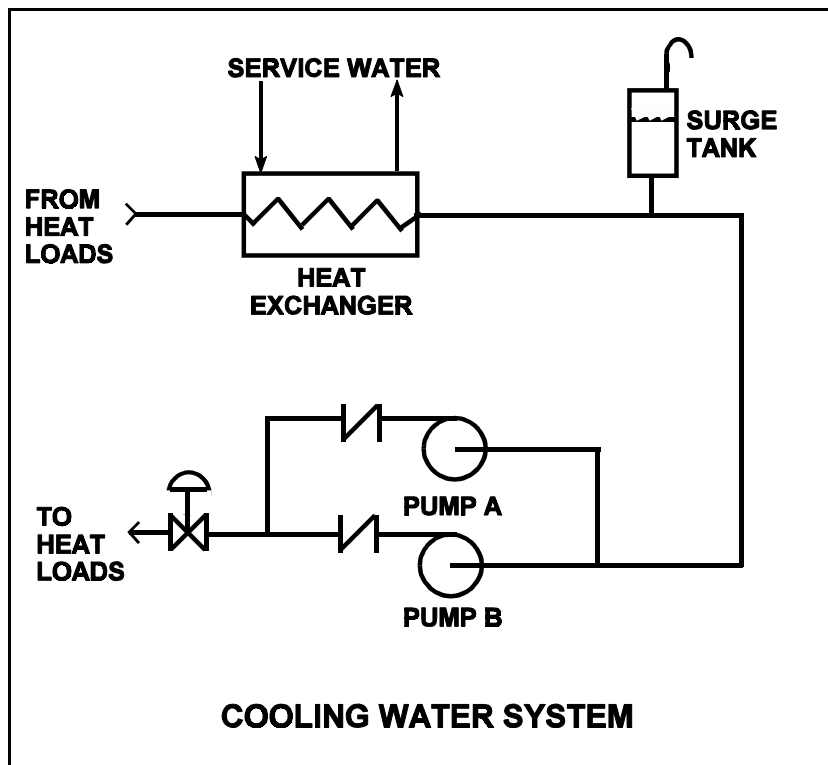
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QUESTION: 10

Refer to the drawing of a cooling water system in which only centrifugal pump A is operating and the common pump discharge valve is currently 90% open (see figure below).

An abnormal total heat load on the cooling water system is causing pump A to approach operation at runout conditions. Which one of the following will cause pump A to operate farther away from runout conditions? (Assume that satisfactory available net positive suction head is maintained at all times.)

- A. Starting pump B.
- B. Positioning the discharge valve to 100% open.
- C. Raising the water level in the surge tank by 2 feet.
- D. Decreasing heat exchanger service water flow rate by 10%.



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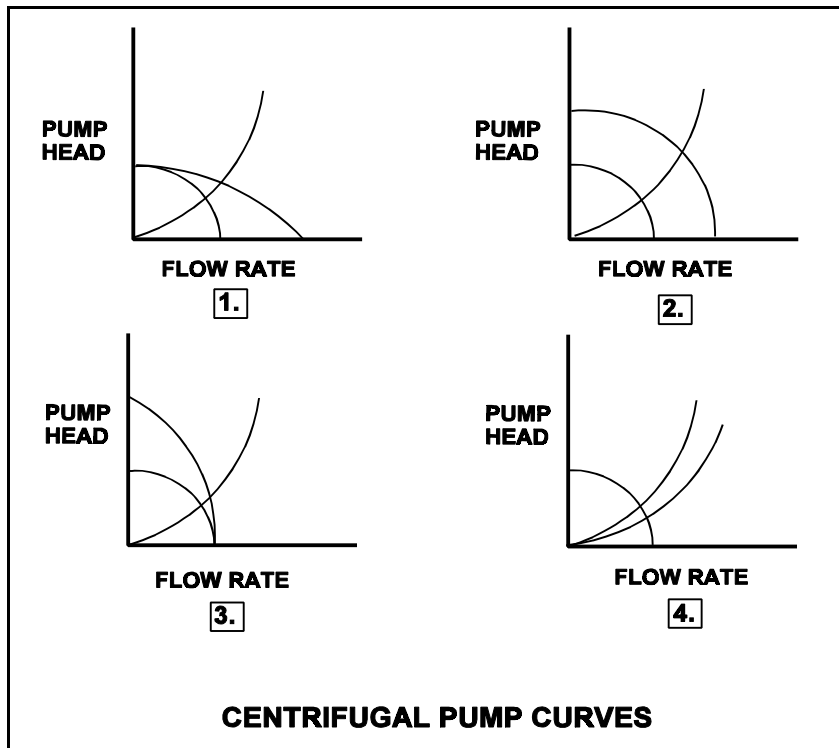
QUESTION: 11

Refer to the drawing of four centrifugal pump operating curves (see figure below).

A centrifugal pump is initially operating normally in a cooling water system. Then debris becomes lodged in the screen in the pump suction line.

Which set of operating curves depicts the “before” and “after” conditions described above?

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



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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 pump eye is located 5 feet above the reservoir water level.
- The pump has a 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 pump eye will the fire hose spray nozzle first be unable to provide flow? (Disregard all sources of system frictional head loss.)

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

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QUESTION: 13

The minimum required net positive suction head for a typical positive displacement pump will increase the most if the pump...

- A. motor speed increases from 1200 rpm to 1600 rpm.
- B. discharge pressure decreases from 100 psig to 50 psig.
- C. suction temperature increases from 75 °F to 85 °F.
- D. discharge valve is positioned from 90% open to fully open.

QUESTION: 14

A main generator is operating in parallel with an infinite power grid. If the voltage supplied to the generator field is slowly and continuously decreased, the generator will experience high current due to... (Assume no generator protective actuations occur.)

- A. excessive generator MWe.
- B. excessive generator KVAR (lagging).
- C. excessive generator KVAR (leading).
- D. generator reverse power.

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QUESTION: 15

Which one of the following causes starting current to be greater than running current for a typical ac induction motor?

- A. The rotor field induces an opposing voltage in the stator that is proportional to rotor speed.
- B. The rotor does not develop maximum current flow until it has achieved synchronous speed.
- C. After the motor starts, resistors are added to the electrical circuit to limit the running current.
- D. A large amount of starting current is required to initially establish the rotating magnetic field.

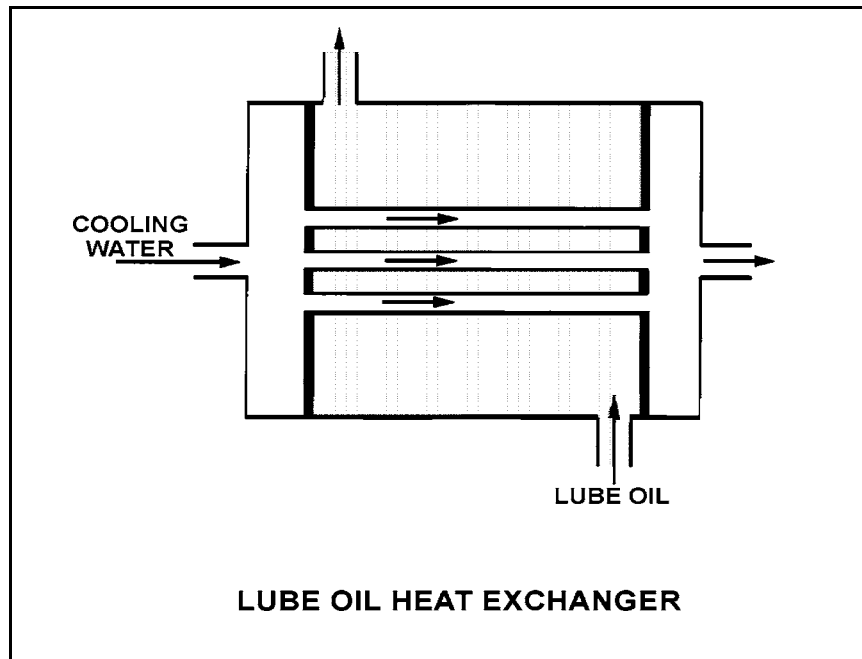
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QUESTION: 16

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

Assume that the inlet oil and inlet cooling water temperatures are constant and cooling water flow rate remains the same. Decreasing the oil flow rate through the heat exchanger will cause the oil outlet temperature to _____ and the cooling water outlet temperature to _____.

- A. increase, increase
- B. increase, decrease
- C. decrease, increase
- D. decrease, decrease



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QUESTION: 17

A nuclear power plant is operating at steady-state 100% power. Assuming that condenser cooling water inlet temperature and flow rate do not change, if condenser vacuum decreases, condensate temperature will...

- A. increase because condensate subcooling has decreased.
- B. increase because condenser saturation pressure has increased.
- C. decrease because condensate subcooling has increased.
- D. decrease because condenser saturation pressure has decreased.

QUESTION: 18

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

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

- A. Increasing flow rate through the ion exchanger
- B. Increasing pressure drop across the ion exchanger
- C. Increasing ion exchanger inlet water conductivity
- D. Increasing ion exchanger outlet water conductivity

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QUESTION: 19

A nuclear power plant is operating at 70% stable power level when the temperature of the reactor coolant letdown passing through a boron-saturated mixed bed ion exchanger is increased by 20°F.

As a result, the boron concentration in the effluent of the ion exchanger will _____ because the affinity of the ion exchanger for boron atoms has _____.

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

QUESTION: 20

Which one of the following will cause a loss of indication from the remote breaker position indicating lights associated with a typical 480 Vac load supply breaker?

- A. Loss of breaker line voltage
- B. Locally opening the breaker
- C. Burnout of the local breaker position indicating lights
- D. Removing the breaker control power fuses

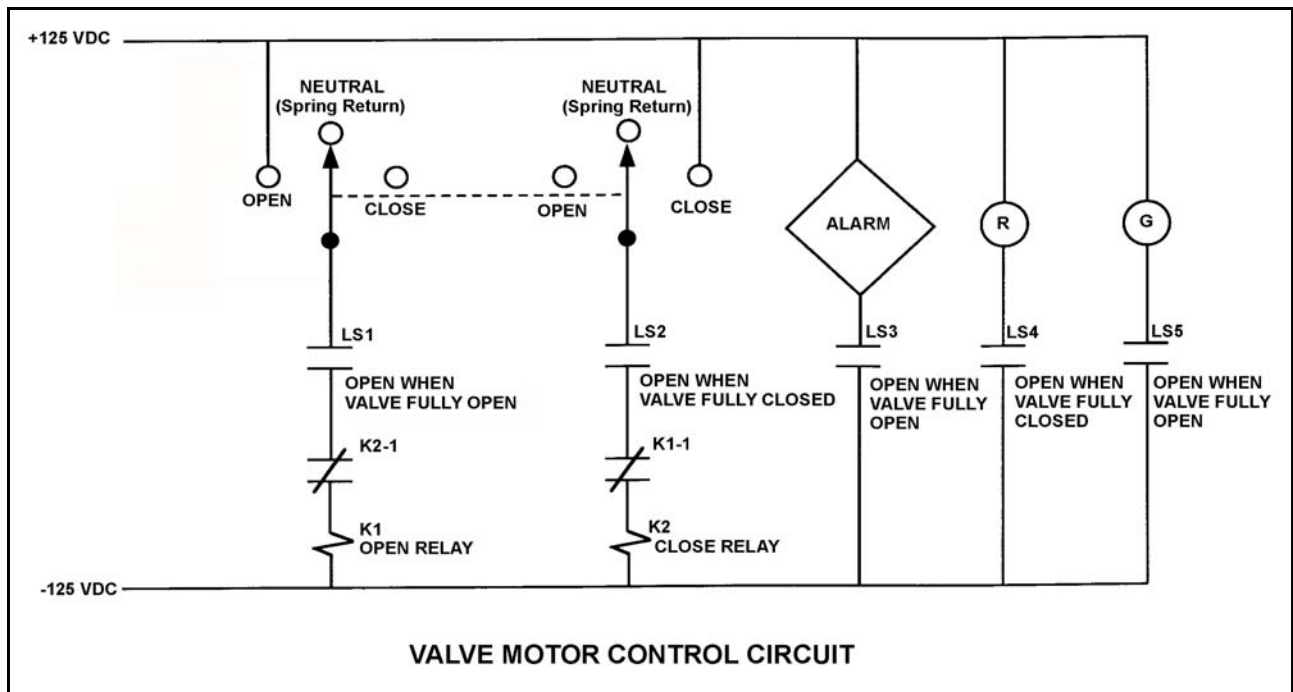
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QUESTION: 21

Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully closed and has a 10-second stroke time. (Note: Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts follow the standard convention for control circuit drawings.)

The operator takes the control switch to “Open” for 5 seconds and then releases the switch. After one minute the operator takes the control switch to “Close” for 5 seconds and then releases the switch. Which one of the following describes the valve position immediately after the control switch is released the second time?

- A. Approximately fully open.
- B. Approximately fully closed.
- C. Approximately 50% open.
- D. Cannot be determined without additional information.



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QUESTION: 22

A main generator is being paralleled to the power grid. Generator voltage has been properly adjusted and the synchroscope is rotating slowly in the clockwise direction.

The generator breaker must be closed as the synchroscope pointer reaches the 12 o'clock position to prevent...

- A. motoring of the generator due to unequal frequencies.
- B. excessive MWe load transfer to the generator due to unequal frequencies.
- C. excessive MWe load transfer to the generator due to out-of-phase voltages.
- D. excessive arcing within the generator output breaker due to out-of-phase voltages.

QUESTION: 23

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the delayed neutron is more likely to... (Assume that each neutron remains in the reactor core.)

- A. cause fission of a U-238 nucleus.
- B. cause fission of a U-235 nucleus.
- C. travel to an adjacent fuel assembly.
- D. experience resonance absorption in the core.

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QUESTION: 24

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of water at a temperature of 100°F and a boron concentration of 2,000 ppm.

Which one of the following will increase K_{eff} ?

- A. An unrodded spent fuel assembly is removed from the core.
- B. Refueling water temperature increases to 105°F.
- C. A new neutron source is installed in the core.
- D. Excore nuclear instrumentation is repositioned to increase source range count rate.

QUESTION: 25

A reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

- A. 10
- B. 100
- C. 1,000
- D. 10,000

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QUESTION: 26

Which one of the following contains the nuclides responsible for most of the resonance capture of fission neutrons in a reactor core at the beginning of the sixth fuel cycle? (Assume that each refueling replaces one-third of the fuel.)

- A. U-235 and Pu-239
- B. U-235 and U-238
- C. U-238 and Pu-239
- D. U-238 and Pu-240

QUESTION: 27

A reactor is exactly critical at the point of adding heat during a xenon-free reactor startup at the beginning of core life. Reactor power is ramped to 50% over the next 4 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

- A. buildup of core Xe-135.
- B. increased fuel temperature.
- C. burnout of burnable poisons.
- D. increased reactor coolant temperature.

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QUESTION: 28

A reactor is exactly critical at the point of adding heat (POAH) during a reactor startup at the end of core life. Control rods are manually withdrawn for 5 seconds and then stopped.

Assuming only ambient heat removal from the reactor coolant system (RCS), when plant parameters stabilize, reactor power will be _____ the POAH, and RCS average temperature will be _____.

- A. at; higher
- B. at; the same
- C. greater than; higher
- D. greater than; the same

QUESTION: 29

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

- A. IRW is the slope of the DRW curve.
- B. IRW is the inverse of the DRW curve.
- C. IRW is the sum of the DRWs between the initial and final control rod positions.
- D. IRW is the sum of the DRWs of all control rods at any specific control rod position.

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QUESTION: 30

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

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

QUESTION: 31

After a reactor shutdown from equilibrium core xenon conditions, the maximum xenon -135 negative reactivity (height of the xenon peak) is _____ preshutdown equilibrium power level.

- A. independent of
- B. exactly proportional to
- C. inversely proportional to
- D. dependent on but not exactly proportional to

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QUESTION: 32

During continuous full-power reactor operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically to compensate for fuel depletion. What other core age-related factor requires a periodic decrease in reactor coolant boron concentration?

- A. Decreasing control rod worth
- B. Buildup of fission product poisons
- C. Burnout of burnable poisons
- D. Decreasing fuel temperature

QUESTION: 33

Which one of the following is not required to determine the estimated critical boron concentration for a reactor startup to be performed 48 hours following an inadvertent reactor trip?

- A. Reactor power level just prior to the trip
- B. Steam generator levels just prior to the trip
- C. Xenon reactivity in the core just prior to the trip
- D. Samarium reactivity in the core just prior to the trip

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QUESTION: 34

A nuclear reactor is critical at $10^{-6}\%$ power. Control rods are withdrawn for 5 seconds and then stopped, resulting in a stable startup rate (SUR) of positive 0.2 decades per minute (dpm).

If control rods had been inserted (instead of withdrawn) for 5 seconds with the reactor initially critical at $10^{-6}\%$ power, the stable SUR would have been: (Assume equal absolute values of reactivity are added in both cases.)

- A. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in smaller delayed neutron fractions.
- B. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases are less limited by delayed neutrons.
- C. slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in larger delayed neutron fractions.
- D. slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases are more limited by delayed neutrons.

QUESTION: 35

After taking critical data during a reactor startup, the operator establishes a stable 0.52 dpm startup rate to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\bar{\beta}_{\text{eff}} = 0.006$.)

- A. -0.01 % $\Delta K/K$
- B. -0.06 % $\Delta K/K$
- C. -0.10 % $\Delta K/K$
- D. -0.60 % $\Delta K/K$

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QUESTION: 36

A nuclear power plant is operating at 90% power at the end of core life with manual rod control when a turbine control system malfunction opens the turbine control valves an additional 5 percent. Reactor power will initially...

- A. increase because the rate of neutron absorption in the moderator initially decreases.
- B. increase because the rate of neutron absorption at U-238 resonant energies initially decreases.
- C. decrease because the rate of neutron absorption in the moderator initially increases.
- D. decrease because the rate of neutron absorption at U-238 resonant energies initially increases.

QUESTION: 37

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

- A. 8 psia, 20 inches Hg absolute, 2 psig
- B. 8 psia, 2 psig, 20 inches Hg absolute
- C. 20 inches Hg absolute, 2 psig, 8 psia
- D. 20 inches Hg absolute, 8 psia, 2 psig

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QUESTION: 38

An open container holds one pound-mass of liquid water at saturated conditions and atmospheric pressure. The addition of 4 Btus will...

- A. raise the temperature of the water by 4°F.
- B. vaporize a portion of the water.
- C. increase the density of the water.
- D. result in 4°F of superheat.

QUESTION: 39

Main steam is being used to reheat high-pressure (HP) turbine exhaust in a moisture separator reheater (MSR).

Given:

- The HP turbine exhaust enters the MSR reheater section as saturated steam (100% quality).
- The exhaust enters and exits the reheater section at 280 psia and a flow rate of 1.0E6 lbm/hr.
- The main steam heat transfer rate in the reheater section is 42.1E6 Btu/hr.

Which one of the following is the approximate temperature of the HP turbine exhaust leaving the reheater section of the MSR?

- A. 450°F
- B. 475°F
- C. 500°F
- D. 525°F

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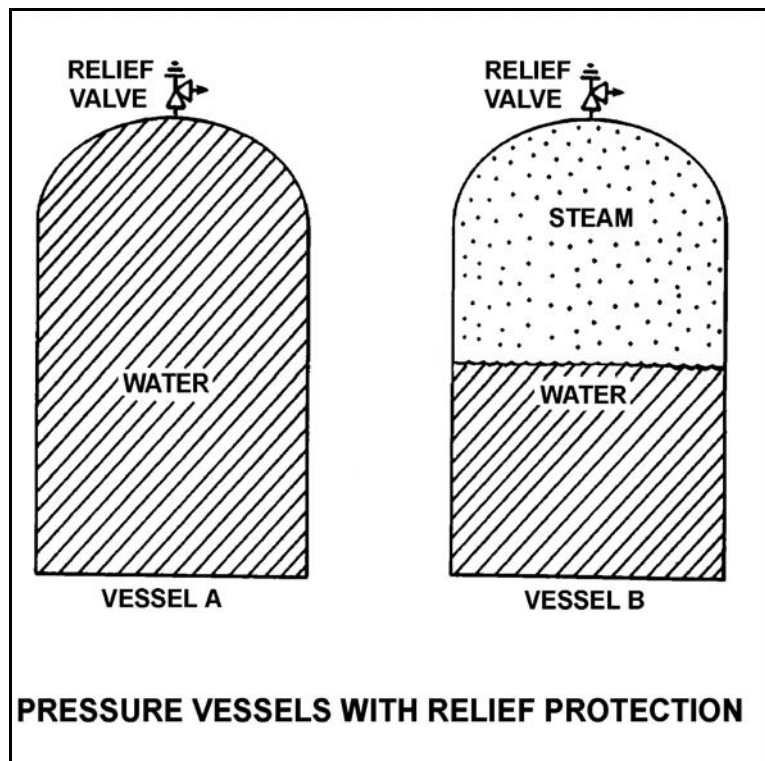
QUESTION: 40

Refer to the drawing of two 1,000 ft³ pressure vessels with relief protection (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% quality) volume and one-half saturated water (0% quality) volume. Both vessels are protected by identical relief valves.

If both relief valves begin to leak at a rate of 0.1% 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



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QUESTION: 41

Turbine X and turbine Y are ideal steam turbines that exhaust to a condenser at 1.0 psia. Turbine X is driven by saturated steam (100% quality) at 500 psia. Turbine Y is driven by saturated steam (100% quality) at 700 psia.

The greatest amount of specific work is being performed by turbine _____; the greatest moisture content exists in the exhaust of turbine _____.

- A. X; X
- B. X; Y
- C. Y; X
- D. Y; Y

QUESTION: 42

A nuclear power plant is recovering from a loss of offsite power that caused all reactor coolant pumps (RCPs) to stop. Pressurizer level indication is off-scale high.

Which one of the following is most likely to occur if the steam generator (S/G) temperatures are 50°F higher than their associated reactor coolant system (RCS) loop temperatures when an RCP is restarted?

- A. Localized water hammer in the RCS
- B. Pressurized thermal shock to the S/Gs
- C. A large pressure spike throughout the RCS
- D. Inadvertent lifting of a S/G atmospheric relief valve

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004 PWR--FORM A**

QUESTION: 43

A four-loop nuclear power plant uses four identical reactor coolant pumps (RCPs) to supply reactor coolant flow through the reactor vessel. The plant is currently operating at 20% power with all RCPs in operation.

Which one of the following describes the stable RCS flow rate through the reactor vessel following the trip of one RCP? (Assume that no operator actions are taken and the reactor does not scram.)

- A. Less than 75% of the original flow rate.
- B. Exactly 75% of the original flow rate.
- C. Greater than 75% of the original flow rate.
- D. Unpredictable without pump curves for the RCPs.

QUESTION: 44

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being lower than actual reactor power?

- A. The feedwater temperature used in the heat balance calculation was 10°F lower than actual feed water temperature.
- B. The reactor coolant pump heat input term was omitted from the heat balance calculation.
- C. The feedwater flow rate used in the heat balance calculation was 10% lower than actual feedwater flow rate.
- D. The steam pressure used in the heat balance calculation was 50 psi lower than actual steam pressure.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004 PWR--FORM A**

QUESTION: 45

A reactor is shutdown at normal operating temperature and pressure with all control rods inserted. Which one of the following will decrease the departure from nucleate boiling ratio for this reactor? (Assume the reactor remains shutdown.)

- A. Fully withdrawing a bank of shutdown rods
- B. Diluting RCS boron concentration by 50 ppm
- C. Reducing RCS flowrate by 1%
- D. Increasing RCS pressure by 10 psig

QUESTION: 46

If the fission rate in a reactor core steadily increases, the mode of heat transfer that occurs immediately after the critical heat flux is reached is called...

- A. transition boiling.
- B. subcooled nucleate boiling.
- C. saturated nucleate boiling.
- D. stable film boiling.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004 PWR--FORM A**

QUESTION: 47

Which one of the following is most likely to result in steam bubble formation in a reactor vessel head while maintaining a 40°F subcooling margin in the hottest RCS hot leg?

- A. Performing a 25°F/Hr RCS cooldown on natural circulation.
- B. Performing a 25°F/Hr RCS cooldown on forced circulation.
- C. Performing a 50°F/Hr RCS cooldown on natural circulation.
- D. Performing a 50°F/Hr RCS cooldown on forced circulation.

QUESTION: 48

Which one of the following describes the mechanism for core heat removal during reflux cooling?

- A. Forced coolant flow
- B. Natural circulation coolant flow
- C. Conduction with stagnant coolant flow
- D. Radiation with total core voiding

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004 PWR--FORM A**

QUESTION: 49

A reactor is operating at steady-state 80% power at the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. The moderator temperature coefficient is negative.

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

- A. One bank of control rods is inserted 10%.
- B. Power is maintained constant for one month.
- C. Turbine load/reactor power is reduced by 20%.
- D. Reactor coolant system boron concentration is increased by 50 ppm.

QUESTION: 50

Two identical reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles with an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles with an average power capacity of 60%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

- A. Reactor A due to the lower average power capacity.
- B. Reactor A due to the greater number of heatup/cooldown cycles.
- C. Reactor B due to the higher average power capacity.
- D. Reactor B due to the fewer number of heatup/cooldown cycles.

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

**MARCH 2004 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	A	26	40	D
2	16	B	27	41	B
3	17	D	28	42	A
4	18	C	29	43	C
5	19	D	30	44	A
6	20	C	31	45	D
7	21	D	32	46	B
8	22	C	33	47	B
9	23	A	34	48	D
10	24	A	35	49	C
11	25	A or D	36	50	B
12	26	B	37	1	A
13	27	A	38	2	B
14	28	C	39	3	B
15	29	A	40	4	D
16	30	D	41	5	D
17	31	B	42	6	C
18	32	B	43	7	C
19	33	C	44	8	C
20	34	D	45	9	C
21	35	B	46	10	A
22	36	D	47	11	C
23	37	B	48	12	B
24	38	B	49	13	A
25	39	A	50	14	A