

**UNITED STATES NUCLEAR REGULATORY COMMISSION  
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005--FORM A**

**Please Print**

Name: \_\_\_\_\_

Docket No.: \_\_\_\_\_

Facility: \_\_\_\_\_

Start Time: \_\_\_\_\_ Stop Time: \_\_\_\_\_

**INSTRUCTIONS TO APPLICANT**

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item. Each test item has equal point value. A score of at least 80% is required to pass this portion of the NRC operator licensing written 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 performed 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 your individual docket number.
3. Fill in the name of your facility.
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 and Mollier Diagram provided by your proctor.
6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.
7. Scrap paper will be provided for calculations.
8. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.
9. Restroom trips are limited. Only **ONE** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside of the examination room.
10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination.
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**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

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

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

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

**CONVERSIONS**

---

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

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

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

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

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

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

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

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

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

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QUESTION: 1

The difference between the set point pressure at which a safety valve opens and the pressure at which it closes is called...

- A. blowdown.
- B. accumulation.
- C. set point tolerance.
- D. set point deviation.

QUESTION: 2

A typical Limitorque<sup>®</sup> motor-operated valve is installed in an emergency core cooling system (ECCS) application. The ECCS actuation signal is designed to energize the valve motor and open the valve. The valve is currently open, but being manually/locally closed by a technician as required by a surveillance test procedure. The declutch lever has been operated and released, and the valve is being closed by operation of the valve handwheel.

If an ECCS actuation signal is received, how will the valve be affected?

- A. The handwheel will disengage and the valve will automatically open.
- B. The handwheel will disengage and the valve will remain in the current position.
- C. The handwheel will remain engaged and the valve will automatically open.
- D. The handwheel will remain engaged and the technician can continue to close the valve.

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QUESTION: 3

A main steam flow rate differential pressure detector was properly calibrated to produce a main steam flow rate indication of 500,000 lbm/hr with the following initial input conditions:

Detector high pressure input: 1,000 psia  
Detector low pressure input: 950 psia

The current detector input conditions are as follows:

Detector high pressure input: 985 psia  
Detector low pressure input: 935 psia

Assume that the detector and associated circuitry do not have steam density compensation. Also assume that the main steam quality and volumetric flow rate do not change.

The current main steam flow rate indication is \_\_\_\_\_ 500,000 lbm/hr; and the current main steam flow rate is \_\_\_\_\_ 500,000 lbm/hr.

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

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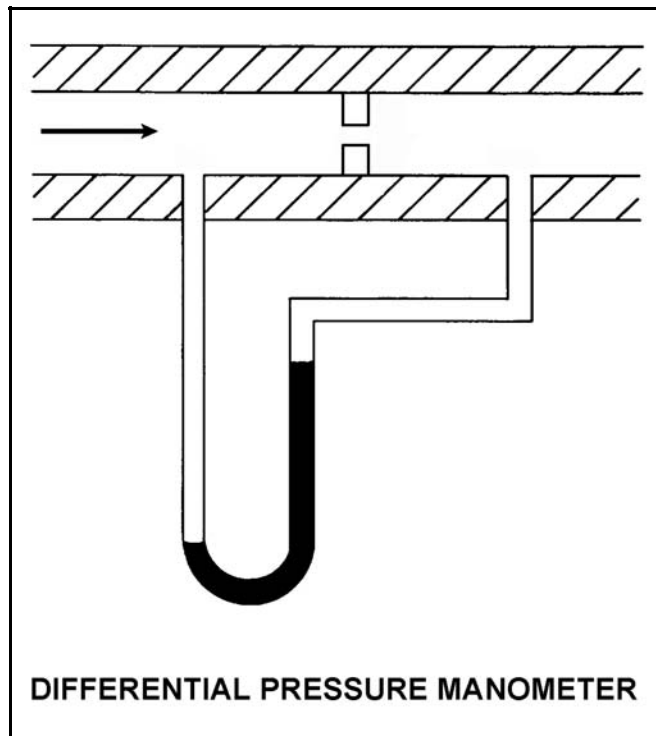
QUESTION: 4

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

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow. The manometer is currently indicating a water level difference of 8 inches at an air flow rate of 300 cubic feet per minute ( $\text{ft}^3/\text{min}$ ).

Which one of the following will be the approximate air flow rate when the manometer indicates a water level difference of 4 inches?

- A. 75  $\text{ft}^3/\text{min}$
- B. 150  $\text{ft}^3/\text{min}$
- C. 188  $\text{ft}^3/\text{min}$
- D. 212  $\text{ft}^3/\text{min}$



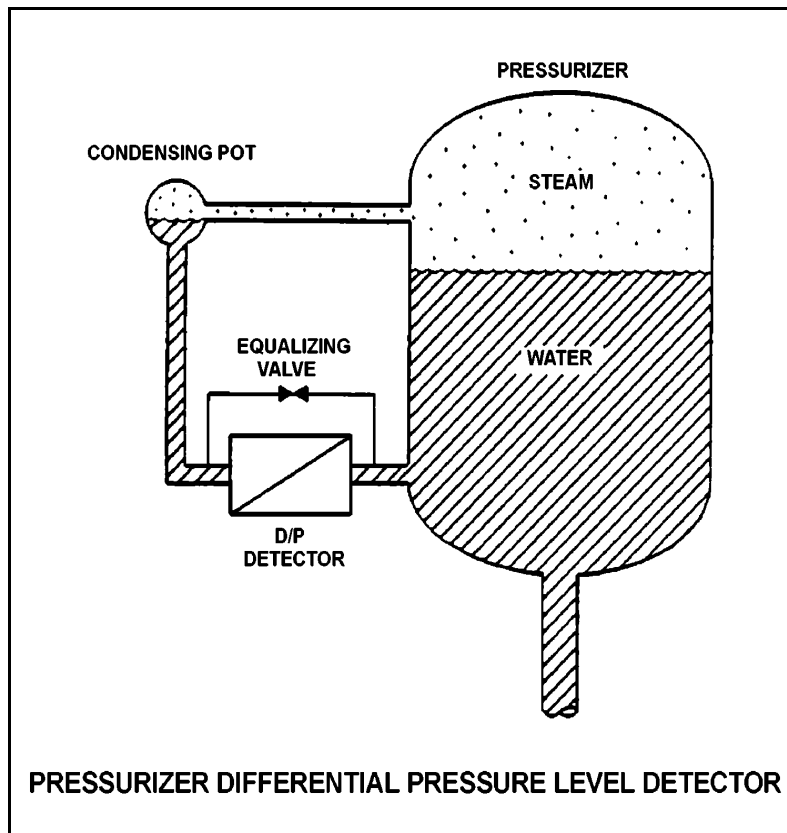
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QUESTION: 5

Refer to the drawing of a pressurizer and differential pressure (D/P) level detector that was recently calibrated at normal operating conditions (see figure below). Assume that the associated pressurizer level instrument does not use density compensation.

With the nuclear power plant shut down at reduced reactor coolant system temperature and pressure, the pressurizer level instrument will indicate \_\_\_\_\_ than actual water level because the D/P currently sensed by the D/P detector is \_\_\_\_\_ than the D/P for the same pressurizer water level at normal operating conditions.

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



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QUESTION: 6

A boron trifluoride ( $\text{BF}_3$ ) detector (proportional counter) is normally used to monitor only source range core neutron level. How will the detector and source range count rate indication be affected if normal detector high voltage is inadvertently applied during nuclear reactor operation in the power range?

- A. The  $\text{BF}_3$  gas will become completely ionized and source range indication will stabilize at a constant low value.
- B. The  $\text{BF}_3$  gas will become completely ionized and source range indication will stabilize at a constant high value.
- C. The detector electrodes will become exposed to an extremely high neutron flux and cause a false high reading on the source range indication.
- D. The detector electrodes will become exposed to an extremely high gamma flux and cause a false high reading on the source range indication.



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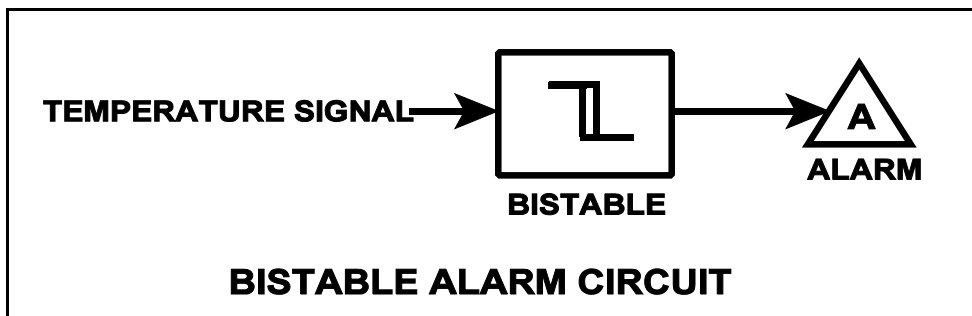
QUESTION: 7

Refer to the drawing of a temperature bistable in a bistable alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram. The bistable turns on to actuate an alarm at a temperature of 130°F. The bistable has a 5°F dead band, or neutral zone.

If the current temperature is 150°F, which one of the following describes the alarm response as temperature slowly decreases to 110°F?

- A. The alarm is currently actuated and will not turn off.
- B. The alarm will actuate at 130°F and will not turn off.
- C. The alarm is currently actuated and will turn off at 125°F.
- D. The alarm will actuate at 130°F and will turn off at 125°F.



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QUESTION: 8

Which one of the following describes a characteristic of pneumatic valve positioners?

- A. They can provide automatic and manual demand signals to pneumatic controllers and valve actuators.
- B. They can increase or decrease air pressure to valve actuators to obtain the proper valve response.
- C. They can either supply or receive air to/from pneumatic controllers, depending on the direction of valve travel.
- D. They can increase air pressure to valve actuators above existing main air header pressure.

QUESTION: 9

A system pressure controller has the following features:

- The controller output signal is null when the differential pressure ( $\Delta P$ ) between the pressure setpoint and the actual system pressure is zero.
- The controller output signal increases linearly with the  $\Delta P$ .
- The controller output signal is not affected by the rate of change of the  $\Delta P$ .
- The controller output signal is not affected by the length of time the  $\Delta P$  exists.

Which one of the following lists the type(s) of control used by the controller described above?

- A. Bistable only
- B. Proportional only
- C. Proportional plus integral
- D. Proportional plus derivative

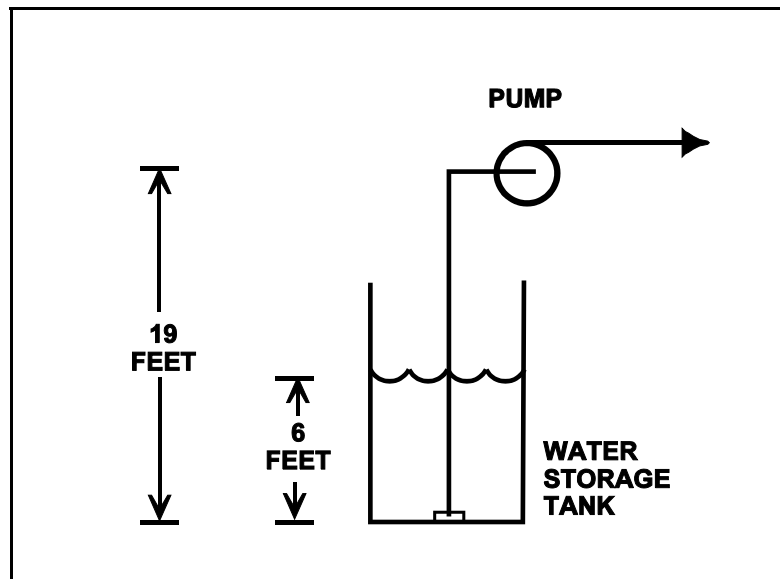
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QUESTION: 10

Refer to the drawing below of a centrifugal pump taking suction from the bottom of an open storage tank containing water at 66°F. Pump and water level elevations are indicated in the figure. Assume standard atmospheric pressure.

Assuming that pump suction fluid velocity head loss is negligible, what is the approximate value of net positive suction head available to the pump.

- A. 6 feet
- B. 13 feet
- C. 20 feet
- D. 25 feet



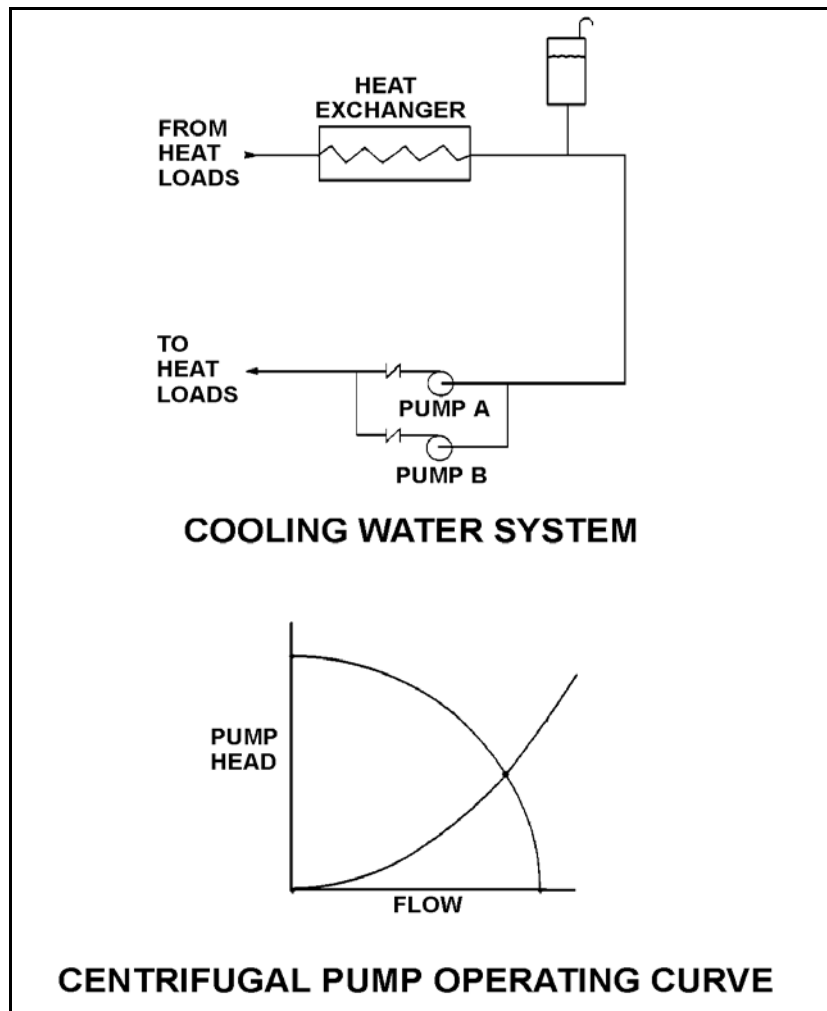
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QUESTION: 11

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below) in which pumps A and B are identical single-speed centrifugal pumps and only pump A is operating.

If pump B is started, system flow rate will be \_\_\_\_\_ and common pump discharge pressure will be \_\_\_\_\_.

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



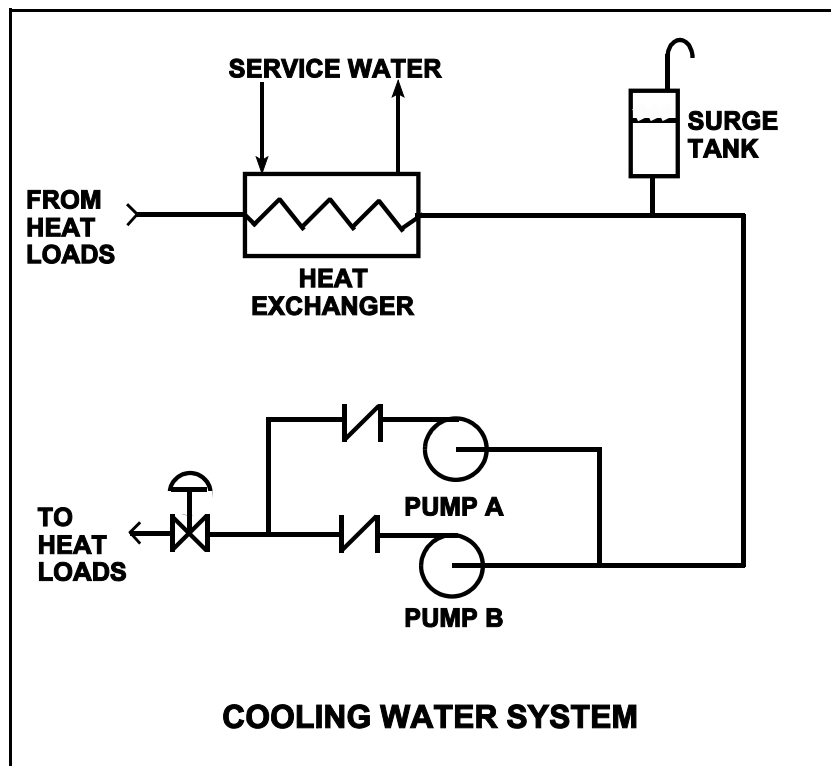
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QUESTION: 12

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: 13

If the speed of a positive displacement pump is increased, the available net positive suction head will \_\_\_\_\_ and the probability of cavitation will \_\_\_\_\_.

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

QUESTION: 14

An ac generator is supplying an isolated electrical system with a power factor of 1.0. If generator voltage is held constant while real load (kW) increases, the current supplied by the generator will increase in direct proportion to the \_\_\_\_\_ of the change in real load. (Assume power factor remains constant at 1.0.)

- A. cube
- B. square
- C. amount
- D. square root

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QUESTION: 15

Select the option that correctly fills in the blanks.

To minimize the adverse effects of starting current, an ac induction motor should be started \_\_\_\_\_ to \_\_\_\_\_ the stator counter electromotive force (CEMF).

- A. unloaded; quickly establish
- B. unloaded; delay
- C. partially loaded; quickly establish
- D. partially loaded; delay

QUESTION: 16

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

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

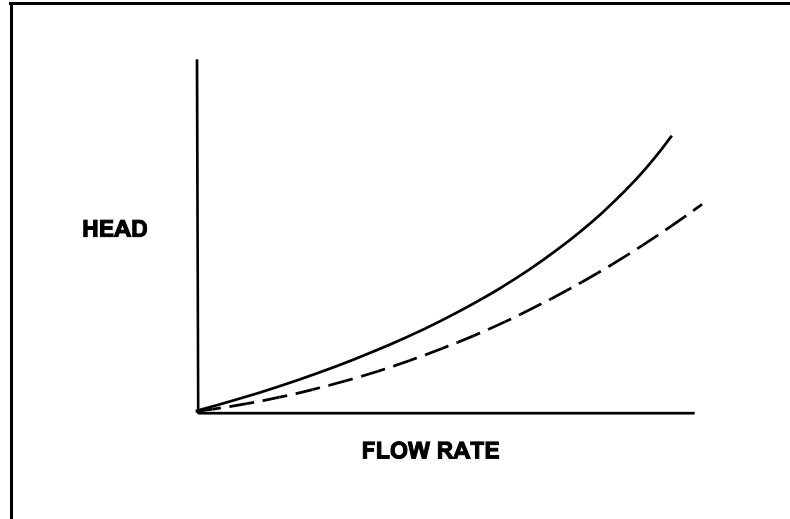
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QUESTION: 17

Refer to the drawing of two system curves for a typical main condenser cooling water system (see figure below).

Which one of the following will result in the system curve shifting from the solid curve toward the dashed curve?

- A. The main condenser tubes are cleaned.
- B. The main condenser tubes become increasingly fouled.
- C. Cooling water flow rate is increased by 25% by starting an additional cooling water pump.
- D. Cooling water flow rate is decreased by 25% by stopping one of the operating cooling water pumps.





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QUESTION: 18

A lower than expected differential pressure across a demineralizer is an indication of...

- A. depletion of the cation resin.
- B. channeling through the resin bed.
- C. improper resin regeneration.
- D. excessive accumulation of suspended solids.

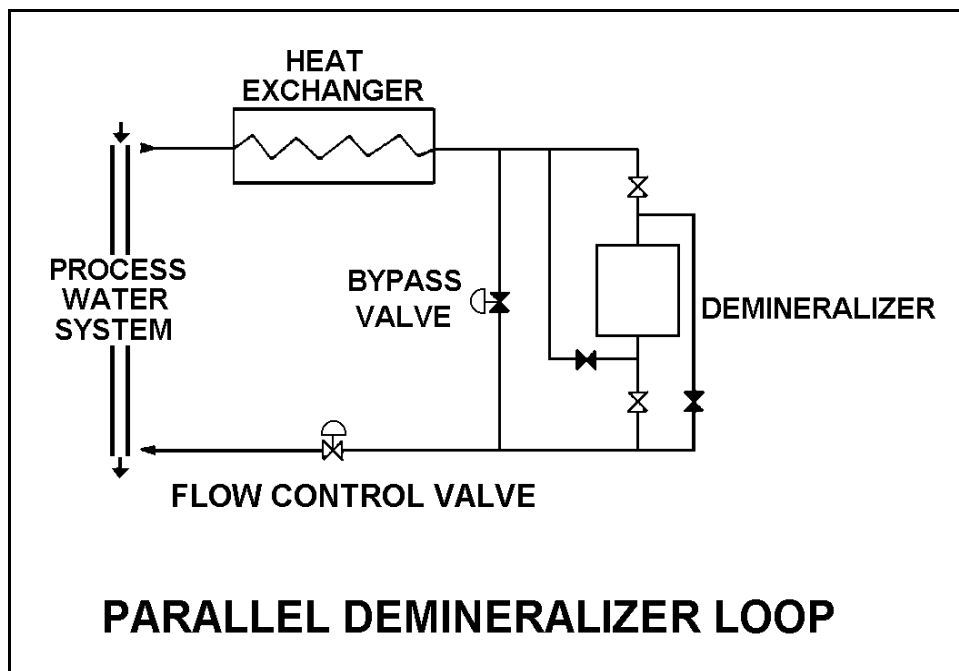
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QUESTION: 19

Refer to the drawing of a parallel demineralizer loop that is currently aligned for normal flow direction through the demineralizer (see figure below).

Which one of the following is most likely to cause a decrease in the demineralizer decontamination factor for ionic impurities?

- A. Divert 50% of the demineralizer loop flow to bypass the demineralizer.
- B. Decrease the process water system pressure from 125 psig to 75 psig.
- C. Decrease the flow rate in the demineralizer loop from 105 gpm to 65 gpm.
- D. Increase the temperature in the demineralizer loop from 140°F to 200°F.



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QUESTION: 20

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

<u>Generator A</u>	<u>Generator B</u>
22 KV	22 KV
60.2 Hertz	60.2 Hertz
200 MW	200 MW
25 MVAR (out)	50 MVAR (out)

A malfunction causes the voltage regulator setpoint for generator B to slowly increase continuously toward a maximum of 25 KV. If no operator action is taken, generator A output current will...

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

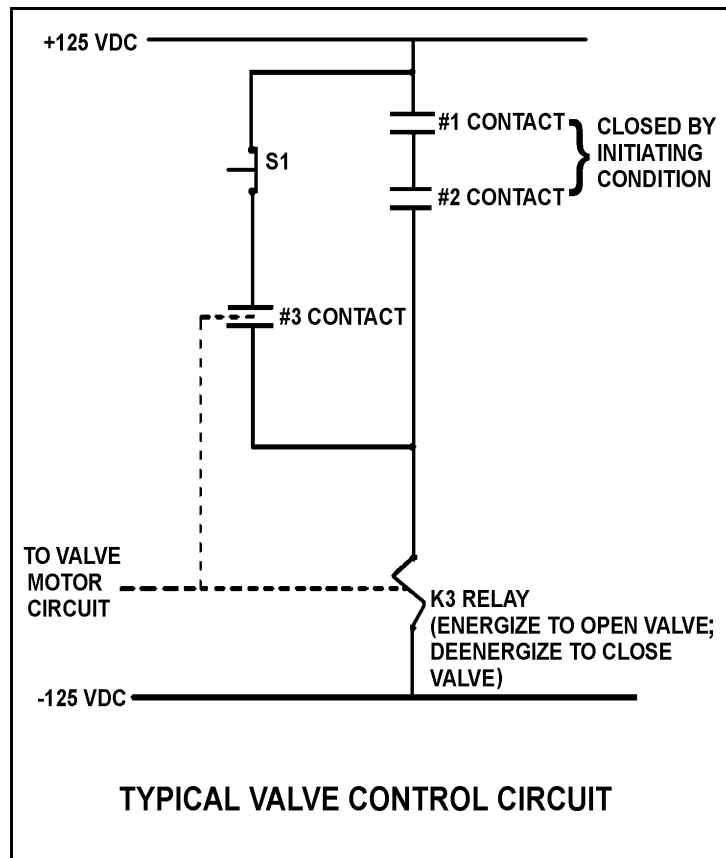
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QUESTION: 21

Refer to the drawing of a typical valve control circuit (see figure below).

What is the purpose of depressing the S1 pushbutton?

- A. To deenergize the K3 relay after the initiating condition has cleared.
- B. To prevent energizing the K3 relay when the initiating condition occurs.
- C. To manually energize the K3 relay in the absence of the initiating condition.
- D. To maintain the K3 relay energized after the initiating condition has cleared.



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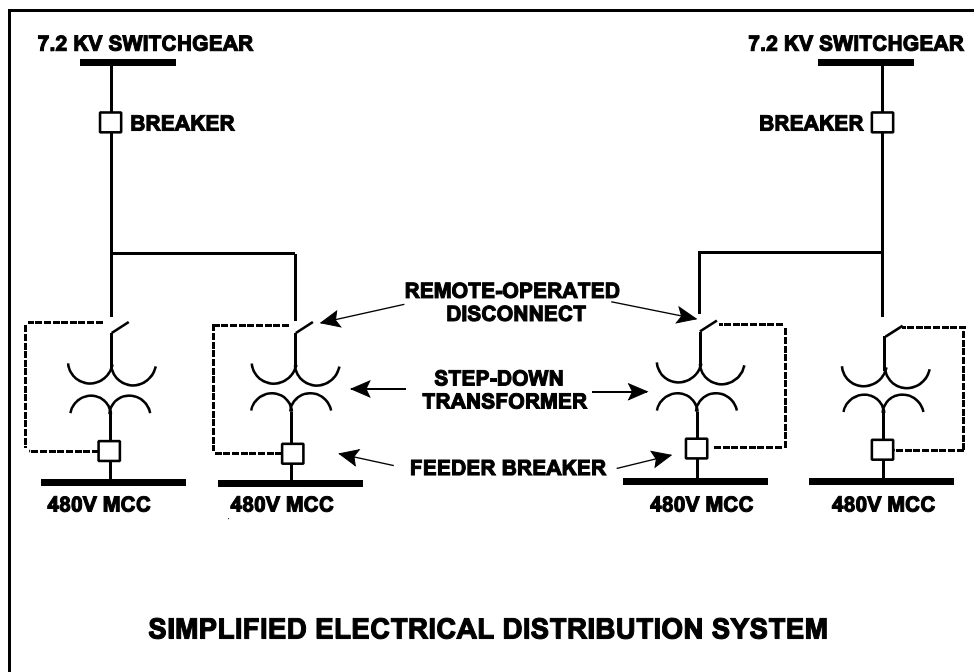
QUESTION: 22

Refer to the simplified drawing of an electrical distribution system (see figure below).

The high voltage side of each step-down transformer has a remote-operated disconnect to allow transformer maintenance while keeping the other transformers in service. The control circuit for each disconnect is position-interlocked with the associated MCC feeder breaker.

Which one of the following describes the purpose served by the interlock?

- A. Prevent damage to the disconnect.
- B. Prevent damage to the transformer.
- C. Prevent damage to the feeder breaker.
- D. Prevent damage to the 480V MCC.



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QUESTION: 23

Which one of the following types of neutrons in a nuclear reactor is more 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 fission neutron beginning to slow down
- C. Delayed fission neutron beginning to slow down
- D. Neutron at a U-238 resonance energy

QUESTION: 24

With a nuclear power plant operating at 85% power and rod control in Manual, the operator borates the reactor coolant system an additional 10 ppm. Assuming reactor power does not change during the boration, shutdown margin will...

- A. decrease and stabilize at a lower value.
- B. decrease, then increase to the original value as coolant temperature changes.
- C. increase and stabilize at a higher value.
- D. increase, then decrease to the original value as coolant temperature changes.

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QUESTION: 25

A step positive reactivity addition of  $0.001 \Delta K/K$  is made to a nuclear reactor with a stable neutron population and an initial core  $K_{\text{eff}}$  of 0.99. Consider the following two cases:

Case 1: The reactor is near the beginning of core life.

Case 2: The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case. Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

- A. The prompt jump will be greater for case 1, but the final stable neutron population will be the same for both cases.
- B. The prompt jump will be greater for case 2, but the final stable neutron population will be the same for both cases.
- C. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 1.
- D. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 2.

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QUESTION: 26

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

Reactor power is 50%.

Average reactor coolant temperature is 570°F.

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

Reactor power is 80%.

Average reactor coolant temperature is 582°F.

Assume that the initial and current reactor coolant boron concentrations are the same. Which one of the following describes the current differential boron worth (DBW) in comparison to the initial DBW?

- A. The current DBW is more negative because a 1 °F increase in reactor coolant temperature will remove more boron-10 atoms from the core.
- B. The current DBW is more negative because a 1 ppm increase in reactor coolant boron concentration will add more boron-10 atoms to the core.
- C. The current DBW is less negative because a 1 °F increase in reactor coolant temperature will remove fewer boron-10 atoms from the core.
- D. The current DBW is less negative because a 1 ppm increase in reactor coolant boron concentration will add fewer boron-10 atoms to the core.



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QUESTION: 27

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

- A. 3% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 60% power

QUESTION: 28

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

Core average thermal neutron flux =  $1.0 \times 10^{12}$  neutrons/cm<sup>2</sup>-sec  
Control rod tip neutron flux =  $5.0 \times 10^{12}$  neutrons/cm<sup>2</sup>-sec

If the control rod is slightly withdrawn such that the tip of the control rod is located in a neutron flux of  $1.0 \times 10^{13}$  neutrons/cm<sup>2</sup>-sec, then the differential control rod worth will increase by a factor of \_\_\_\_\_. (Assume the average flux is constant.)

- A. 0.5
- B. 1.4
- C. 2.0
- D. 4.0

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QUESTION: 29

Why are control rod insertion limits established for power operation?

- A. To minimize the worth of a postulated dropped control rod.
- B. To maintain a negative moderator temperature coefficient in the reactor.
- C. To provide adequate shutdown margin after a reactor trip.
- D. To ensure sufficient positive reactivity is available to compensate for the remaining power defect.

QUESTION: 30

Which one of the following explains why core Xe-135 oscillations are a concern in a nuclear reactor?

- A. They can adversely affect core power distribution and can prevent a reactor startup following a reactor trip.
- B. They can adversely affect core power distribution and can require operation below full rated power.
- C. They can cause rapid reactor power changes during power operation and can prevent a reactor startup following a reactor trip.
- D. They can cause rapid reactor power changes during power operation and can require operation below full rated power.

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QUESTION: 31

A nuclear power plant startup is in progress 5 hours after a reactor trip from 100% equilibrium power. The power plant is currently at 10% power and being returned to 100% power at 0.25% per minute instead of the normal rate of 0.5% per minute.

At the slower rate of power increase, the maximum amount of core xenon-135 will occur \_\_\_\_\_ than normal; and the amount of equilibrium core xenon-135 at 100% power will be \_\_\_\_\_.

- A. sooner; the same
- B. sooner; smaller
- C. later; the same
- D. later; smaller

QUESTION: 32

Why are burnable poisons installed in a new nuclear reactor core instead of using a larger reactor coolant boron concentration?

- A. To prevent boron precipitation during normal operation.
- B. To establish a more negative moderator temperature coefficient.
- C. To minimize the distortion of the neutron flux distribution caused by soluble boron.
- D. To allow the loading of excessive reactivity in the form of higher fuel enrichment.

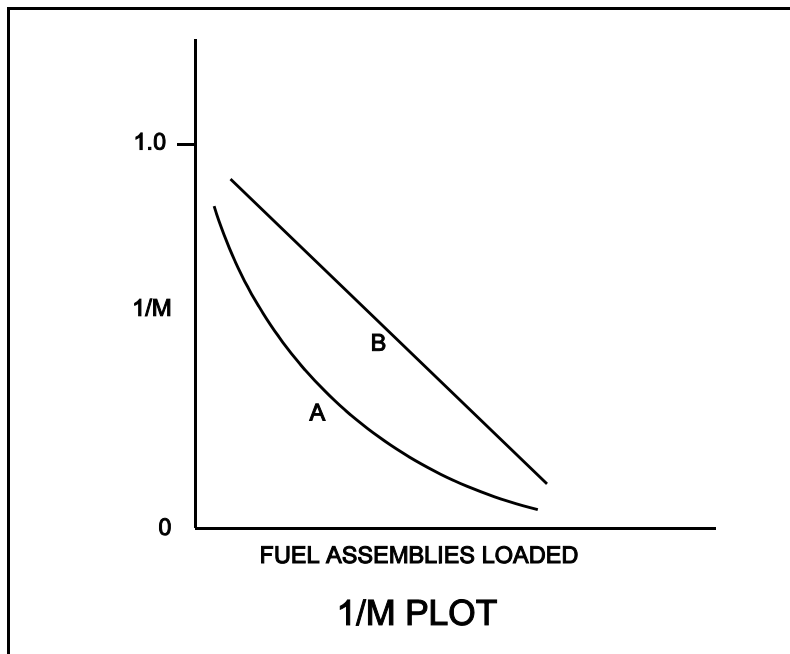
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QUESTION: 33

Refer to the drawing of a  $1/M$  plot with curves A and B (see figure below). Assume that each axis has linear units.

Curve A would result if each fuel assembly loaded during the early stages of the refueling caused a relatively \_\_\_\_\_ fractional change in source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal \_\_\_\_\_.

- A. small; fuel enrichment
- B. small; reactivity
- C. large; fuel enrichment
- D. large; reactivity



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QUESTION: 34

To predict critical control rod position prior to commencing a nuclear reactor startup, the operator must consider the amount of reactivity added by post-shutdown changes in...

- A. reactor coolant boron concentration, neutron flux level, and burnable poisons.
- B. control rod positions, core xenon-135 concentration, and moderator temperature.
- C. neutron flux level, reactor coolant boron concentration, and control rod positions.
- D. moderator temperature, burnable poisons, and core xenon-135 concentration.

QUESTION: 35

A nuclear reactor has just achieved criticality at 10<sup>-8</sup>% reactor power during a reactor startup from xenon-free conditions. The operator establishes a 0.5 decade per minute startup rate to increase power. Over a period of 10 minutes, startup rate decreases to zero and then becomes increasingly negative.

Which one of the following is a possible cause for these indications?

- A. Fuel depletion
- B. Burnable poison burnout
- C. Reactor power reaching the point of adding heat
- D. Inadvertent boration of the reactor coolant system

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 36

During a reactor startup, source range count rate is observed to double every 30 seconds. Which one of the following is the approximate startup rate in decades per minute (dpm)?

- A. 0.6 dpm
- B. 0.9 dpm
- C. 1.4 dpm
- D. 2.0 dpm

QUESTION: 37

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

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
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QUESTION: 38

Consider a pressurizer containing a saturated water/vapor mixture at 500°F. The mixture is currently stable with no net 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; increase
- B. decrease; decrease
- C. remain the same; increase
- D. remain the same; decrease

QUESTION: 39

Given the following:

- A saturated steam-water mixture with an inlet quality of 40% is flowing through a moisture separator.
- The moisture separator is 100% efficient for removing water.

How much water will be removed by the moisture separator from 50 lbm of the steam-water mixture?

- A. 10 lbm
- B. 20 lbm
- C. 30 lbm
- D. 40 lbm

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 40

A heatup and pressurization of the reactor coolant system (RCS) is in progress following a maintenance shutdown. RCS pressure is 800 psia with a steam bubble in the pressurizer. Pressurizer power-operated relief valve (PORV) tailpipe temperature has been steadily rising. Assume 97.5% quality saturated steam in the pressurizer vapor space, PORV downstream pressure is 30 psia, and PORV leakage is an ideal throttling process.

Which one of the following is the approximate PORV tailpipe temperature if a PORV is leaking by?

- A. 262°F
- B. 282°F
- C. 302°F
- D. 322°F

QUESTION: 41

Consider the thermal efficiency of a nuclear power plant operating at rated power.

If the pressure at which saturated steam is produced in the steam generators is increased, thermal efficiency will \_\_\_\_\_; and if the temperature of the feedwater entering the steam generators is increased, thermal efficiency will \_\_\_\_\_.

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



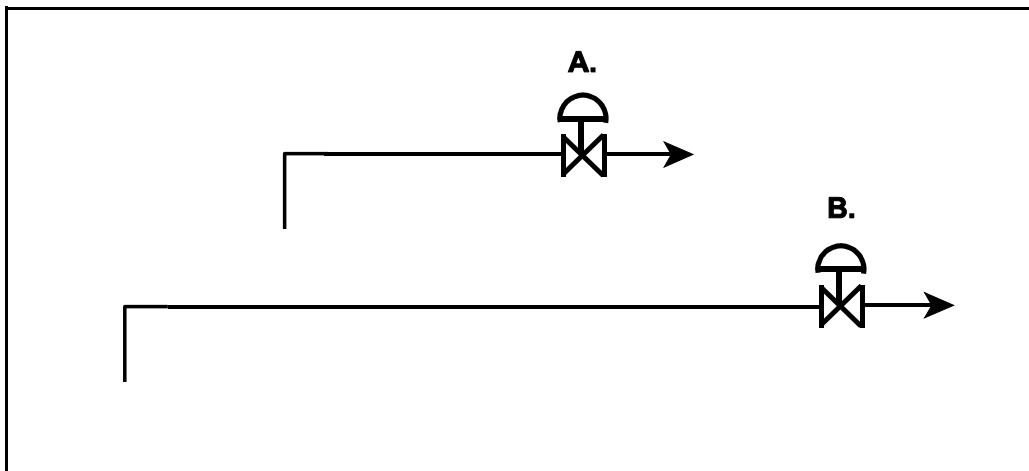
**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 42

Refer to the drawing of two lengths of 6-inch diameter piping, each containing an identical automatic isolation valve. The actual pipe lengths are proportional to their symbols in the drawing

Water at 65°F is flowing at 1,000 gpm through each pipe. If the isolation valves suddenly and simultaneously close, valve A and its associated piping will experience a maximum pressure that is \_\_\_\_\_ the maximum pressure experienced by valve B and its associated piping. The pressure spike will dissipate quicker in the \_\_\_\_\_ length of pipe.

- A. equal to; shorter
- B. equal to; longer
- C. less than; shorter
- D. less than; longer



**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 43

A length of pipe in a cooling water system uses a reducer fitting to decrease the pipe diameter from 6 inches to 4 inches. The flow rate in the 6-inch diameter section of pipe is 200 gpm. What is the flow rate in the 4-inch diameter section of pipe?

- A. 133 gpm
- B. 200 gpm
- C. 300 gpm
- D. 450 gpm

QUESTION: 44

Nuclear reactor fuel rods are normally charged with \_\_\_\_\_ gas to improve the heat transferred by \_\_\_\_\_ from the fuel pellets to the cladding.

- A. helium; convection
- B. helium; conduction
- C. nitrogen; convection
- D. nitrogen; conduction

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 45

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

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

QUESTION: 46

If the fission rate in a nuclear 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  
DECEMBER 2005 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 60°F subcooling margin in the hottest RCS hot leg?

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

QUESTION: 48

Single-phase coolant flow resistance (head loss) in a nuclear reactor core is directly proportional to the square of coolant \_\_\_\_\_ and inversely proportional to \_\_\_\_\_.

- A. velocity; fuel assembly length
- B. temperature; fuel assembly length
- C. velocity; coolant channel cross-sectional area
- D. temperature; coolant channel cross-sectional area

**USNRC GENERIC FUNDAMENTALS EXAMINATION  
DECEMBER 2005 PWR--FORM A**

QUESTION: 49

A nuclear reactor is operating at 75% power at the middle of a fuel cycle with radial power distribution peaked in the center of the core. All control rods are fully withdrawn and in manual control.

Assuming all control rods remain fully withdrawn, except as noted, which one of the following will cause the maximum steady-state radial peaking (or hot channel) factor to decrease?

- A. Turbine load/reactor power is reduced by 20%.
- B. A control rod located at the edge of the core drops into the core.
- C. Reactor coolant system boron concentration is reduced by 10 ppm.
- D. The reactor is operated continuously at 75% power for three months.

QUESTION: 50

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

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

- A. Reactor A because it has produced the fewer total number of fissions.
- B. Reactor B because it has produced the greater total 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.

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

**DECEMBER 2005 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	A	27	41	D
3	17	C	28	42	D
4	18	D	29	43	C
5	19	C	30	44	B
6	20	A	31	45	C
7	21	B	32	46	B
8	22	B	33	47	D
9	23	B	34	48	B
10	24	C	35	49	D
11	25	D	36	50	A
12	26	A	37	1	C
13	27	D	38	2	A
14	28	C	39	3	C
15	29	A	40	4	B
16	30	D	41	5	C
17	31	A	42	6	A
18	32	B	43	7	B
19	33	D	44	8	B
20	34	D	45	9	A
21	35	A	46	10	A
22	36	A	47	11	B
23	37	B	48	12	C
24	38	C	49	13	D
25	39	B	50	14	A