

**UNITED STATES NUCLEAR REGULATORY COMMISSION  
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000--FORM B**

**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) power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
THERMODYNAMICS	1 - 28		
COMPONENTS	29 - 72		
REACTOR THEORY	73 - 100		
TOTALS	100		

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

))))))))))))))))))))))))))))))))))))))  
Applicant's Signature

**RULES AND GUIDELINES FOR THE  
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**

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

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

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

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

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

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

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

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

$$t = \frac{\bar{\beta} - \beta}{\beta_{\text{eff}}}$$

$$\beta = \frac{\ell^*}{t} + \frac{\bar{\beta}}{1 + \beta_{\text{eff}} t}$$

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

$$\beta_{\text{eff}} = 0.1 \text{ seconds}^{-1}$$

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

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

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

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

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

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

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

$$A = p r^2$$

$$F = PA$$

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

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

$$E = IR$$

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

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

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

**CONVERSIONS**

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

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

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

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

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

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

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

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

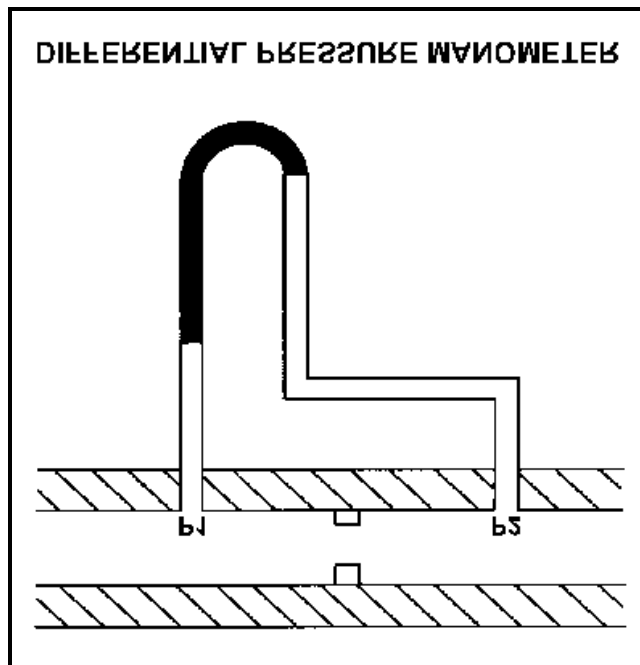
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$^{\circ}\text{F} = (9/5)(^{\circ}\text{C}) + 32$   
QUESTION: 1

Refer to the drawing of a differential pressure manometer (see figure below).

A differential pressure manometer containing water is installed across an orifice in a ventilation duct to determine the direction of airflow. P1 and P2 are pressures sensed in the ventilation duct. With the conditions shown in the drawing, P1 pressure is \_\_\_\_\_ than P2 pressure, and airflow is to the \_\_\_\_\_.

- A. less; left
- B. less; right
- C. greater; left
- D. greater; right



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QUESTION: 2

Consider a pressurizer containing a saturated water/vapor mixture at 500°F. The mixture is currently stable with no heat gain or loss occurring. Water and steam each occupy 50% of the pressurizer volume.

If a leak near the bottom of the pressurizer results in a loss of 10% of the liquid volume from the pressurizer, the temperature of the mixture will \_\_\_\_\_, and the overall quality of the mixture will \_\_\_\_\_. (Assume the mixture remains saturated.)

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

QUESTION: 3

An open vessel contains one pound-mass of water at 206°F and atmospheric pressure. Which one of the following will be caused by the addition of 3 Btu to the water?

- A. The water temperature will rise by 3°F.
- B. 3% of the water mass will vaporize.
- C. The water density will decrease by 3%.
- D. The water will become superheated by 3°F.

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QUESTION: 4

What is the approximate condensate depression in a condenser operating at 27 inches Hg vacuum with a condensate temperature of 100°F?

- A. 2°F
- B. 4°F
- C. 8°F
- D. 16°F

QUESTION: 5

An operator is involved in a routine plant shutdown with a steam bubble (100% quality) in the pressurizer. Pressurizer pressure is 415 psig and pressurizer pressure and level are slowly decreasing. The operator suspects a pressurizer power-operated relief valve (PORV) is partially open but the position indicating lights are not working.

Which one of the following will be the approximate PORV tailpipe temperature if the PORV is partially open? (Assume downstream pressure is atmospheric and no heat is lost from the tailpipe.)

- A. 212°F
- B. 280°F
- C. 330°F
- D. 450°F

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QUESTION: 6

If the moisture content of the steam supplied to a main turbine increases, (assume no change in steam pressure, condenser pressure, or control valve position) turbine work will:

- A. decrease because the enthalpy of the steam being supplied to the turbine has decreased.
- B. decrease because moist steam results in more windage losses in the turbine.
- C. increase because the enthalpy of the steam being supplied to the turbine has increased.
- D. increase because moist steam results in less windage losses in the turbine.

QUESTION: 7

Which one of the following operating practices minimizes the possibility of water hammer?

- A. Change valve positions as rapidly as possible.
- B. Start centrifugal pumps with the discharge valve throttled.
- C. Start positive displacement pumps with the discharge valve closed.
- D. Vent systems only after initiating system flow.

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QUESTION: 8

An 80 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 100 psig?

- A. 36 gpm
- B. 53 gpm
- C. 56 gpm
- D. 65 gpm

QUESTION: 9

Which of the following completes the following statement?

Pump cavitation occurs when vapor bubbles are formed at the eye of a pump impeller...

- A. because the localized flow velocity exceeds sonic velocity for the existing fluid temperature.
- B. because the localized pressure exceeds the vapor pressure for the existing fluid temperature.
- C. and enter a high pressure region of the pump where they collapse causing damaging pressure pulsations.
- D. and are discharged from the pump where they expand into larger bubbles causing damaging pressure pulsations.



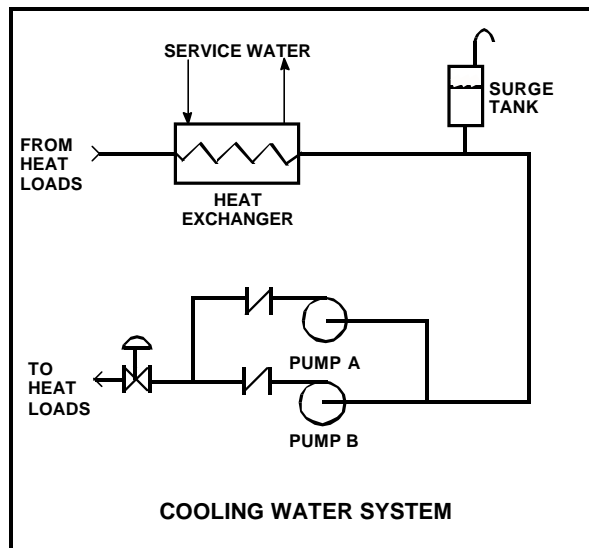
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QUESTION: 10

Refer to the drawing of a cooling water system in which only pump A is operating and the pump discharge valve is currently 50% open (see figure below).

Which one of the following will cause pump A to operate closer to the conditions that will cause cavitation?

- A. Starting pump B
- B. Positioning the discharge valve to 40% open
- C. Raising the water level in the surge tank by 2 feet
- D. Increasing heat exchanger service water flow rate by 10%



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QUESTION: 11

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1000 psig.

Given the following information:

Centrifugal Pumps

Shutoff head:	1500 psig
Maximum design pressure:	2000 psig

Positive Displacement Pumps

Maximum design pressure:	2000 psig
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Which one of the following pump configurations will supply the highest makeup flow rate to the system if system pressure is at 800 psig?

- A. One PDP and one CP in series (CP supplying PDP)
- B. One PDP and one CP in parallel
- C. Two CPs in series
- D. Two CPs in parallel

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QUESTION: 12

The following 100% rated power conditions existed before a plant outage:

Main condenser pressure: 1.20 psia  
Cooling water inlet temperature: 60°F  
Cooling water outlet temperature: 92°F

During the outage, 6% of the main condenser tubes were plugged. After the outage, the following 100% rated power conditions exist:

Main condenser pressure: 1.31 psia  
Cooling water inlet temperature: 60°F  
Cooling water outlet temperature: ?

Which one of the following is the approximate cooling water outlet temperature after the outage?

- A. 92°F
- B. 94°F
- C. 96°F
- D. 98°F

QUESTION: 13

A reactor is operating at power. Total feed water flow rate to all steam generators is  $7.0 \times 10^6$  lbm/hr at a temperature of 440°F. The steam exiting the steam generators is at 1000 psia with 100% steam quality.

Ignoring all other heat gain and loss mechanisms, what is the core thermal power?

- A. 1335 MWt
- B. 1359 MWt
- C. 1589 MWt
- D. 1612 MWt

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QUESTION: 14

Subcooled reactor coolant flows into the bottom of a fuel assembly coolant channel and exits the top of the channel as a saturated steam-water mixture with a 98% moisture content. How does the convective heat transfer coefficient in the coolant channel change as the coolant travels upward along the channel?

- A. Increases only
- B. Increases, then decreases
- C. Decreases only
- D. Decreases, then increases

QUESTION: 15

Which one of the following is a characteristic of saturated nucleate boiling but not subcooled nucleate boiling?

- A.  $T_{\text{Bulk Coolant}}$  equals  $T_{\text{Sat}}$
- B.  $T_{\text{Bulk Coolant}}$  is less than  $T_{\text{Sat}}$
- C.  $T_{\text{Clad}}$  equals  $T_{\text{Sat}}$
- D.  $T_{\text{Clad}}$  is greater than  $T_{\text{Sat}}$

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QUESTION: 16

If  $\Delta T$  is the temperature difference between the fuel rod clad and the coolant, which one of the following describes the heat transfer from a fuel rod at the departure from nucleate boiling?

- A. Steam bubbles begin to form on the fuel rod clad, causing a rapid decrease in the heat flux from the fuel rod for a given  $\Delta T$ .
- B. Steam bubbles completely blanket the fuel rod clad, causing a rapid increase in the heat flux from the fuel rod for a given  $\Delta T$ .
- C. Steam bubbles begin to blanket the fuel rod clad, causing a rapid increase in the  $\Delta T$  for a given heat flux.
- D. Steam bubbles completely blanket the fuel rod clad, causing a rapid decrease in the  $\Delta T$  for a given heat flux.

QUESTION: 17

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 temperature by 5°F
- D. Decreasing RCS pressure by 10 psig

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QUESTION: 18

How does critical heat flux (CHF) vary with core height during normal full power operation of the reactor?

- A. CHF increases from the bottom to the top of the core.
- B. CHF decreases from the bottom to the core midplane, then increases from the midplane to the top of the core.
- C. CHF decreases from the bottom to the top of the core.
- D. CHF increases from the bottom to the core midplane, then decreases from the midplane to the top of the core.

QUESTION: 19

If a 30°F subcooling margin is maintained in the RCS hot legs during each of the following shutdown reactor cooldown operations, which one of the cooldowns will achieve the greatest subcooling margin in the reactor vessel head?

- A. Performing a 25°F/Hr RCS cooldown on natural circulation using one steam generator
- B. Performing a 25°F/Hr RCS cooldown with all RCPs running
- C. Performing a 100°F/Hr RCS cooldown on natural circulation using all steam generators
- D. Performing a 100°F/Hr RCS cooldown with one RCP running

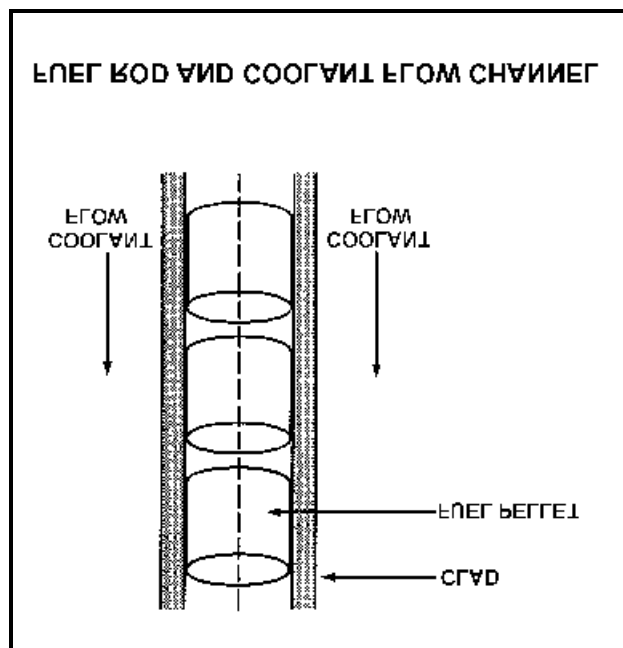
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QUESTION: 20

Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

At 100% reactor power, the greatest temperature difference in a fuel channel radial temperature profile will occur across the: (Assume the temperature profile begins at fuel centerline.)

- A. fuel centerline to fuel surface.
- B. fuel-to-clad gap.
- C. zircaloy cladding.
- D. flow channel boundary (laminar) layer.



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QUESTION: 21

Which one of the following is the approximate percentage of total reactor vessel coolant flow that bypasses the fuel coolant channels in a reactor operating at 100% power?

- A. 0.01%
- B. 0.1%
- C. 1%
- D. 10%

QUESTION: 22

A reactor is operating at 80% of rated thermal power with power distribution peaked both radially and axially in the center of the core. Reactor power is then increased to 100% over the next two hours using only reactor coolant boron adjustments for reactivity control.

Neglecting any effect from core Xe-135, when power is stabilized at 100%, the maximum core radial peaking factor will be \_\_\_\_\_ and the maximum core axial peaking factor will be \_\_\_\_\_.

- A. larger; smaller
- B. larger; larger
- C. the same; smaller
- D. the same; larger



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QUESTION: 23

Which one of the following describes the basis for the Emergency Core Cooling Systems design criterion that maximum fuel clad temperature will not exceed 2200°F in an accident?

- A. 2200°F is approximately 500°F below the fuel clad melting temperature.
- B. The rate of the zircaloy-steam reaction increases significantly above 2200°F.
- C. If fuel clad temperature reaches 2200°F, departure from nucleate boiling is imminent.
- D. The differential expansion between the fuel pellets and the fuel clad becomes excessive above 2200°F.

QUESTION: 24

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

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

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QUESTION: 25

Brittle fracture of a low-carbon steel reactor vessel can only occur when the temperature of the vessel is \_\_\_\_\_ the nil ductility temperature, and will normally occur when the applied stress is \_\_\_\_\_ the steel's yield strength (or yield stress).

- A. greater than; greater than
- B. greater than; less than
- C. less than; greater than
- D. less than; less than

QUESTION: 26

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel and other reactor coolant system (RCS) components?

- A. Maximum setpoint for pressurizer safety valves
- B. Maximum RCS pressure vs. temperature for given RCS heatup rate
- C. Maximum differential pressure between RCS and steam generator
- D. Maximum differential temperature between RCS and steam generator

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QUESTION: 27

Which one of the following stresses is compressive on the outer wall of the reactor pressure vessel during a reactor coolant system cooldown?

- A. Yield stress
- B. Thermal stress
- C. Pressure stress
- D. Embrittlement stress

QUESTION: 28

Two identical reactors are currently shut down for refueling. Reactor A has achieved an average lifetime power capacity of 60% while operating for 15 years. Reactor B has also achieved an average lifetime power capacity of 60% while operating for 12 years.

Which reactor, if either, will have the lower reactor vessel nil ductility transition temperature?

- A. Reactor A because it has produced the greater number of fissions.
- B. Reactor B because it has produced the fewer number of fissions.
- C. Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.
- D. Both reactors will have approximately the same nil ductility transition temperature because the fission rate in a shut down core is not significant.

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QUESTION: 29

Water storage tanks A and B are identical except that tank A receives overpressure protection from an installed relief valve. Tank B has an installed safety valve. The relief valve and safety valve have the same pressure set point and design flow rate.

Water is continuously added to each tank at the same rate (50% of the design flow rate of the relief/safety valve). After tank pressure reaches the set point for each valve, tank A pressure will \_\_\_\_\_ and tank B pressure will \_\_\_\_\_.

- A. stabilize slightly above the pressure setpoint; stabilize slightly above the pressure setpoint
- B. stabilize slightly above the pressure setpoint; fluctuate within a few percent of the pressure setpoint
- C. fluctuate within a few percent of the pressure setpoint; stabilize slightly above the pressure setpoint
- D. fluctuate within a few percent of the pressure setpoint; fluctuate within a few percent of the pressure setpoint

QUESTION: 30

A typical check valve is designed to:

- A. permit flow in only one direction.
- B. prevent system overpressure.
- C. isolate system components.
- D. perform automatic pump venting.

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QUESTION: 31

In a comparison between ball valves and butterfly valves in the same liquid process system application, the valves that would typically allow more leakage under high pressure are \_\_\_\_\_ valves, and the valves that would cause a higher system pressure drop when fully open are \_\_\_\_\_ valves.

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

QUESTION: 32

Which one of the following describes the function and use of the backseat on a manual valve?

- A. Removes pressure from the packing/stuffing box and is normally only used when needed to prevent packing leakage.
- B. Removes pressure from the packing/stuffing box and is the normal method used to isolate the stuffing box for valve repacking.
- C. Acts as a backup in case the primary seat leaks and is normally used during system isolation for personnel protection.
- D. Acts as a backup in case the primary seat leaks and is only used when needed to prevent the primary seat from leaking excessively.

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QUESTION: 33

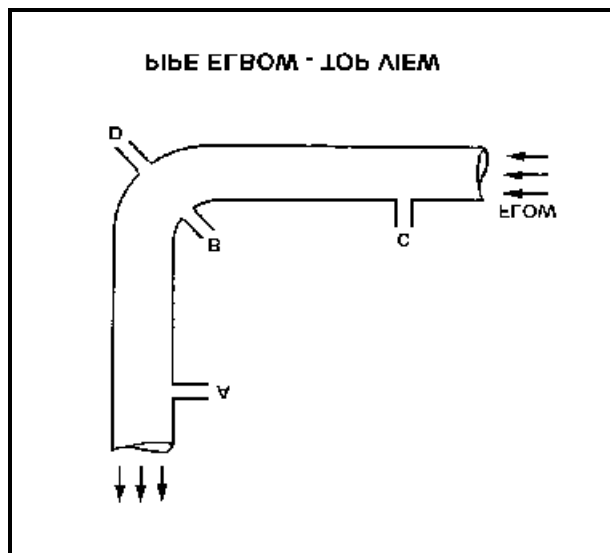
Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows-type differential pressure flow detectors are connected to taps A, B, C, and D as follows:

<u>DETECTOR</u>	<u>TAPS</u>
AD	A and D
BD	B and D
CD	C and D

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap B experiences a significant leak? (Assume water system pressure does not change.)

- A. All detectors will fail low.
- B. All detectors will fail high.
- C. Only one detector will fail, and it will fail low.
- D. Only one detector will fail, and it will fail high.



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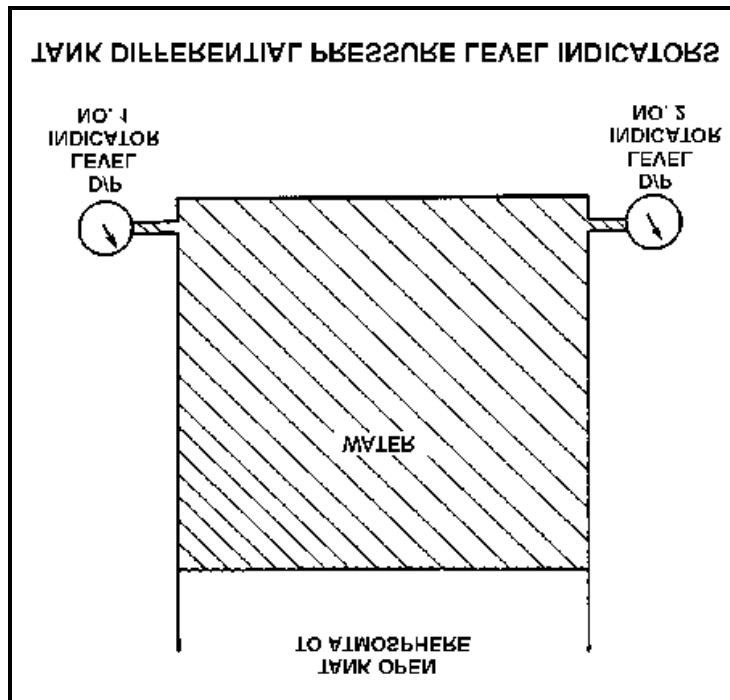
QUESTION: 34

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

Two D/P level indicators are installed on a large water storage tank. Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which one will indicate the higher level?

- A. Indicator 1 at all water temperatures
- B. Indicator 2 at all water temperatures
- C. Indicator 1 below 150°F, indicator 2 above 150°F
- D. Indicator 2 below 150°F, indicator 1 above 150°F



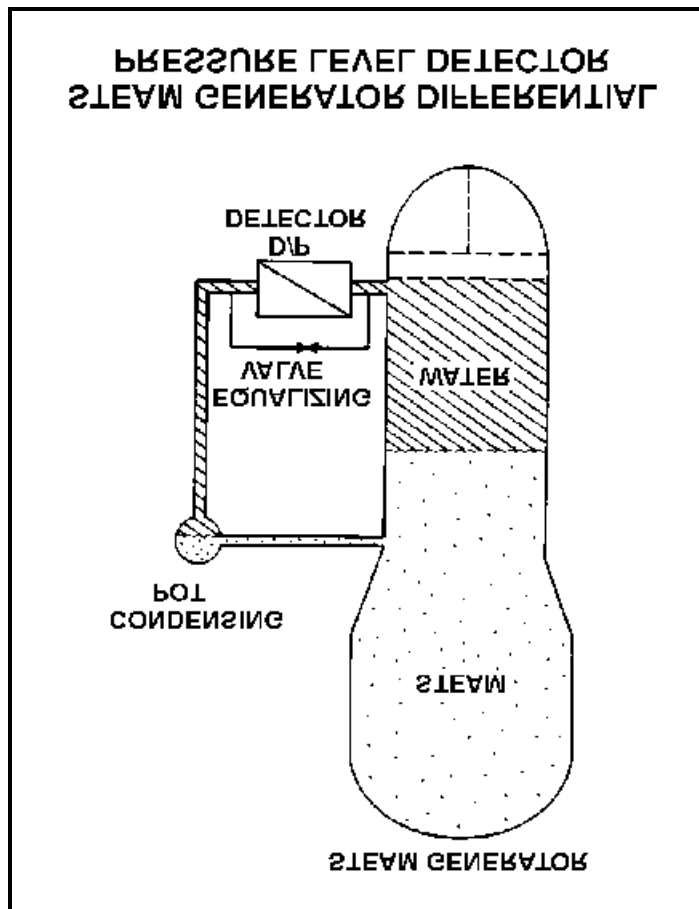
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QUESTION: 35

Refer to the drawing of a steam generator (S/G) differential pressure (D/P) level detector (see figure below).

The S/G is at normal operating temperature and pressure with accurate level indication. Which one of the following events will result in a S/G level indication that is lower than actual level?

- A. Actual S/G level decreases by 6 inches.
- B. The temperature surrounding the reference leg decreases by 20°F.
- C. The external pressure surrounding the D/P detector decreases by 2 psi.
- D. S/G pressure decreases by 50 psi with no change in actual water level.





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QUESTION: 36

If the steam pressure input signal to a density-compensated steam flow instrument fails high, the indicated flow rate will:

- A. increase, because the density input has increased.
- B. increase, because the density input has decreased.
- C. decrease, because the density input has increased
- D. decrease, because the density input has decreased.

QUESTION: 37

A properly calibrated 0 to 100 psia diaphragm pressure detector is connected to a pressurized system; the low pressure side of the detector is vented to the atmosphere. The detector is currently producing a system pressure indication of 75 psia.

If the detector diaphragm ruptures, indicated pressure will be approximately:

- A. 0 psia.
- B. 15 psia.
- C. 60 psia.
- D. 90 psia.

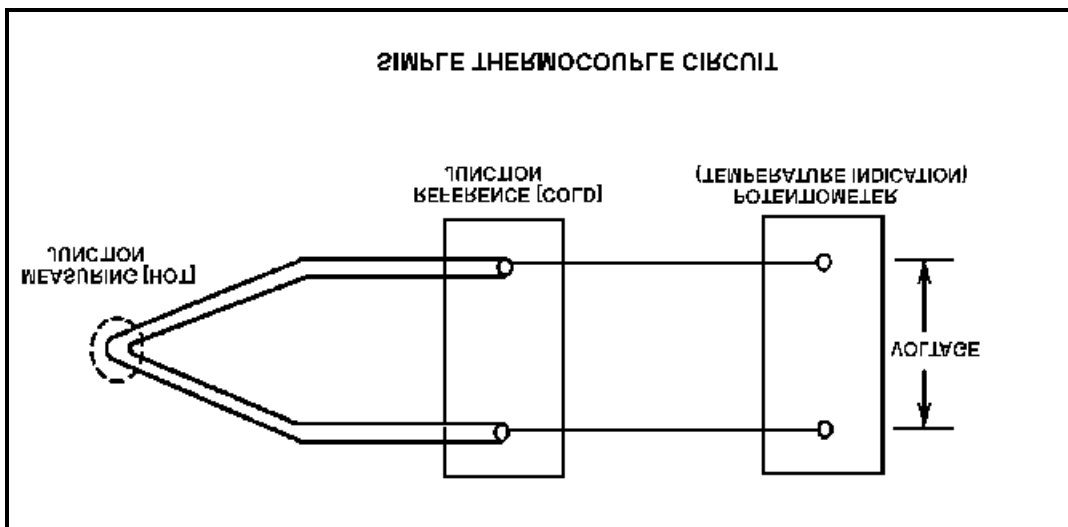
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QUESTION: 38

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

Thermocouple temperature indication is currently  $390^{\circ}\text{F}$ . If a small steam leak occurs that raises reference (cold) junction temperature by  $20^{\circ}\text{F}$ , the new temperature indication will be: (Assume measuring junction temperature remains constant.)

- A.  $370^{\circ}\text{F}$ .
- B.  $390^{\circ}\text{F}$ .
- C.  $400^{\circ}\text{F}$ .
- D.  $410^{\circ}\text{F}$ .



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QUESTION: 39

Reed switches are being used in an electrical measuring circuit to monitor the position of a control rod in a reactor. The reed switches are mounted in a column above the reactor vessel such that the control rod drive shaft passes by individual reed switches as the control rod is withdrawn.

Which one of the following describes the action that causes the electrical output of the reed switch circuit to change as the control rod is withdrawn?

- A. An ac coil on the control rod drive shaft induces a voltage into each reed switch as the drive shaft passes by.
- B. A metal tab on the control rod drive shaft mechanically closes each reed switch as the drive shaft passes by.
- C. The primary and secondary coils of each reed switch attain maximum magnetic coupling as the drive shaft passes by.
- D. A permanent magnet on the control rod drive shaft attracts the movable contact arm of each reed switch as the drive shaft passes by.

QUESTION: 40

A plant has experienced a loss of coolant accident with degraded safety injection flow. Core voiding is homogeneous and is currently 20%.

Which one of the following describes excore source/startup range neutron level indication as homogeneous core voiding increases from 20% to 100% of the core? (Assume the neutron detectors are located adjacent to the bottom portion of the core.)

- A. Increases, then decreases
- B. Increases continuously
- C. Decreases, then increases
- D. Decreases continuously

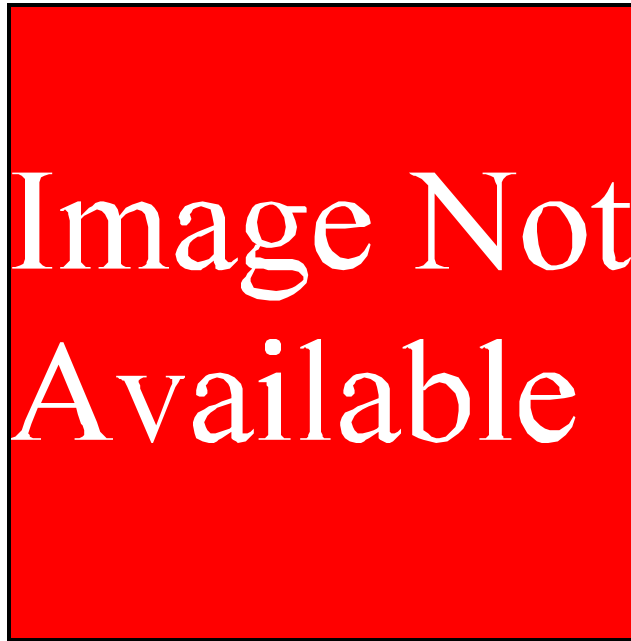
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QUESTION: 41

Refer to the drawing of a gas-filled radiation detector characteristic curve (see figure below).

Which one of the following statements describes how a gas-filled radiation detector, operating in the "proportional" region, functions?

- A. Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations are independent of the applied voltage on a logarithmic scale.
- B. The number of ions collected from both primary and secondary ionizations vary directly with the applied voltage on a logarithmic scale.
- C. Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations vary directly with the applied voltage on a logarithmic scale.
- D. The number of ions collected from both primary and secondary ionizations are independent of the applied voltage on a logarithmic scale.



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 42

Three identically-sized, gas-filled radiation detectors are being used to detect alpha, beta, and neutron radiation. The neutron detector is a fission chamber. All three detectors are operating in the ionization region, and each detector is in a separate radiation field consisting of only alpha, beta, or neutron radiation. The radiation fields have equivalent energy and produce equal reaction rates with the associated detectors.

Which one of the following lists the detectors in order from highest to lowest output based on the number of ion pairs collected per unit time on the electrodes?

- A. Alpha, Beta, Neutron
- B. Alpha, Neutron, Beta
- C. Neutron, Alpha, Beta
- D. Neutron, Beta, Alpha

QUESTION: 43

An automatic flow controller is being used to position a valve in a cooling water system. The controller develops a flow error signal and then increases the magnitude of the signal to drive the valve operator.

The factor by which the magnitude of the flow error signal is increased is referred to as:

- A. bias.
- B. gain.
- C. error.
- D. feedback.

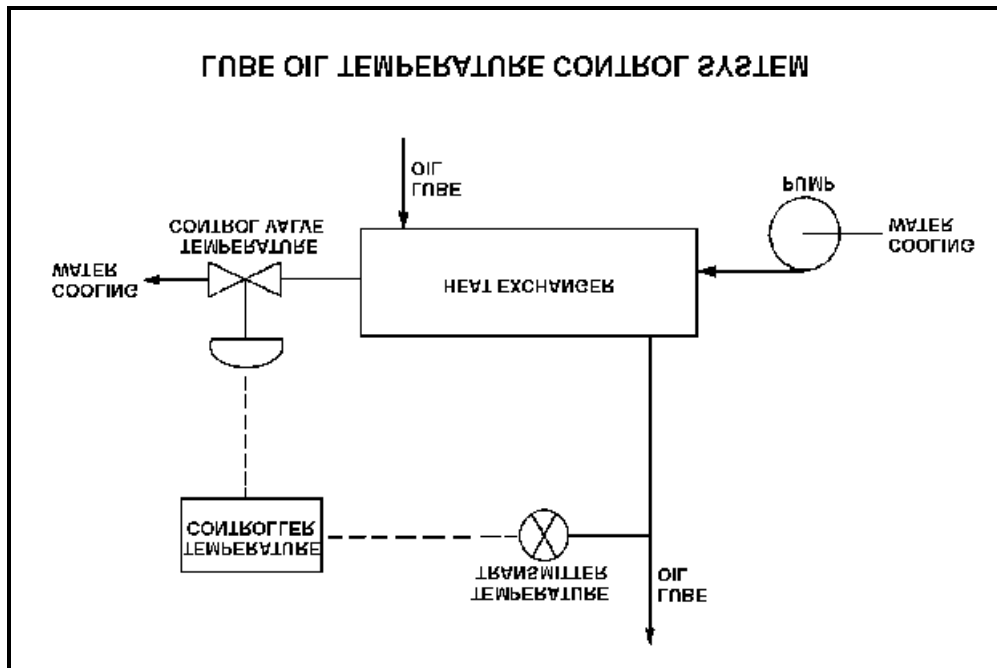
USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B

QUESTION: 44

Refer to the drawing of a lube oil temperature control system (see figure below).

If the temperature transmitter fails high (high temperature output signal), the temperature controller will \_\_\_\_\_ the temperature control valve, causing the actual heat exchanger lube oil outlet temperature to \_\_\_\_\_.

- A. open; decrease
- B. open; increase
- C. close; decrease
- D. close; increase



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 45

An air-operated isolation valve requires 2,400 lbf applied to the top of the actuator diaphragm to open against spring pressure. The actuator diaphragm has a diameter of 12 inches.

If control air pressure to the valve actuator begins to decrease from 100 psig, which one of the following is the approximate air pressure at which the valve will begin to close?

- A. 5.3 psig
- B. 16.7 psig
- C. 21.2 psig
- D. 66.7 psig

QUESTION: 46

Which one of the following describes the operation of a typical pneumatic valve positioner?

- A. Receives a valve position error signal from the valve controller and positions the valve as necessary to null the valve position error signal.
- B. Receives a demand signal from the valve controller and supplies the appropriate air pressure to the valve actuator to move the valve to the demanded position.
- C. Compares the valve controller demand signal with actual valve position and sends an error signal to the valve controller for adjustment of the demand signal.
- D. Compares the valve controller automatic and manual set points and sends an error signal to the valve controller to ensure the manual demand signal is tracking the automatic demand signal.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 47

The level in a drain collection tank is being controlled by an automatic level controller and is initially at the controller set point. Flow rate into the tank increases, slowly at first, and then faster until a stable high flow rate is attained.

As tank level increases, the controller slowly opens a tank drain valve. The level controller output signal increases both as the tank level increases and as the rate of tank level change quickens. After a few minutes, a new, steady-state tank level at the original level is established, with the drain flow rate equal to the supply flow rate.

The controller in this system uses \_\_\_\_\_ control.

- A. proportional only
- B. proportional plus derivative only
- C. proportional plus integral only
- D. proportional plus integral plus derivative

QUESTION: 48

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



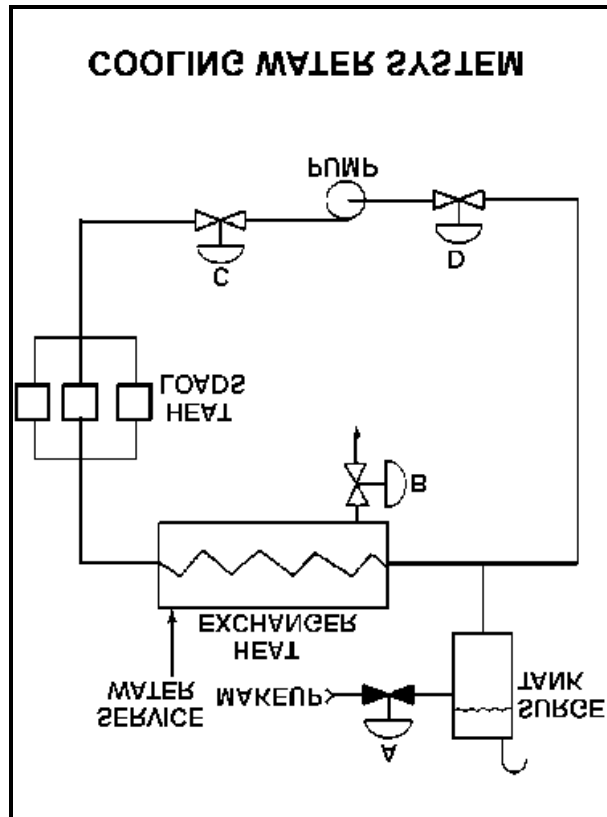
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OCTOBER 2000 PWR--FORM B

QUESTION: 49

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

Which one of the following will increase the available net positive suction head for the centrifugal pump?

- A. Draining the surge tank to decrease level by 10%
- B. Positioning the service water valve B more closed
- C. Positioning the pump discharge valve C more open
- D. Reducing the heat loads on the cooling water system



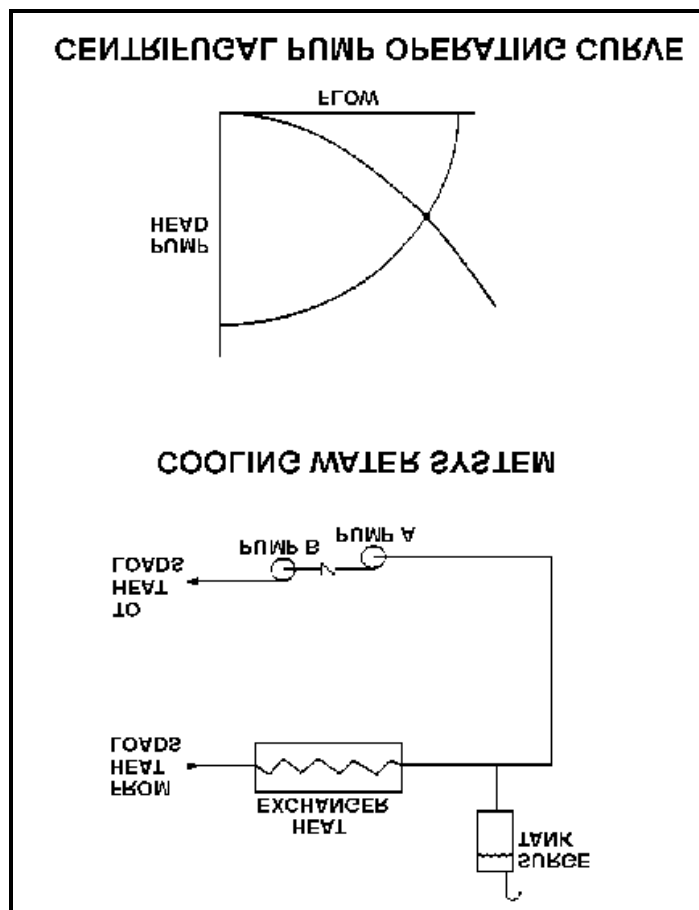
**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 50

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below).

Pumps A and B are identical single-speed centrifugal pumps and both pumps are operating. If pump B trips, after the system stabilizes, system flow rate will be:

- A. more than one-half the original flow.
- B. one-half the original flow.
- C. the same; only the pump head will change.
- D. less than one-half the original flow.



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

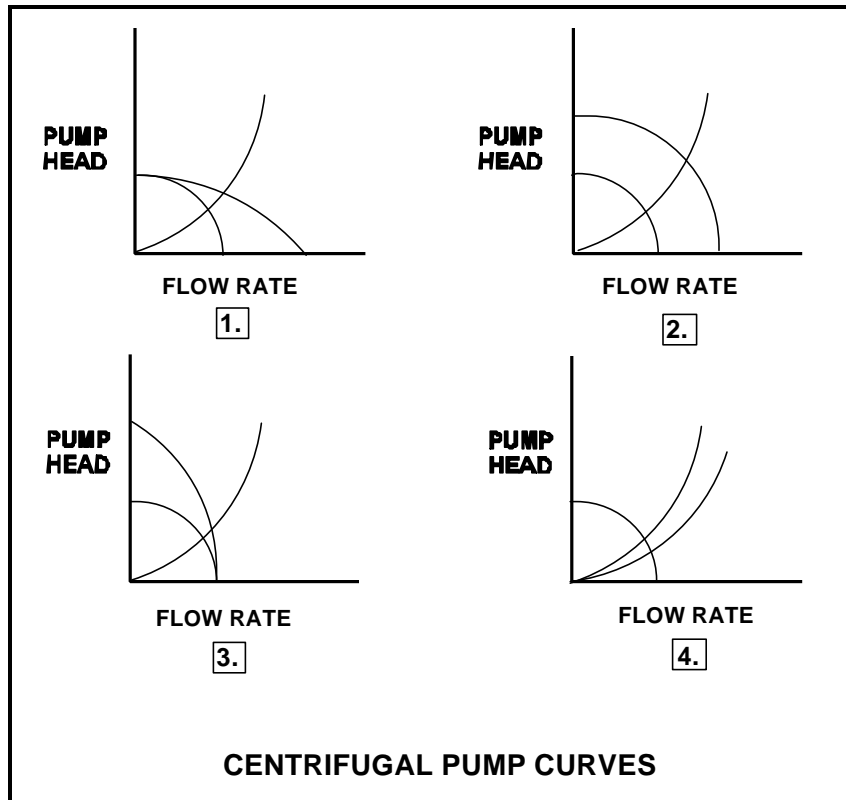
QUESTION: 51

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

A two-speed centrifugal pump is operating at fast speed in a cooling water system and discharging through a heat exchanger. The pump is then switched to slow speed.

Which set of curves illustrates the initial and final operating conditions?

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



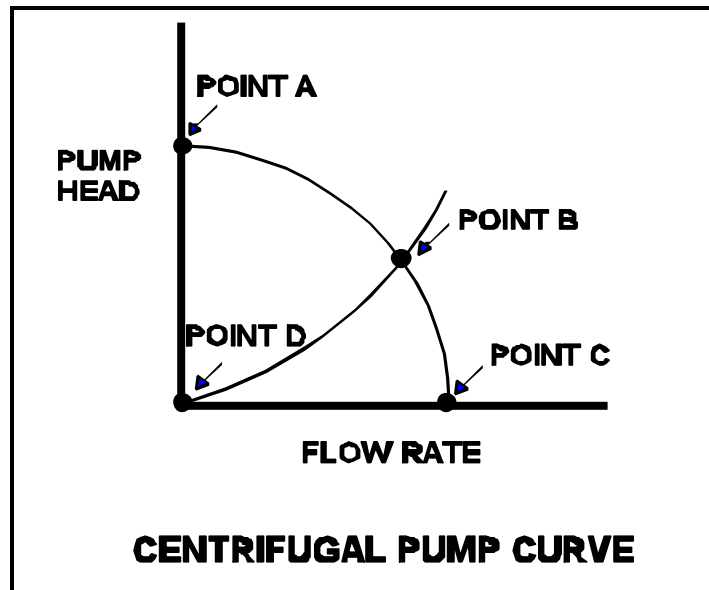
**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 52

Refer to the drawing of a centrifugal pump operating curve (see figure below).

A centrifugal pump operating in a cooling water system exhibits the operating curve shown below. Which one of the following points on the curve will be closest to the pump operating conditions after the pump suction valve is inadvertently closed?

- A. Point A
- B. Point B
- C. Point C
- D. Point D



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 53

A centrifugal pump is circulating water at 180°F with a motor current of 200 amps. After several hours, system temperature has changed such that the water density has increased by 6%.

Assuming pump head and volumetric flow rate do not change, which one of the following is the new pump motor current?

- A. 203 amps
- B. 206 amps
- C. 212 amps
- D. 224 amps

QUESTION: 54

An ideal (no slip) reciprocating positive displacement pump is operating in an open system to provide makeup water to a coolant system that is being maintained at 800 psig. The discharge valve of the pump is full open.

If the pump discharge valve is subsequently throttled to 80% open, pump flow rate will \_\_\_\_\_ and pump head will \_\_\_\_\_.

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 55

To provide protection against damage to a motor, which one of the following breaker trip signals will trip the motor breaker if a motor bearing seizes while the motor is running?

- A. Instantaneous overcurrent
- B. Time-delayed overcurrent
- C. Underfrequency
- D. Undervoltage

QUESTION: 56

A diesel generator (D/G) is the only power source supplying an electrical bus. If D/G frequency is decreased from 60 to 59.8 Hertz, D/G KW will be \_\_\_\_\_ and D/G amps will be \_\_\_\_\_.

(Disregard the effect of the frequency change on individual reactive loads. Assume the D/G output breaker remains closed.)

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 57

A centrifugal pump is operating with the following parameters:

Speed	= 1,800 rpm
Current	= 40 amperes
Pump head	= 20 psi
Pump flow rate	= 400 gpm

What will be the approximate value of pump head and current if pump speed is decreased to 1,200 rpm?

- A. 13 psi, 18 amps
- B. 13 psi, 12 amps
- C. 9 psi, 18 amps
- D. 9 psi, 12 amps

QUESTION: 58

The starting current in a typical ac induction motor is significantly higher than the full-load running current because:

- A. starting torque is lower than running torque.
- B. starting torque is higher than running torque.
- C. rotor speed during start is too low to generate sufficient counter electromotive force (CEMF) in the stator.
- D. rotor current during start is too low to generate sufficient CEMF in the stator.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 59

Two identical 4160 Vac induction motors are connected to identical centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

When the motors are started under these conditions, the shorter time period required to reach a stable running current will be experienced by motor \_\_\_\_\_, and the higher stable running current will be experienced by motor \_\_\_\_\_.

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

QUESTION: 60

A parallel-flow heat exchanger and a counter-flow heat exchanger are being used in the same water-to-water cooling application. Each heat exchanger is identical in construction and each heat exchanger has the same mass flow rates and inlet temperatures.

Under these conditions, the counter-flow heat exchanger will have the \_\_\_\_\_ heat transfer rate because \_\_\_\_\_.

- A. lower; the average  $\Delta T$  across the tube walls is smaller
- B. lower; the average outlet temperature of the two fluids is lower
- C. higher; the average  $\Delta T$  across the tube walls is larger
- D. higher; the average outlet temperature of the two fluids is higher



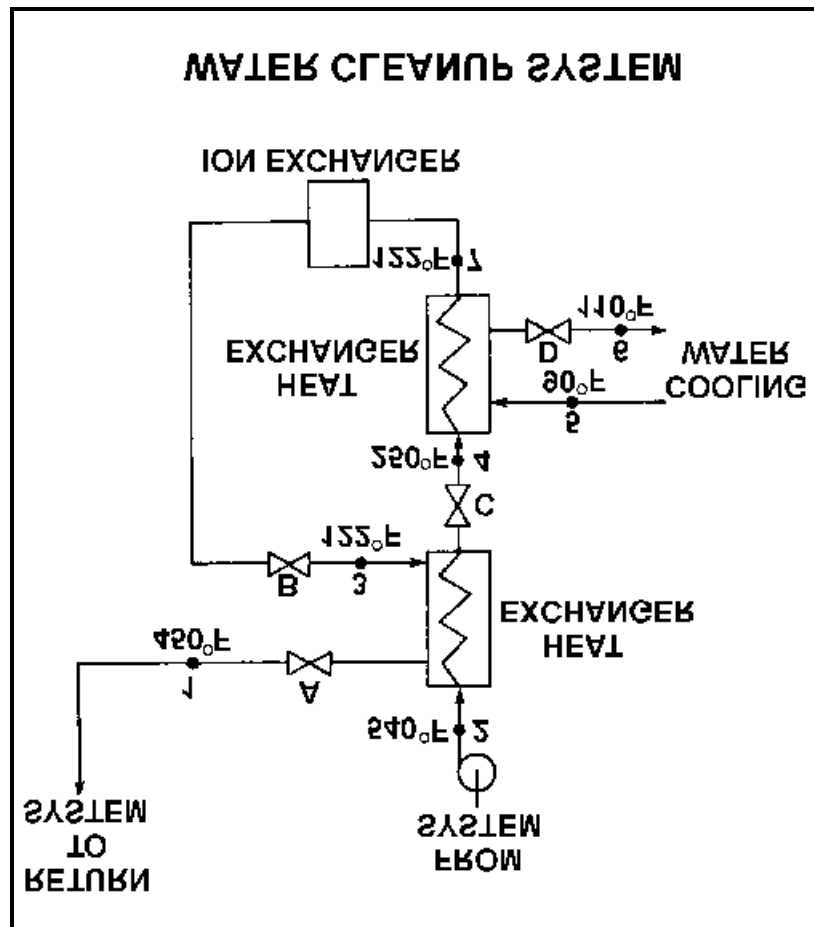
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OCTOBER 2000 PWR--FORM B**

QUESTION: 61

Refer to the drawing of a water cleanup system (see figure below).

Valves A, B, and C are fully open. Valve D is 80% open. All temperatures are as shown. If valve D is then throttled to 50%, the temperature at point:

- A. 3 will decrease.
- B. 4 will increase.
- C. 5 will increase.
- D. 6 will decrease.



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 62

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

The lube oil heat exchanger is in service with the following inlet temperatures:

Lube oil inlet temperature: 130°F

Cooling water inlet temperature: 70°F

Assuming that cooling water flow rate is significantly larger than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is possible? (Assume both fluids have the same specific heat.)

	<u>Lube Oil Outlet Temp</u>	<u>Cooling Water Outlet Temp</u>
A.	100°F	90°F
B.	100°F	100°F
C.	110°F	90°F
D.	110°F	100°F



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 63

The demineralization factor of a demineralizer can be expressed as:

- A. (Inlet Conductivity) - (Outlet Conductivity).
- B. (Outlet Conductivity) - (Inlet Conductivity).
- C. (Inlet Conductivity)  $\div$  (Outlet Conductivity).
- D. (Outlet Conductivity)  $\div$  (Inlet Conductivity).

QUESTION: 64

A demineralizer that is continuously exposed to flowing water with high concentrations of suspended solids will first develop an increase in:

- A. conductivity at the demineralizer outlet.
- B. decontamination factor across the demineralizer.
- C. differential pressure across the demineralizer.
- D. pH at the demineralizer outlet.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 65

A plant has been operating normally at 100% power for one month and with the same reactor coolant boron concentration for the last 24 hours.

Which one of the following changes associated with an in-service reactor coolant demineralizer will cause an increase in reactor coolant boron concentration in the demineralizer effluent?

- A. Increase the temperature of the reactor coolant being processed from 95°F to 105°F.
- B. Decrease the temperature of the reactor coolant being processed from 105°F to 95°F.
- C. Increase the flow rate of reactor coolant being processed from 75 gpm to 100 gpm.
- D. Decrease the flow rate of reactor coolant being processed from 75 gpm to 50 gpm.

QUESTION: 66

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 67

Two identical 1000 MW electrical generators are operating in parallel supplying all the loads on a common electrical bus. The generator output breakers also provide identical protection for the generators. Generator A and B output indications are as follows:

<u>Generator A</u>	<u>Generator B</u>
28,000 KV	28,000 KV
60 Hertz	60 Hertz
150 MW	100 MW
25 MVAR (out)	50 MVAR (out)

A malfunction causes the voltage regulator setpoint for generator B to slowly and continuously decrease. If no operator action is taken, the current indication for generator B will:

- A. initially decrease, and then increase until the output breaker for generator A trips on overcurrent.
- B. initially decrease, and then increase until the output breaker for generator B trips on overcurrent.
- C. decrease continuously until the output breaker for generator A trips on overcurrent.
- D. decrease continuously until the output breaker for generator B trips on reverse power.

QUESTION: 68

Which one of the following is an unsafe practice if performed when working on or near energized electrical equipment?

- A. Use insulated tools to prevent inadvertent contact with adjacent equipment.
- B. Cover exposed energized circuits with insulating material to prevent inadvertent contact.
- C. Attach a metal strap from your body to a nearby neutral ground to ensure that you are grounded.
- D. Have a person standing by with the ability to remove you from the equipment in the event of an emergency.

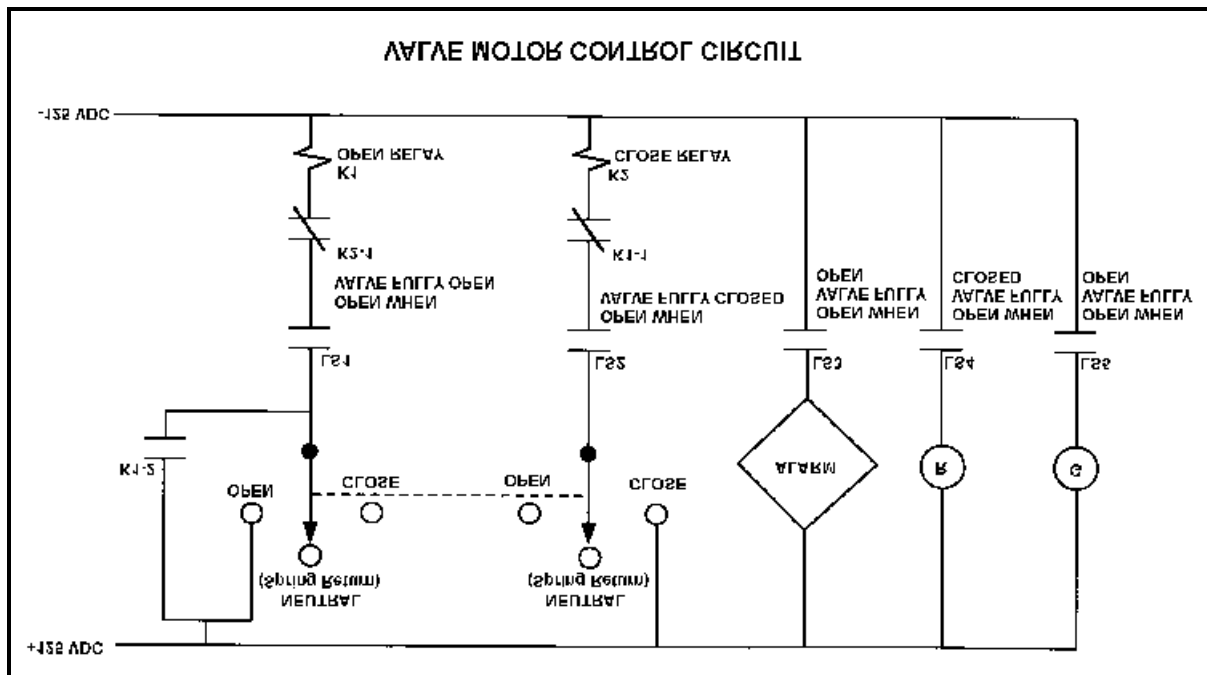
**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 69

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: "LS" contacts are not necessarily shown in their current condition.)

Which one of the following describes the valve response if the control switch is taken to the "Open" position for two seconds and then released?

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

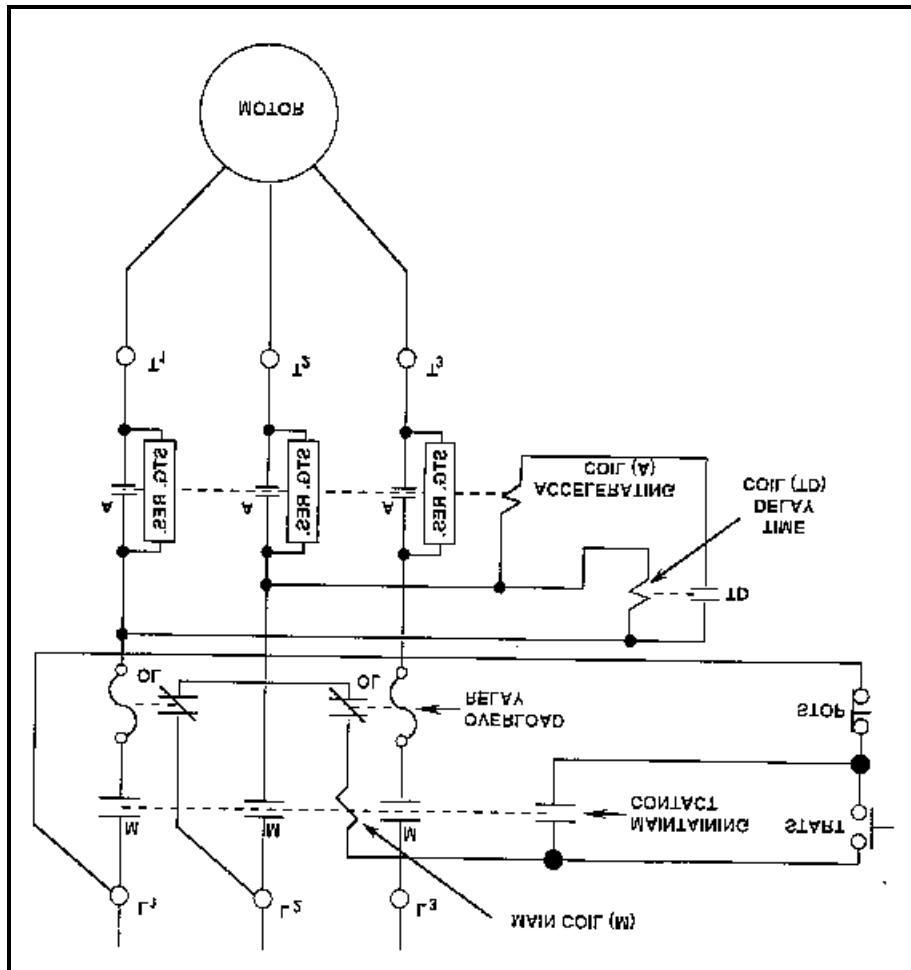


**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 70

What is the purpose of the Time Delay (TD) coil in the motor controller diagram below?

- A. Ensures the motor cannot be started until the overload relays are reset.
- B. Ensures the motor cannot be started until the accelerating coil is energized.
- C. Allows the motor to come up to speed before placing the starting resistors in the circuit.
- D. Allows the motor to come up to speed before bypassing the starting resistors.



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 71

A main generator is being paralleled and connected to the grid with the following conditions:

Generator frequency:	60.1 Hz
Grid frequency:	59.9 Hz
Generator voltage:	115.1 kV
Grid voltage:	114.8 kV

When the generator output breaker is closed, the generator will:

- A. acquire real load and reactive load.
- B. acquire real load, but become a reactive load to the grid.
- C. become a real load to the grid, but acquire reactive load.
- D. become a real load and a reactive load to the grid.

QUESTION: 72

A 480 Vac motor control center supplies a load through a breaker and a manual disconnect. If both isolation devices are operated to isolate the load, 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 first |
| C. Open disconnect first | Shut breaker first    |
| D. Open disconnect first | Shut disconnect first |



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 73

Which one of the following types of neutrons in a reactor is most likely to cause fission of a U-238 nucleus in the reactor fuel? (Assume that each type of neutron remains in the reactor core until it interacts with a U-238 nucleus.)

- A. Thermal neutron
- B. Prompt neutron at birth
- C. Delayed neutron at birth
- D. Neutron at a U-238 resonance energy

QUESTION: 74

Which one of the following is a reason for installing excess reactivity ( $k_{\text{excess}}$ ) in the core?

- A. To compensate for burnout of Xe-135 and Sm-149 during power changes
- B. To ensure reactor coolant boron concentration is low enough to ensure a negative moderator coefficient
- C. To compensate for the negative reactivity added by the power defect during a power increase
- D. To compensate for the conversion of U-238 to Pu-239 over core life

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 75

A reactor is operating at steady-state 50% power. A plant test requires a 4°F decrease in reactor coolant system (RCS) average temperature (T-avg). The operator accomplishes this temperature decrease by adjusting RCS boron concentration. No other operator actions are taken.

If the initial shutdown margin was 3.0%  $\beta$  K/K, which one of the following describes the shutdown margin at the lower RCS T-avg with the reactor still at steady-state 50% power?

- A. Less than 3.0%  $\beta$  K/K, because RCS T-avg is lower.
- B. More than 3.0%  $\beta$  K/K, because RCS boron concentration is higher.
- C. Equal to 3.0%  $\beta$  K/K, because the reactivity change caused by the change in RCS T-avg offsets the reactivity change caused by the change in RCS boron concentration.
- D. Equal to 3.0%  $\beta$  K/K because shutdown margin in an operating reactor will not change unless control rod position changes.

QUESTION: 76

A typical PWR reactor plant is operating at equilibrium 50% power when a control rod is ejected from the core. Which one of the following combinations of fission percentages, by fuel, would result in the highest reactor startup rate? (Assume the reactivity worth of the ejected control rod is the same for each case.)

Percentage of Fissions by Fuel

	<u>U-235</u>	<u>U-238</u>	<u>Pu-239</u>
A.	60%	6%	34%
B.	70%	7%	23%
C.	80%	6%	14%
D.	90%	7%	3%

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 77

A reactor is operating at equilibrium 75% power with the following conditions:

Total power defect	= -0.0185 ? K/K
Shutdown margin	= 0.0227 ? K/K
Effective delayed neutron fraction	= 0.0061
Effective prompt neutron fraction	= 0.9939

How much positive reactivity must be added to make the reactor "prompt critical"?

- A. 0.0061 ? K/K
- B. 0.0185 ? K/K
- C. 0.0227 ? K/K
- D. 0.9939 ? K/K

QUESTION: 78

Which one of the following describes the net reactivity effect of a moderator temperature increase in an overmoderated reactor core?

- A. Negative reactivity will be added because more neutron leakage will occur.
- B. Negative reactivity will be added because more neutrons will be captured by the moderator.
- C. Positive reactivity will be added because less neutron leakage will occur.
- D. Positive reactivity will be added because fewer neutrons will be captured by the moderator.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 79

Compared to operation at a low power level, the fuel temperature coefficient of reactivity at a high power level is \_\_\_\_\_ negative due to \_\_\_\_\_. (Assume the same core age.)

- A. less; improved pellet-to-clad heat transfer
- B. more; buildup of fission product poisons
- C. less; higher fuel temperature
- D. more; increased neutron flux

QUESTION: 80

Given the following initial parameters:

Total power coefficient	= -0.020% ? K/K/%
Boron worth	= -0.010% ? K/K/ppm
Rod worth	= -0.025% ? K/K/inch inserted
Initial reactor coolant system (RCS) boron concentration	= 600 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 40% to 80% by boration/dilution with 40 inches of outward control rod motion? (Assume no change in core xenon-135 reactivity.)

- A. 420 ppm
- B. 580 ppm
- C. 620 ppm
- D. 780 ppm

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 81

Neglecting the effects of core Xe-135, which one of the following power changes requires the greatest amount of positive reactivity addition?

- A. 3% power to 10% power
- B. 10% power to 25% power
- C. 25% power to 65% power
- D. 65% power to 100% power

QUESTION: 82

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux =  $1 \times 10^{12}$  n/cm<sup>2</sup>-sec

Control rod tip thermal neutron flux =  $5 \times 10^{12}$  n/cm<sup>2</sup>-sec

If the control rod is slightly withdrawn such that the control rod tip is located in a thermal neutron flux of  $1 \times 10^{13}$  n/cm<sup>2</sup>-sec, then the differential control rod worth will increase by a factor of \_\_\_\_\_. (Assume the core average thermal neutron flux is constant.)

- A. 2
- B. 4
- C. 10
- D. 100

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 83

Which one of the following events will cause control rod worth to become less negative?

- A. Fuel temperature decreases as the fuel pellets come into contact with the fuel clad.
- B. RCS boron concentration increases by 5 ppm at 80% power with no rod motion.
- C. Reactor power is decreased from 100% to 90% with no rod motion.
- D. Early in core life, the concentration of burnable poison decreases.

QUESTION: 84

Which one of the following describes why most of the power is produced in the lower half of a reactor core that has been operating at 100% power for several weeks with all control rods withdrawn at the beginning of core life?

- A. Xenon concentration is lower in the lower half of the core.
- B. The moderator to fuel ratio is lower in the lower half of the core.
- C. The fuel loading in the lower half of the core contains a higher U-235 enrichment.
- D. The moderator temperature coefficient of reactivity is adding less negative reactivity in the lower half of the core.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 85

The control rod insertion limits are power dependent because the magnitude of:

- A. power defect increases as power increases.
- B. control rod worth decreases as power increases.
- C. Doppler (fuel temperature) coefficient decreases as power increases.
- D. moderator temperature coefficient increases as power increases.

QUESTION: 86

Reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating at end of core life and reactor B is operating at beginning of core life.

Which reactor has the greatest core Xe-135 concentration?

- A. Reactor A due to the smaller 100% power thermal neutron flux
- B. Reactor A due to the greater 100% power thermal neutron flux
- C. Reactor B due to the greater 100% power thermal neutron flux
- D. Reactor B due to the smaller 100% power thermal neutron flux

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 87

Which one of the following combinations of core age (beginning of core life (BOL) or end of core life (EOL)) and long-term power history (20% or 100%) will require the greatest amount of positive reactivity addition to attain reactor criticality during peak core Xe-135 conditions after a reactor trip from equilibrium core Xe-135 conditions?

- A. EOL and 20% power
- B. EOL and 100% power
- C. BOL and 20% power
- D. BOL and 100% power

QUESTION: 88

Given:

- A reactor had been operating at 100% power for six weeks when a scram occurred.
- A reactor startup was performed and criticality was reached 16 hours after the scram.
- Two hours later, the reactor is steady at 30% power with control rods in Manual.

If no operator actions are taken over the next hour, average reactor coolant temperature will \_\_\_\_\_ because core Xe-135 is \_\_\_\_\_.

- A. increase; decreasing
- B. increase; increasing
- C. decrease; decreasing
- D. decrease; increasing



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 89

A reactor has been operating at steady-state 30% power for 3 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

- A. Increasing toward a peak
- B. Decreasing toward an upturn
- C. Increasing toward equilibrium
- D. Decreasing toward equilibrium

QUESTION: 90

A plant was shut down following three months of operation at full power. The shutdown occurred over a 3 hour period with a constant rate of power decrease.

Which one of the following describes the reactivity added by core xenon-135 during the shutdown?

- A. Xenon buildup added negative reactivity.
- B. Xenon buildup added positive reactivity.
- C. Xenon burnout added negative reactivity.
- D. Xenon burnout added positive reactivity.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 91

A reactor is operating at 60% power immediately after a one-hour power increase from equilibrium 40% power. To keep RCS T-avg stable over the next two hours, the operator must \_\_\_\_\_ control rods or \_\_\_\_\_ reactor coolant boron concentration.

- A. insert; increase
- B. insert; decrease
- C. withdraw; increase
- D. withdraw; decrease

QUESTION: 92

A reactor has been operating at 100% power for three months following a refueling outage. If the reactor is operated at 100% power without making RCS boron additions or dilutions for the next month, RCS boron concentration will:

- A. decrease because boron atoms decompose at normal RCS operating temperatures.
- B. decrease because irradiated boron-10 atoms undergo a neutron-alpha reaction.
- C. remain constant because irradiated boron-10 atoms become stable boron-11 atoms.
- D. remain constant because irradiated boron-10 atoms still have large absorption cross sections for thermal neutrons.

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QUESTION: 93

During a reactor startup, the first reactivity addition caused the count rate to increase from 20 to 30 cps. The second reactivity addition caused the count rate to increase from 30 to 60 cps. Assume  $k_{\text{eff}}$  was 0.97 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

- A. The first reactivity addition was approximately 50% larger than the second.
- B. The second reactivity addition was approximately 50% larger than the first.
- C. The first and second reactivity additions were approximately the same.
- D. There is not enough data given to determine the relationship of reactivity values.

QUESTION: 94

While withdrawing control rods during an approach to criticality, the stable count rate doubles. If the same amount of reactivity that caused the first doubling is added again, stable count rate will \_\_\_\_\_ and the reactor will be \_\_\_\_\_.

- A. double; subcritical
- B. more than double; subcritical
- C. double; critical
- D. more than double; critical

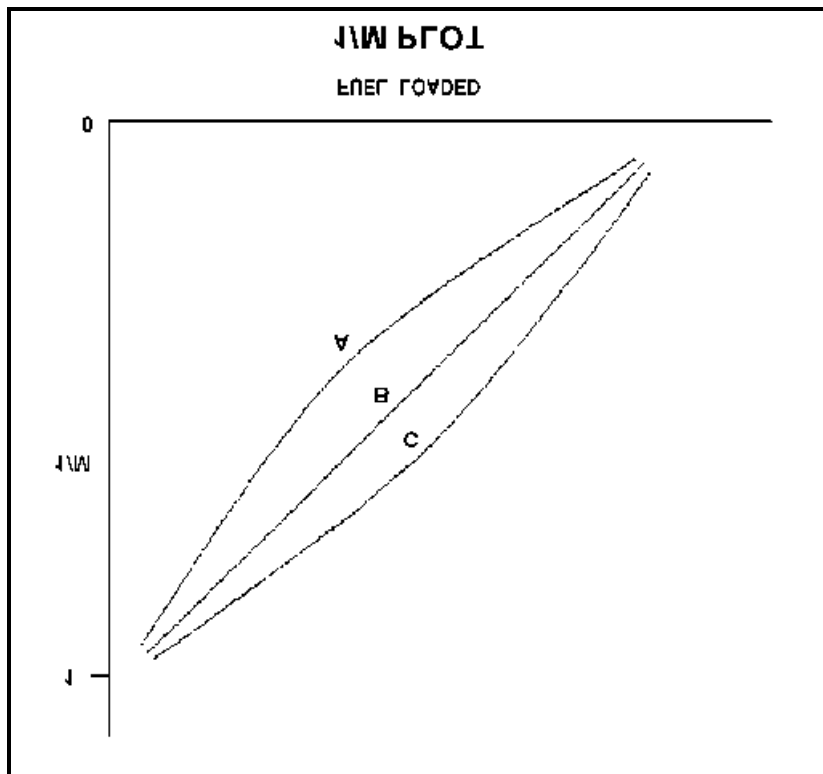
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QUESTION: 95

Refer to the drawing of a  $1/M$  plot (see figure below).

The least conservative approach to criticality is represented by curve \_\_\_\_\_ and could possibly be the result of recording count rates at \_\_\_\_\_ time intervals after incremental fuel loading steps than for the situations represented by the other curves.

- A. A; shorter
- B. A; longer
- C. C; shorter
- D. C; longer



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QUESTION: 96

A reactor startup is in progress; control rod withdrawal has just been stopped to assess criticality. Which one of the following is a combination of indications in which each listed indication supports a declaration that the reactor is critical?

- A. Stable startup rate equals 0.0 dpm; source range count rate is stable; inverse multiplication (1/M) value equals 1.111.
- B. Stable startup rate equals +0.2 dpm; source range count rate is slowly increasing; inverse multiplication (1/M) value equals 1.000
- C. Stable startup rate equals 0.0 dpm; source range count rate is stable; inverse multiplication (1/M) value equals 0.111.
- D. Stable startup rate equals +0.2 dpm; source range count rate is slowly increasing; inverse multiplication (1/M) value equals 0.000.

QUESTION: 97

Reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the longer reactor period five minutes after the scram?

- A. Reactor A because its delayed neutron fraction will be smaller.
- B. Reactor B because its delayed neutron fraction will be larger.
- C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.
- D. Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

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QUESTION: 98

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a bank of control rods for 20 seconds to establish a stable 1.0 DPM startup rate (SUR). One minute later (prior to reaching the point of adding heat), the operator inserts the same bank of control rods for 25 seconds.

During the rod insertion, the SUR becomes negative:

- A. immediately when the control rod insertion is initiated.
- B. after the control rods pass through the critical rod height.
- C. just as the control rods pass through the critical rod height.
- D. prior to the control rods passing through the critical rod height.

QUESTION: 99

Which one of the following describes the process for inserting control rods during a normal reactor shutdown?

- A. Control rods are inserted in reverse order one bank at a time to maintain acceptable power distribution.
- B. Control rods are inserted in reverse order one bank at a time to maintain a rapid shutdown capability from the remainder of the control rods.
- C. Control rods are inserted in reverse order in a bank overlapping sequence to maintain a relatively constant differential control rod worth.
- D. Control rods are inserted in reverse order in a bank overlapping sequence to limit the amount of positive reactivity added during a rod ejection accident.

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
OCTOBER 2000 PWR--FORM B**

QUESTION: 100

A reactor has been operating for one hour at 50% power following six months of operation at steady-state 100% power. What percentage of rated thermal power is currently being generated by reactor decay heat?

- A. 1% to 2%
- B. 3% to 5%
- C. 6% to 8%
- D. 9% to 11%