

**UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003--FORM A**

Please Print

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided. Each item has equal point value. A score of at least 80% is required to pass this portion of the written licensing examination. All examination papers will be collected 4.0 hours after the examination starts. This examination applies to a typical pressurized water reactor (PWR) power plant.

| SECTION | QUESTIONS | % OF TOTAL | SCORE |
|----------------|-----------|------------|-------|
| COMPONENTS | 1 - 44 | | |
| REACTOR THEORY | 45 - 72 | | |
| THERMODYNAMICS | 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

$$Q' = \dot{m} c_p \Delta T$$

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

$$Q' = UA \Delta T$$

$$Q' \% = \dot{m}_{\text{Nat Circ}}^3$$

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

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

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

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

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

$$\rho = \frac{\bar{R}}{\tau} \% \frac{\bar{\beta}}{1 \% \lambda_{\text{eff}} \tau}$$

$$\bar{R} = 1 \times 10^{-4} \text{ sec}$$

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

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

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

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

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

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

$$CR_1(1 - K_{\text{eff}1}) = CR_2(1 - K_{\text{eff}2})$$

$$1/M = CR_1/CR_x$$

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

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

$$v(P_2 - P_1) + \frac{(v_2^2 - v_1^2)}{2g_c} + \frac{g(z_2 - z_1)}{g_c} = 0$$

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

CONVERSIONS

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

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

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

$$\text{EC} = (5/9)(\text{EF} - 32)$$

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

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

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

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

$$EF = (9/5)(EC) + 32$$

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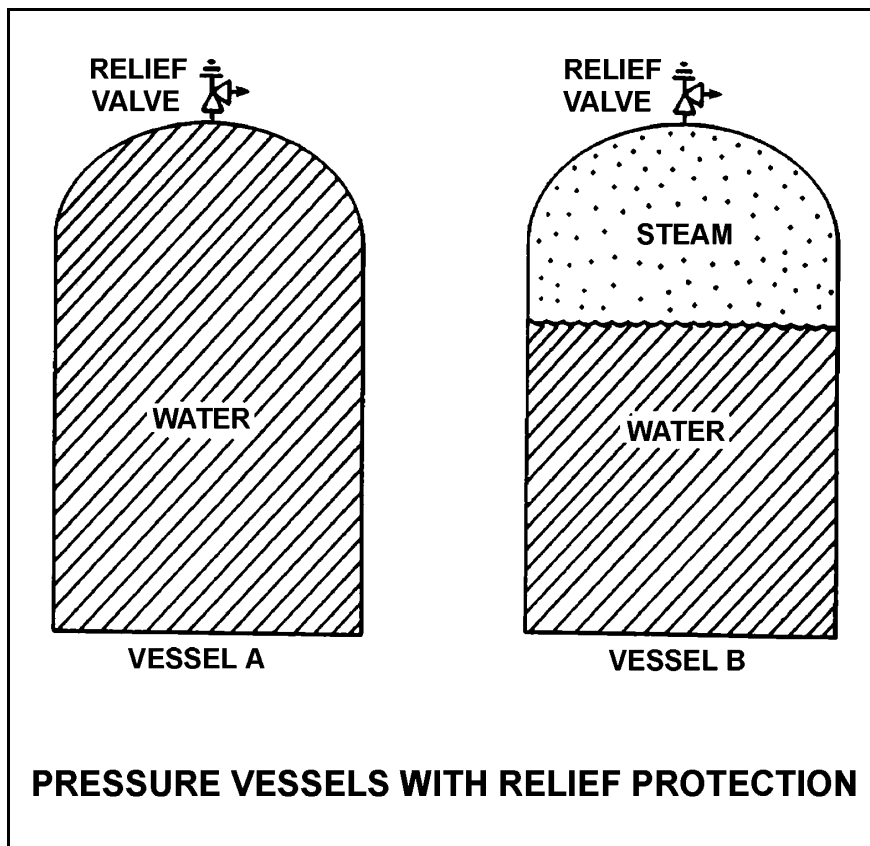
QUESTION: 1

Refer to the drawing of two identical pressure vessels with identical relief protection (see figure below).

Vessel A is completely filled with subcooled water at 80°F and vessel B is in a saturated, two-phase condition. Both vessels are currently pressurized to 50 psig and isolated.

If both relief valves fully open simultaneously, the faster pressure reduction will initially occur in vessel _____ and the faster mass loss will initially occur in vessel _____.

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



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QUESTION: 2

Which one of the following statements describes the flow rate characteristics of a typical globe valve in an operating water system?

- A. The first 25% of valve disk travel in the open direction will produce a smaller change in flow rate than the last 25% of valve disk travel.
- B. The first 25% of valve disk travel in the open direction will produce a greater change in flow rate than the last 25% of valve disk travel.
- C. The first 25% of valve disk travel in the open direction will produce approximately the same change in flow rate as the last 25% of valve disk travel.
- D. A globe valve that has been opened to 25% of valve disk travel will result in approximately 25% of full flow rate.

QUESTION: 3

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

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QUESTION: 4

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

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

QUESTION: 5

A steam flow measuring instrument uses density compensation and square root extraction to convert the differential pressure across the flow element to flow rate in lbm/hr.

The purpose of density compensation in this flow measuring instrument is to convert _____ to _____.

- A. volumetric flow rate; mass flow rate
- B. volumetric flow rate; differential pressure
- C. differential pressure; mass flow rate
- D. differential pressure; volumetric flow rate

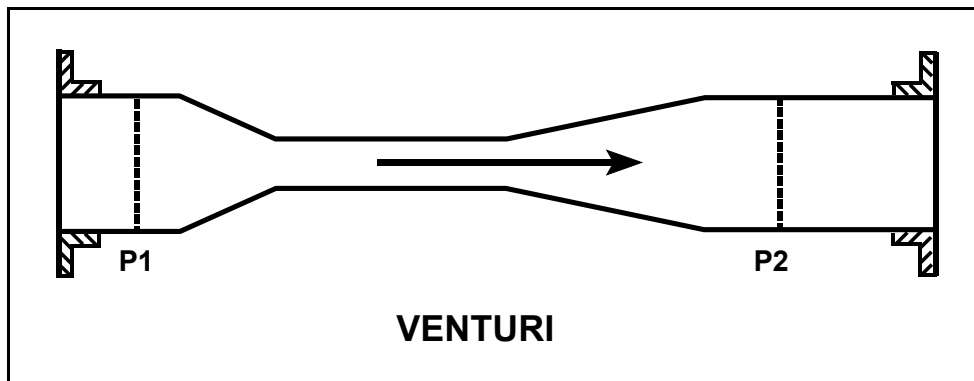
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QUESTION: 6

Refer to the drawing in which subcooled water is flowing through a convergent-divergent venturi (see figure below). The pipe diameters at P1 and P2 are equal.

Compared to the conditions at the inlet of the venturi (P1), the pressure at the outlet of the venturi (P2) has _____ and water velocity at the outlet of the venturi has _____. (Assume "real" conditions.)

- A. remained the same; remained the same
- B. remained the same; decreased slightly
- C. decreased slightly; remained the same
- D. decreased slightly; decreased slightly



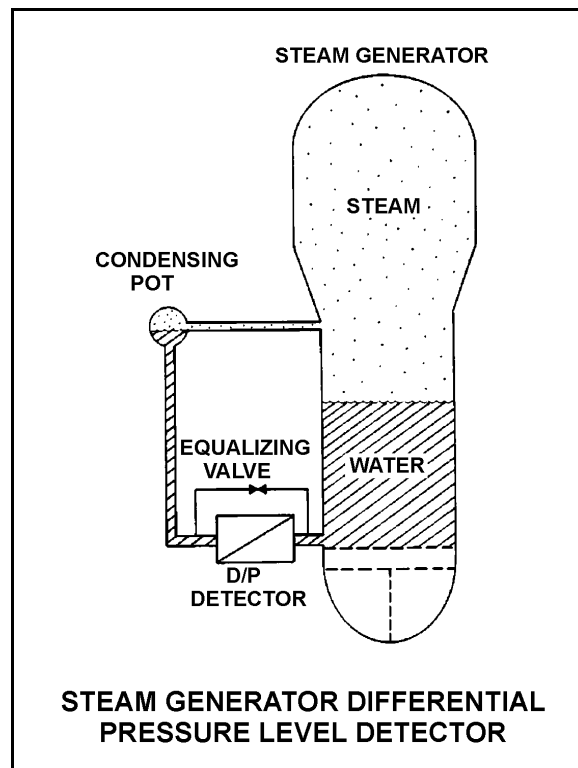
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QUESTION: 7

Refer to the drawing of a steam generator differential pressure (D/P) level detector that was calibrated at normal operating conditions (see figure below).

A reactor coolant system cooldown has resulted in a decrease in steam generator pressure from 900 psia to 400 psia. Without density compensation of the level instrumentation, at the end of the cooldown, steam generator level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

- A. lower; reference leg
- B. lower; steam generator
- C. higher; reference leg
- D. higher; steam generator



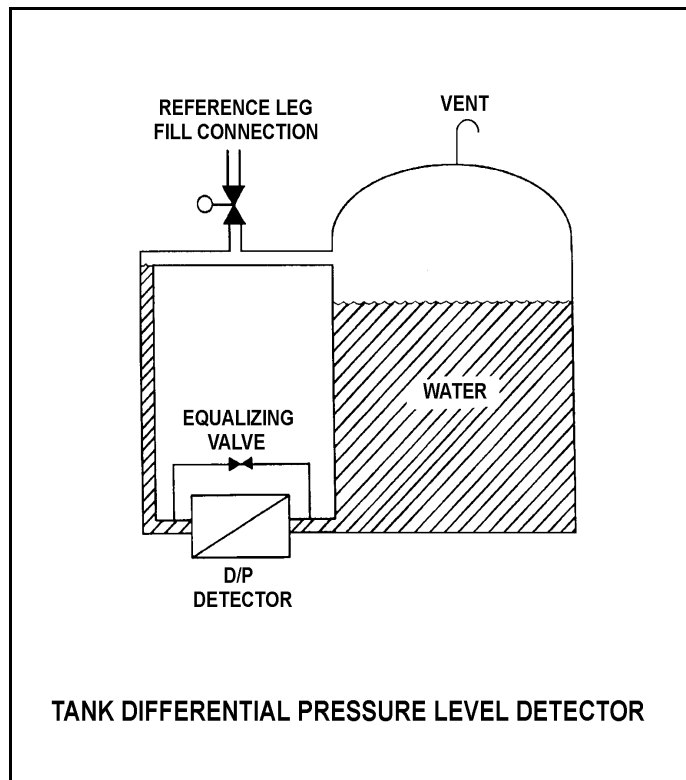
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QUESTION: 8

Refer to the drawing of a tank with differential pressure (D/P) level detector (see figure below). Assume the initial temperature of the reference leg and the water in the tank is 100EF, and that reference leg temperature does not change.

If the temperature of the water in the tank increases by 20EF, the D/P sensed by the detector will _____ as long as the water _____ is maintained constant.

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



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QUESTION: 9

A bourdon tube works on the principle that when the pressure inside the tube decreases, the tube tends to: (Assume detected pressure remains above atmospheric pressure.)

- A. coil due to an increased pressure-induced force on the outside of the tube.
- B. straighten due to an increased pressure-induced force on the outside of the tube.
- C. coil due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.
- D. straighten due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

QUESTION: 10

Cooling water system pressure is being monitored by a simple diaphragm pressure detector with its low pressure side vented to the containment. If a main steam break raises containment pressure by 20 psi, system pressure indication will: (Disregard any temperature effect on the detector.)

- A. increase by the square root of 20 psi.
- B. decrease by the square root of 20 psi.
- C. increase by 20 psi.
- D. decrease by 20 psi.

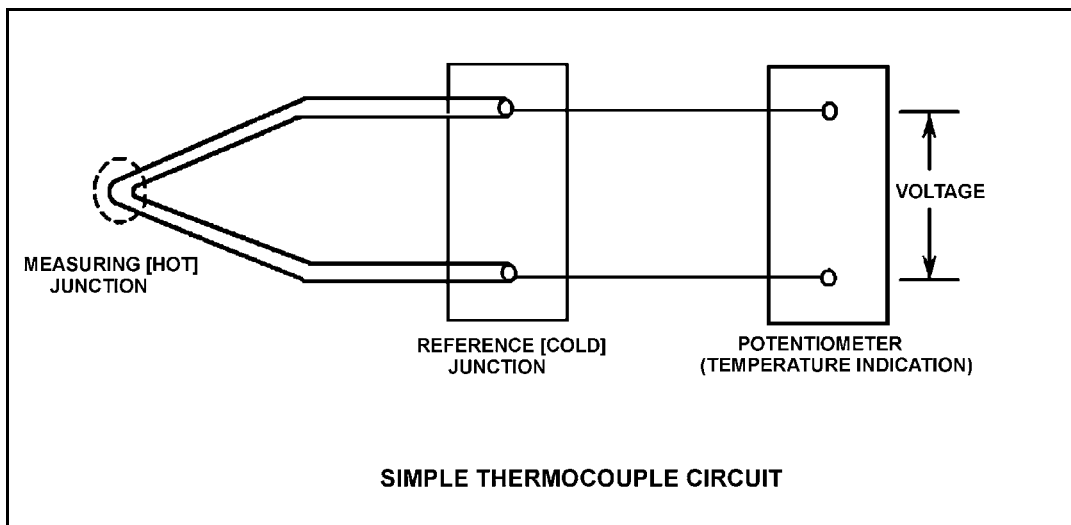
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QUESTION: 11

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

Thermocouple temperature indication is currently 150EF. Reference junction temperature is currently 90EF. Indicator range is from 0EF to 2000EF. If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

- A. Minimum instrument reading (0EF)
- B. 60EF
- C. 90EF
- D. Maximum instrument reading (2000EF)



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QUESTION: 12

During a reactor refueling outage, the fuel assemblies were reconfigured to reduce the radial power peak at the center of the core while maintaining the same rated thermal power. Excore power range detectors were calibrated at 50% power just prior to the outage.

How will actual reactor power compare to indicated reactor power when the plant is stabilized at 50% following the outage?

- A. Actual reactor power will be higher than indicated reactor power due to increased core neutron leakage.
- B. Actual reactor power will be higher than indicated reactor power due to decreased core neutron leakage.
- C. Actual reactor power will be lower than indicated reactor power due to decreased core neutron leakage.
- D. Actual reactor power will be lower than indicated reactor power due to increased core neutron leakage.

QUESTION: 13

A Geiger-Mueller radiation detector is located in a radiation field consisting of beta, gamma, and fast neutron radiation. Assuming each type of radiation enters the detector gas chamber and ionizes the detector gas, which one of the following describes the resulting detector pulse sizes?

- A. Beta radiation will produce a larger pulse size than either gamma or fast neutron radiation.
- B. Gamma radiation will produce a larger pulse size than either beta or fast neutron radiation.
- C. Fast neutron radiation will produce a larger pulse size than either beta or gamma radiation.
- D. Beta, gamma, and fast neutron radiation will produce pulse sizes that are equal in magnitude.

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QUESTION: 14

A gas-filled radiation detector operating in the proportional region is exposed to a constant gamma radiation field. If the applied voltage is decreased but maintained within the proportional region, the rate of ion collection will:

- A. stay approximately the same because all of the primary ions were already being collected at the higher voltage.
- B. stay approximately the same because the ion chamber is still operating at saturated conditions.
- C. decrease because more primary ions are recombining in the detector prior to reaching the electrodes.
- D. decrease because fewer secondary ionizations are occurring in the detector.

QUESTION: 15

Which one of the following is used to describe the delay between a process parameter change and the sensing of that change by the process controller?

- A. Offset
- B. Gain
- C. Dead time
- D. Feedback

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QUESTION: 16

If the turbine shaft speed signal received by a typical turbine governor control system fails low during turbine startup, the turbine governor will cause turbine speed to:

- A. decrease to a minimum speed setpoint.
- B. increase, until the mismatch with demanded turbine speed is nulled.
- C. decrease, until the mismatch with demanded turbine speed is nulled.
- D. increase, until an upper limit is reached or the turbine trips on overspeed.

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QUESTION: 17

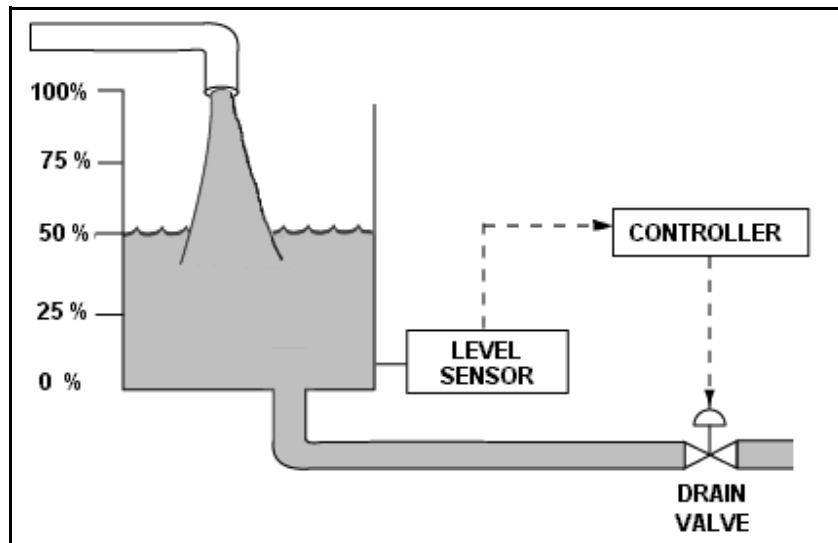
Refer to the drawing of a water storage tank with an automatic level control system (see figure below).

Given:

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

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

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



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QUESTION: 18

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

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

QUESTION: 19

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

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

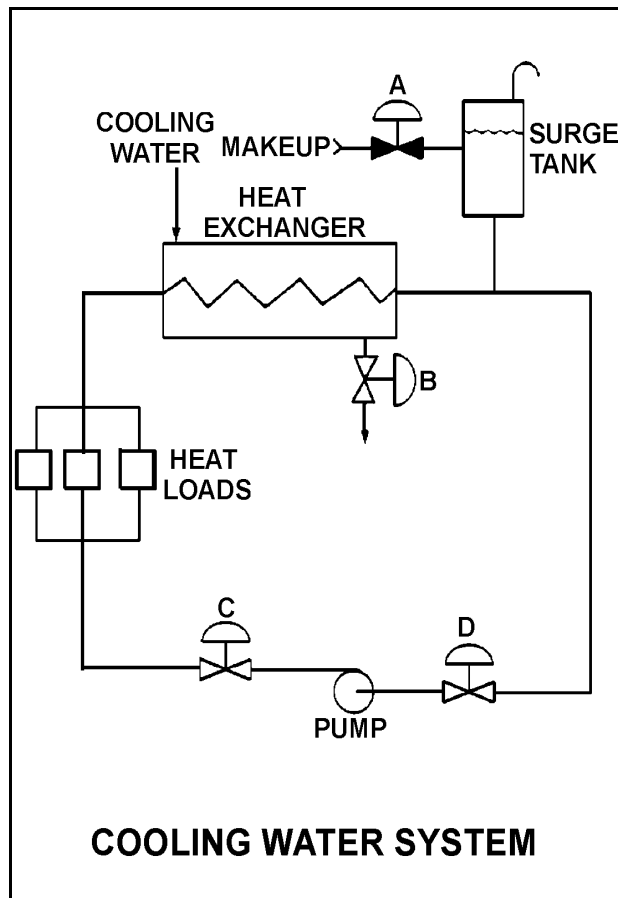
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QUESTION: 20

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

The available net positive suction head for the centrifugal pump will be decreased by:

- A. increasing surge tank level by 5 percent.
- B. throttling heat exchanger cooling water valve "B" more open.
- C. throttling pump discharge valve "C" more closed.
- D. increasing the heat loads on the cooling water system.



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QUESTION: 21

An ac induction motor-driven centrifugal pump is circulating water at 180EF with a motor current of 100 amps. After several hours, system temperature has changed such that the water density has increased by 4%.

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

- A. 84 amps
- B. 96 amps
- C. 104 amps
- D. 116 amps

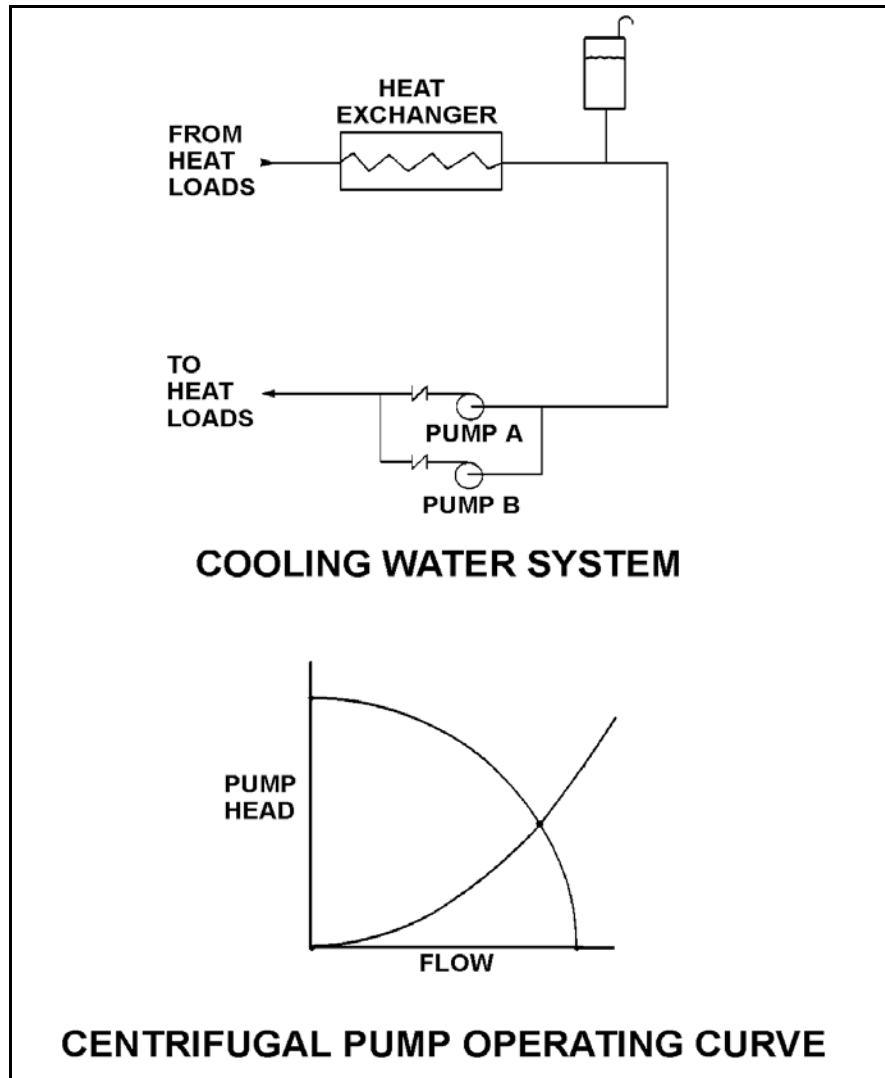
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QUESTION: 22

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 only pump A is operating. If pump B is started, after the system stabilizes system flow rate will be:

- A. twice the original flow.
- B. the same as the original flow.
- C. less than twice the original flow.
- D. more than twice the original flow.



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QUESTION: 23

A centrifugal firewater pump is operating to pressurize a fire main. The pump takes suction on a water reservoir. The reservoir water level and the pump are both at sea level.

Given:

- The pump has a shutoff head of 100 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60EF.
- A fire hose connected to the fire main is being used to suppress an elevated fire.

At which one of the following elevations (referenced to sea level) will the fire hose spray nozzle first be unable to provide flow? (Disregard head loss in the fire main and fire hose.)

- A. 86 feet
- B. 101 feet
- C. 116 feet
- D. 135 feet

QUESTION: 24

A typical single-stage radial-flow centrifugal pump is being returned to service following maintenance on its ac motor. Which one of the following will occur when the pump is started if two of the three motor power leads were inadvertently swapped during restoration?

- A. The motor breaker will trip on instantaneous overcurrent.
- B. The motor will not turn and will emit a humming sound.
- C. The motor will rotate in the reverse direction with reduced or no flow rate.
- D. The motor will rotate in the normal direction with reduced flow rate.

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QUESTION: 25

Minimum required net positive suction head for a typical positive displacement pump will increase the most if the pump:

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

QUESTION: 26

Which one of the following describes the proper location for a relief valve that will be used to prevent exceeding the design pressure of a positive displacement pump and associated piping?

- A. On the pump suction piping upstream of the suction isolation valve
- B. On the pump suction piping downstream of the suction isolation valve
- C. On the pump discharge piping downstream of the discharge isolation valve
- D. On the pump discharge piping upstream of the discharge isolation valve

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QUESTION: 27

A cooling water pump is being driven by an ac induction motor. Which one of the following describes how and why pump motor current will change if the pump shaft shears?

- A. Increases due to increased pump work
- B. Increases due to increased counter electromotive force
- C. Decreases due to decreased pump work
- D. Decreases due to decreased counter electromotive force

QUESTION: 28

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

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QUESTION: 29

A main turbine-generator is operating in parallel with an infinite power grid. If the turbine control valves (or throttle valves) slowly fail open, the generator will experience high current primarily due to: (Assume no generator protective actuations occur.)

- A. excessive generator MWe.
- B. excessive generator KVAR (VARs out).
- C. excessive generator KVAR (VARs in).
- D. generator reverse power.

QUESTION: 30

Which one of the following describes the relationship between the current supplied to an ac induction motor and the amount of heat generation (kW) in the motor windings?

- A. Heat generation is linearly proportional to the current.
- B. Heat generation is proportional to the cube of the current.
- C. Heat generation is proportional to the square of the current.
- D. Heat generation is proportional to the square root of the current.

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QUESTION: 31

Frequent starts of large motors will result in overheating of the motor windings due to high current flow caused by:

- A. windage losses between the rotor and stator.
- B. low electrical resistance of the motor windings.
- C. high counter electromotive force at low rotor speeds.
- D. an electrical short circuit between the rotor and stator.

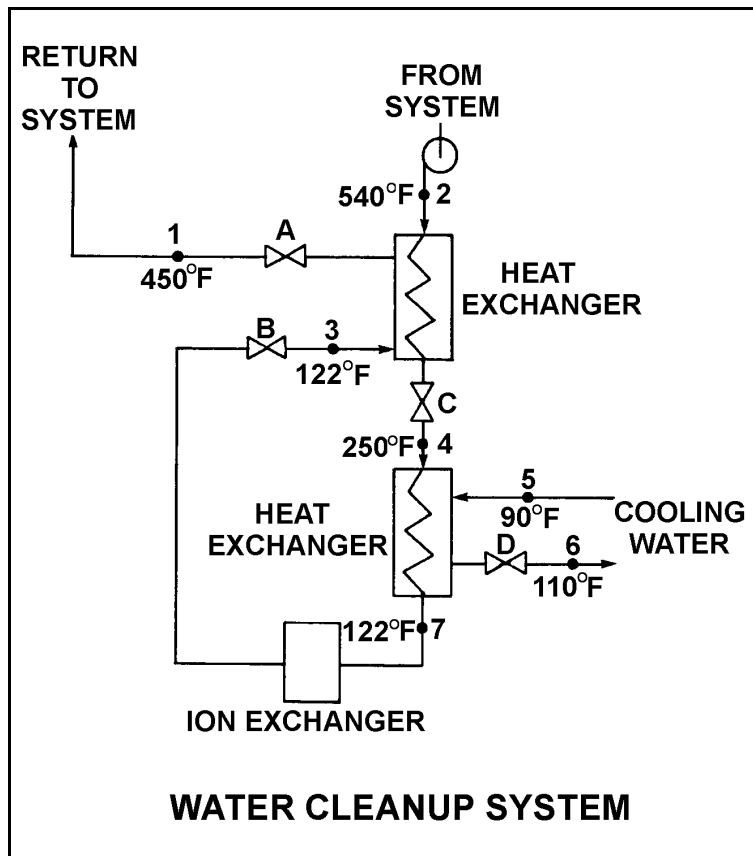
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QUESTION: 32

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

If cooling water flow rate is 1.0×10^6 lbm/hr, what is the approximate water flow rate in the cleanup system?

- A. 1.6×10^5 lbm/hr
- B. 3.2×10^5 lbm/hr
- C. 1.6×10^6 lbm/hr
- D. 3.2×10^6 lbm/hr



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QUESTION: 33

A main turbine-generator is operating at 80% load with the following initial steady-state temperatures for the main turbine lube oil heat exchanger:

$$\begin{aligned}T_{\text{oil in}} &= 174\text{EF} \\T_{\text{oil out}} &= 114\text{EF} \\T_{\text{water in}} &= 85\text{EF} \\T_{\text{water out}} &= 115\text{EF}\end{aligned}$$

After six months of main turbine operation, the following final steady-state lube oil heat exchanger temperatures are observed:

$$\begin{aligned}T_{\text{oil in}} &= 179\text{EF} \\T_{\text{oil out}} &= 119\text{EF} \\T_{\text{water in}} &= 85\text{EF} \\T_{\text{water out}} &= 115\text{EF}\end{aligned}$$

Assume that the final cooling water and lube oil flow rates are the same as the initial flow rates, and that the specific heat values for the cooling water and lube oil do not change.

Which one of the following could be responsible for the differences between the initial and final heat exchanger steady-state temperatures?

- A. The heat exchanger tubes have become fouled with scale.
- B. The temperature of the cooling water source has increased.
- C. The final main turbine-generator load is higher than the initial load.
- D. The final main turbine-generator load is lower than the initial load.

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QUESTION: 34

A reactor plant is operating normally at 50% power. Which one of the following will result from a cooling water tube rupture in the main condenser?

- A. Increased condenser vacuum
- B. Increased conductivity of the condensate
- C. Decreased condensate pump net positive suction head
- D. Decreased condensate pump flow rate

QUESTION: 35

A condensate demineralizer differential pressure (D/P) gauge indicates 4 psid at 50% flow. Over the next two days plant power changes have caused condensate flow to vary between 25% and 100%.

Which one of the following combinations of condensate flow and demineralizer D/P observed during the power changes indicates an increase in the accumulation of corrosion products in the demineralizer?

| | CONDENSATE <u>FLOW</u> | DEMINERALIZER <u>D/P (PSID)</u> |
|----|---------------------------|------------------------------------|
| A. | 25% | 2.0 |
| B. | 60% | 5.0 |
| C. | 75% | 9.0 |
| D. | 100% | 15.0 |

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QUESTION: 36

The decontamination factor (or demineralization factor) of a condensate demineralizer has just been determined to be 10, based on conductivity measurements.

If condensate having a conductivity of 20 $\mu\text{mho/cm}$ is flowing into this demineralizer, which one of the following is the conductivity of the condensate at the outlet of the demineralizer?

- A. 0.5 $\mu\text{mho/cm}$
- B. 2.0 $\mu\text{mho/cm}$
- C. 5.0 $\mu\text{mho/cm}$
- D. 10.0 $\mu\text{mho/cm}$

QUESTION: 37

A PWR plant has two identical mixed resin bed reactor coolant ion exchangers, A and B, which were each conditioned and placed in parallel service continuously for about two weeks with the plant at full power after a refueling outage. Then, ion exchanger A was isolated for standby use while ion exchanger B remained in service. After 10 months of continuous operation at full power, it is necessary to place ion exchanger A in service and isolate ion exchanger B.

Which one of the following describes why the effluent from ion exchanger A is initially drained to a collection facility prior to placing the ion exchanger in service?

- A. To avoid an undesired increase in reactor coolant pH.
- B. To avoid an undesired decrease in reactor coolant pH.
- C. To avoid an undesired increase in reactor coolant boron concentration.
- D. To avoid an undesired decrease in reactor coolant boron concentration.

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QUESTION: 38

Which one of the following describes the normal operation of a local breaker overcurrent trip flag indicator?

- A. Actuates when no lockout is present; satisfies an electrical interlock to remotely close a breaker.
- B. Actuates when a breaker overcurrent trip has occurred; can be manually reset when the overcurrent condition clears.
- C. Actuates when a breaker has failed to trip on an overcurrent condition; can be manually reset when the overcurrent condition clears.
- D. Actuates to cause a breaker trip when the overcurrent trip setpoint is reached; can be remotely reset when the overcurrent condition clears.

QUESTION: 39

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.

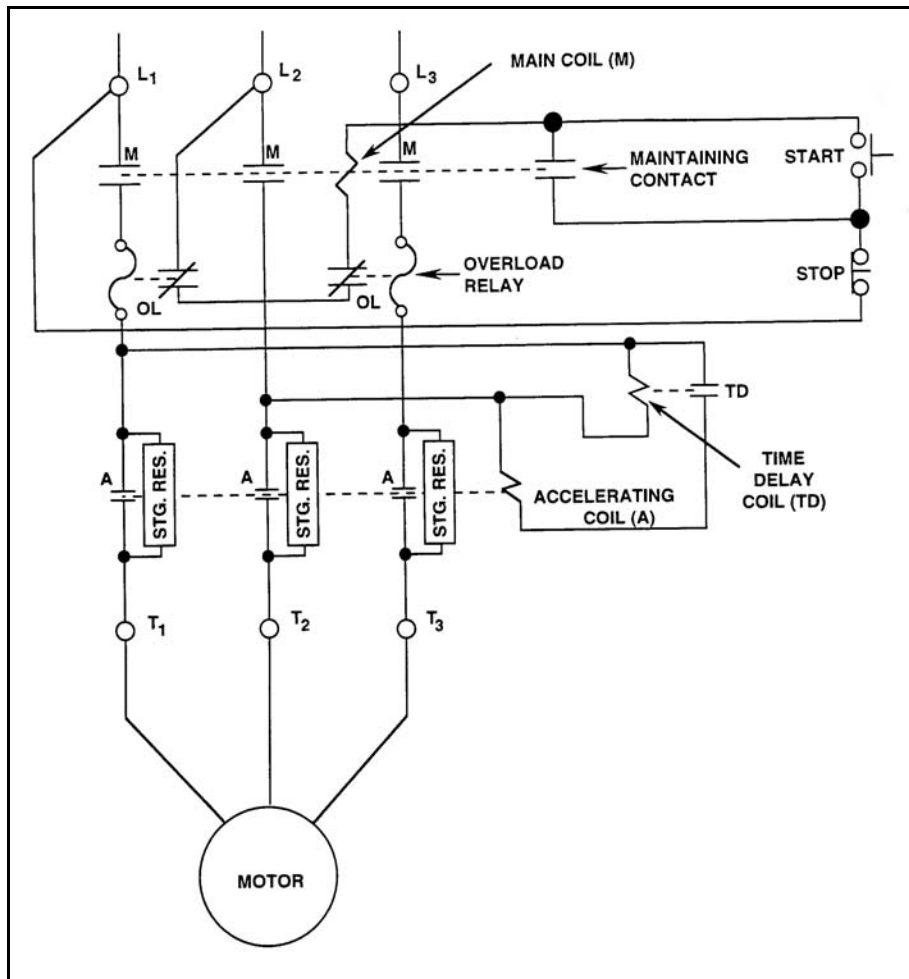
**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 40

Refer to the drawing of a motor controller circuit for a three-phase ac motor (see figure below).

The motor receives overload protection from _____ overload (OL) relays, and _____ OL relay(s) must actuate to deenergize the motor.

- A. two; one
- B. two; two
- C. three; one
- D. three; two



**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 41

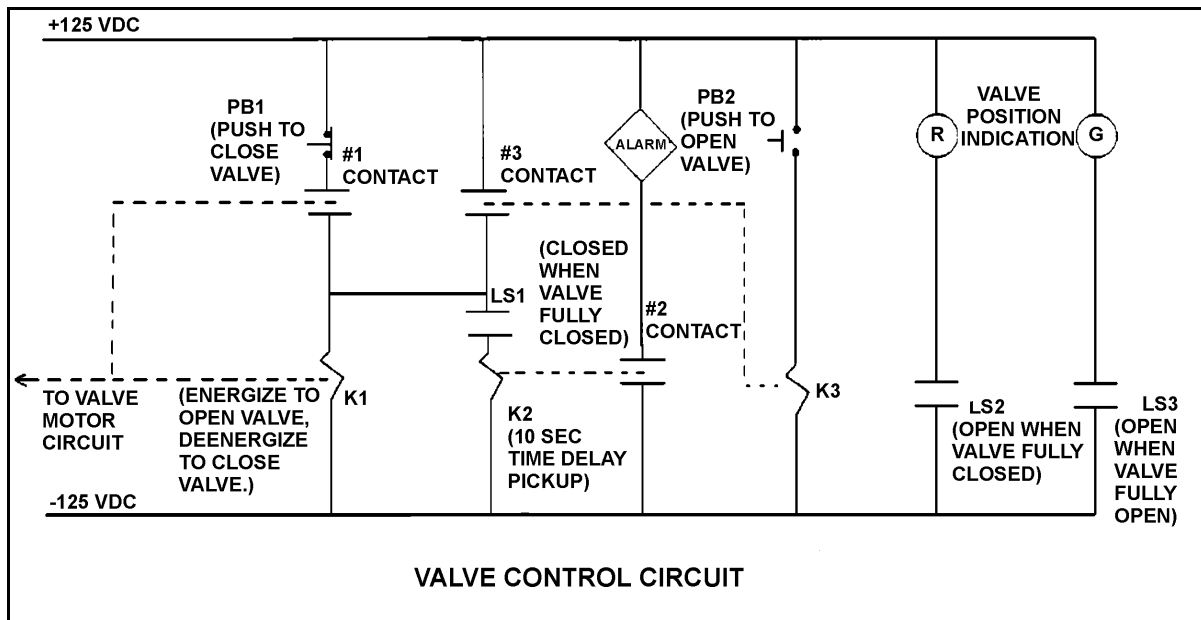
Refer to the drawing of a valve control circuit (see figure below).

Pushbutton PB2 was depressed to open the valve, and the current contact/pushbutton status is as shown with the following exceptions:

- LS1 is closed.
- LS3 is closed.
- #1 contact is closed.
- #2 contact is closed.

Which one of the following describes the condition of the valve and its control circuit?

- A. The valve is closed and the valve motor circuit has just been energized to open the valve.
- B. The valve is closed and an open demand signal has existed for at least 10 seconds.
- C. The valve is partially open and the valve motor circuit is deenergized as PB2 was prematurely released.
- D. The valve is partially open and an open demand signal has existed for at least 10 seconds.



**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 42

A motor control center 480 Vac breaker supplies a load via a manual disconnect. Which one of the following sequences for deenergizing the load will provide the greatest level of personnel safety?

- A. Open the disconnect first, then the breaker.
- B. Open the breaker first, then the disconnect.
- C. Any sequence is acceptable provided the current is less than 50 amps.
- D. Any sequence is acceptable provided the voltage is less than 600 volts.

QUESTION: 43

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

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

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

- A. open; in
- B. closed; in
- C. open; to the test position
- D. closed; to the test position

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 44

A thermal overload device for a large motor protects the motor from:

- A. sustained overcurrent by opening the motor breaker or motor line contacts.
- B. sustained overcurrent by opening contacts in the motor windings.
- C. instantaneous overcurrent by opening the motor breaker or motor line contacts.
- D. instantaneous overcurrent by opening contacts in the motor windings.

QUESTION: 45

A neutron that is born 10^{-2} seconds after the associated fission event is a _____ neutron.

- A. thermal
- B. delayed
- C. prompt
- D. capture

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 46

A reactor plant is currently operating at equilibrium 80% power near the end of its fuel cycle. During the next 3 days of equilibrium power operation no operator action is taken.

How will core K_{eff} be affected during the 3-day period?

- A. Core K_{eff} will gradually increase during the entire period.
- B. Core K_{eff} will gradually decrease during the entire period.
- C. Core K_{eff} will tend to increase, but inherent reactivity feedback will maintain K_{eff} at 1.0.
- D. Core K_{eff} will tend to decrease, but inherent reactivity feedback will maintain K_{eff} at 1.0.

QUESTION: 47

A reactor is initially operating at steady-state 60% power near the end of core life when a fully withdrawn control rod suddenly inserts completely into the core. No operator action is taken and the plant control systems stabilize the reactor at a power level in the power range.

Compared to the initial shutdown margin (SDM), the new steady-state SDM is _____; compared to the initial 60% power core K_{eff} , the new steady-state core K_{eff} is _____.

- A. the same; smaller
- B. the same; the same
- C. less negative; smaller
- D. less negative; the same

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 48

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is near the end of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher shutdown fission rate will exist in reactor _____ because it has a _____ delayed neutron fraction.

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

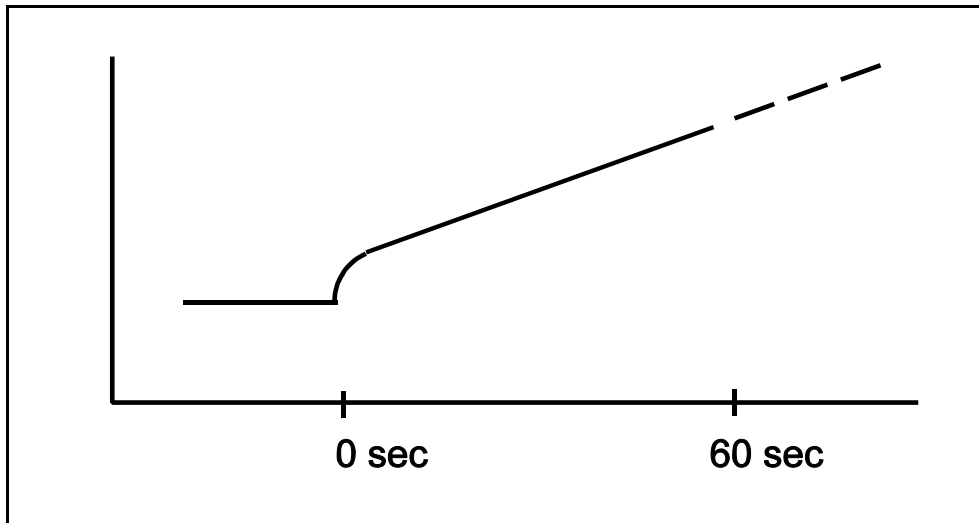
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FEBRUARY 2003 PWR--FORM A

QUESTION: 49

Refer to the unlabeled reactor response curve shown below for a reactor that was initially subcritical in the source range. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that is currently (at time = 60 sec) _____.

- A. startup rate; exactly critical
- B. startup rate; supercritical
- C. reactor fission rate; exactly critical
- D. reactor fission rate; supercritical



**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 50

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

- A. Negative reactivity will be added because more neutrons will be absorbed by U-238 at resonance energies while slowing down.
- B. Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.
- C. Positive reactivity will be added because fewer neutrons will be absorbed by U-238 at resonance energies while slowing down.
- D. Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

QUESTION: 51

With higher concentrations of boron in the reactor coolant, the core neutron flux distribution shifts to _____ energies where the absorption cross-section of boron is _____.

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 52

The amount of pure water required to decrease the reactor coolant boron concentration by 20 ppm at the end of core life (100 ppm) is approximately _____ the amount of pure water required to decrease reactor coolant boron concentration by 20 ppm at the beginning of core life (1000 ppm).

- A. one-tenth
- B. the same as
- C. 10 times
- D. 100 times

QUESTION: 53

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

- A. 2% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 50% power

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 54

A reactor is critical at 50% power. Control rods are inserted a short distance. Assuming that the main turbine-generator load remains constant, actual reactor power will decrease and then...

- A. stabilize in the source range.
- B. stabilize at a lower value in the power range.
- C. increase and stabilize above the original value.
- D. increase and stabilize at the original value.

QUESTION: 55

Which one of the following will cause group differential control rod worth to become less negative? (Assume the affected group of control rods remains 10% inserted for each case.)

- A. During long-term full power operation, fuel temperature decreases as the fuel pellets come into contact with the fuel clad.
- B. The reactor coolant system is cooled from 170EF to 120EF in preparation for a core refueling.
- C. Core Xe-135 builds up in the lower half of the core.
- D. Early in core life, the concentration of burnable poison decreases.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 56

What is a purpose of control rod bank overlap?

- A. Provides a more uniform differential rod worth and axial flux distribution.
- B. Provides a more uniform differential rod worth and allows dampening of xenon-induced flux oscillations.
- C. Ensures that all rods remain within the allowable tolerance between their individual position indicators and their group counters, and ensures rod insertion limits are not exceeded.
- D. Ensures that all rods remain within their allowable tolerance between individual position indicators and their group counters, and provides a more uniform axial flux distribution.

QUESTION: 57

Consider a reactor core with four quadrants: A, B, C, and D. The reactor is operating at steady state 90% power when a fully withdrawn control rod in quadrant C drops to the bottom of the core. Assume that no operator actions are taken and reactor power stabilizes at 88%.

How are the maximum upper and lower core power tilt values (often called quadrant power tilt ratio or azimuthal power tilt) affected?

- A. Upper core value decreases while lower core value increases.
- B. Upper core value increases while lower core value decreases.
- C. Both upper and lower core values decrease.
- D. Both upper and lower core values increase.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 58

Reactor power is increased from 50% to 60% in 1 hour. The most significant contributor to the initial change in core xenon reactivity is the increase in xenon:

- A. production from fission.
- B. decay to cesium.
- C. absorption of neutrons.
- D. production from iodine decay.

QUESTION: 59

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

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

- A. Greater than 585EF and decreasing slowly
- B. Greater than 585EF and increasing slowly
- C. Less than 585EF and decreasing slowly
- D. Less than 585EF and increasing slowly

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 60

A reactor has been shut down for seven days to perform maintenance. A reactor startup is performed and power is ramped to 50% over a 5-hour period.

When power reaches 50%, the magnitude of core xenon negative reactivity will be:

- A. increasing toward a peak.
- B. increasing toward equilibrium.
- C. decreasing toward equilibrium.
- D. decreasing toward a valley.

QUESTION: 61

A reactor startup is being performed 5 hours after a reactor scram from 100% equilibrium power. The plant is being returned to rated power at 2.0%/minute instead of the normal rate of 0.5%/minute.

At the faster rate of power increase, the minimum amount of core xenon will occur _____ and the amount of equilibrium core xenon will be _____.

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 62

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 concentration is _____.

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

QUESTION: 63

Four hours after a reactor trip from equilibrium full power operation, a reactor is taken critical and power is immediately stabilized for critical data. To maintain a constant reactor power, the operator must add _____ reactivity because core Xe-135 concentration is _____.

- A. positive; increasing
- B. positive; decreasing
- C. negative; increasing
- D. negative; decreasing

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 64

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.

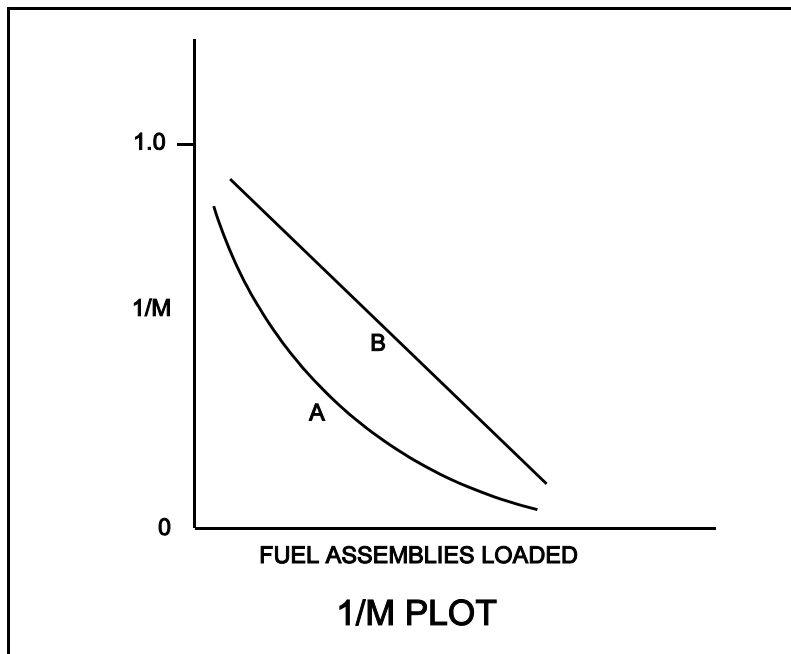
USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A

QUESTION: 65

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



**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 66

With $K_{\text{eff}} = 0.985$, how much reactivity must be added to make a reactor exactly critical?

- A. 1.54% $\Delta K/K$
- B. 1.52% $\Delta K/K$
- C. 1.50% $\Delta K/K$
- D. 1.48% $\Delta K/K$

QUESTION: 67

During a reactor startup from a xenon-free condition, and after recording critical data, the operator establishes a positive startup rate to continue increasing power. Within a few minutes, and prior to reaching the point of adding heat, reactor power stops increasing and begins to slowly decrease.

Which one of the following changes could have caused this behavior?

- A. Inadvertent boration of the RCS
- B. Xenon buildup in the core
- C. Gradual cooling of the RCS
- D. Fission-induced heating of the fuel

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 68

A reactor is slightly supercritical during a reactor startup. A short control rod withdrawal is performed to establish the desired startup rate. Assume that the reactor remains slightly supercritical after the control rod withdrawal, and that reactor power remains well below the point of adding heat.

Immediately after the control rod withdrawal is stopped, the reactor startup rate will initially decrease and then...

- A. stabilize at a positive value.
- B. turn and slowly increase.
- C. stabilize at zero.
- D. continue to slowly decrease.

QUESTION: 69

A reactor startup is in progress and criticality has just been achieved. After recording critical rod height, the operator withdraws control rods for 20 seconds to establish a 1 dpm startup rate. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds.

During the rod insertion, the startup rate will become:

- A. zero during the entire period of control rod insertion.
- B. negative after the control rods pass through the critical rod height.
- C. negative just as the control rods pass through the critical rod height.
- D. negative before the control rods pass through the critical rod height.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 70

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 longest reactor period five minutes after the scram?

- A. Reactor A due to the greater shutdown reactivity.
- B. Reactor B due to the smaller shutdown reactivity.
- 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.

QUESTION: 71

Reactor coolant temperature is being maintained at 500EF one week following a normal shutdown from several months of operation at 100% power. All reactor coolant pumps are operating.

The primary source of heat input to the reactor coolant is from:

- A. fission product decay.
- B. reactor coolant pumps.
- C. subcritical fast fission of U-238.
- D. subcritical thermal fission of U-235 and Pu-239.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 72

A reactor has been shutdown for several weeks when a loss of all ac power results in a loss of forced decay heat removal flow.

Given the following information, what will be the average reactor coolant heatup rate during the 20 minutes immediately after decay heat removal flow is lost? Assume that only ambient losses are removing heat from the reactor coolant system (RCS).

| | |
|-----------------------------------|--------------------------|
| Reactor rated thermal power: | 2800 MWt |
| Decay heat rate: | 0.2% rated thermal power |
| RCS ambient heat loss rate: | 2.4 MWt |
| RCS c_p : | 1.1 Btu/lbm-EF |
| RCS inventory (less pressurizer): | 325,000 lbm |

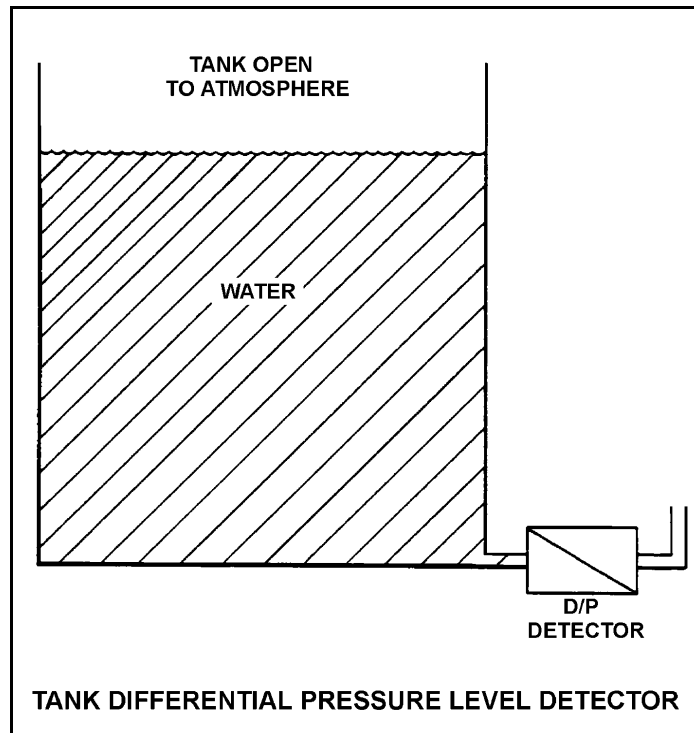
- A. less than 25EF/hour
- B. 26 to 50EF/hour
- C. 51 to 75EF/hour
- D. more than 76EF/hour

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 73

Refer to the drawing of a tank with a differential pressure (D/P) level detector (see figure below). If the tank contains 30 feet of water at 60EF, what is the approximate D/P sensed by the detector?

- A. 2 psid
- B. 13 psid
- C. 20 psid
- D. 28 psid



**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 74

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

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

QUESTION: 75

Which one of the following is the approximate amount of heat required to convert 3 lbm of water at 100EF and 100 psia to a saturated vapor at 100 psia?

- A. 888.6 Btu
- B. 1119.2 Btu
- C. 2665.8 Btu
- D. 3357.6 Btu

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 76

A plant is operating at 80% power with 5EF of condensate depression in the main condenser. If the condensate depression increases to 10EF, plant efficiency will _____ and the probability of condensate pump cavitation will _____.

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

QUESTION: 77

A nuclear plant is shutdown and steam is escaping to atmosphere through a leak in a main steam line. If main steam line pressure is 300 psia, what is the approximate temperature of the steam as it reaches atmospheric pressure? (Assume the steam in the main steam line has a quality of 100%.)

- A. 212°F
- B. 268°F
- C. 322°F
- D. 358°F

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 78

If superheating of the inlet steam to a low pressure turbine is reduced, low pressure turbine work output will _____ and low pressure turbine exhaust steam moisture content will _____. (Assume steam flow rate does not change.)

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

QUESTION: 79

The possibility of water hammer in a liquid system is minimized by:

- A. maintaining temperature above the saturation temperature.
- B. starting centrifugal pumps with the casing vent valve fully open.
- C. starting positive displacement pumps with the discharge valve closed.
- D. venting systems prior to starting centrifugal pumps.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 80

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

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

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

QUESTION: 81

Cavitation is the formation of vapor bubbles in the _____ of a pump and the subsequent collapse of these bubbles in the pump _____.

- A. impeller; casing
- B. impeller; discharge piping
- C. volute; casing
- D. volute; discharge piping

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 82

Water at 90EF and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec. The pipe then splits into two pipes, a 4-inch diameter pipe and an 8-inch diameter pipe. Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 4-inch and 8-inch diameter pipes?

| | 4-inch Pipe <u>(lbm/sec)</u> | 8-inch Pipe <u>(lbm/sec)</u> |
|----|---------------------------------|---------------------------------|
| A. | 20 | 80 |
| B. | 25 | 75 |
| C. | 30 | 70 |
| D. | 33 | 67 |

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 83

Two identical single-speed centrifugal pumps (CPs) and two identical single-speed 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 1,200 psig.

Given the following information:

Centrifugal Pumps

Shutoff head: 1,500 psig
Maximum design pressure: 2,000 psig
Flow rate with no backpressure: 180 gpm

Positive Displacement Pumps

Maximum design pressure: 2,000 psig

Which one of the following makeup water pump configurations will supply the highest initial flow rate to a cooling water system that is drained and depressurized?

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 84

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

- A. Oil to water in a lube oil cooler
- B. Steam to water in a feedwater heater
- C. Water to air in a ventilation heating unit
- D. Water to water in a cooling water heat exchanger

QUESTION: 85

A reactor plant is operating at 100% power with the following reactor coolant system (RCS) and steam generator (S/G) parameters:

| | |
|----------------------------------|----------|
| RCS average coolant temperature: | 575EF |
| RCS hot leg temperatures: | 600EF |
| RCS cold leg temperatures: | 550EF |
| S/G pressures: | 885 psig |

The reactor is shut down and a maintenance outage is performed in which 7% of the tubes in each S/G are plugged. The reactor is restarted and power is ramped to 100%. To establish the same S/G pressure at 100% power, RCS average coolant temperature will have to be increased to:

- A. 584EF.
- B. 582EF.
- C. 580EF.
- D. 578EF.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 86

A reactor is shutdown after several months of operation at full power. The shutdown cooling system is in operation, maintaining an average reactor coolant temperature of 280EF. A pressure control malfunction causes RCS pressure to slowly and continuously decrease from 100 psia while reactor coolant temperature remains constant. (Assume a normal reactor coolant flow direction through the core.)

Which one of the following describes where nucleate boiling will first occur?

- A. At a scratch on the surface of a fuel rod near the top of a fuel assembly
- B. At a scratch on the surface of a fuel rod near the bottom of a fuel assembly
- C. In the bulk fluid of a coolant channel near the top of a fuel assembly
- D. In the bulk fluid of a coolant channel near the bottom of a fuel assembly

QUESTION: 87

A nuclear plant is operating with the following initial conditions:

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

Assuming reactor power level does not change, which one of the following will increase the steady-state departure from nucleate boiling ratio?

- A. One reactor coolant pump trips with automatic rod control.
- B. A spray valve malfunction decreases reactor coolant system pressure by 20 psig with no rod motion.
- C. The operator decreases reactor coolant boron concentration by 5 ppm with no rod motion.
- D. Core Xe-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 88

Which one of the following will be the initial cause of fuel damage if a fuel rod exceeds the critical heat flux at 100% power?

- A. Excessive fuel rod thermal stress
- B. Excessive fuel pellet temperature
- C. Excessive fuel clad temperature
- D. Excessive fuel rod internal pressure

QUESTION: 89

Film boiling is:

- A. the most efficient method of boiling heat transfer.
- B. heat transfer through an oxide film on the cladding.
- C. heat transfer being accomplished with no enthalpy change.
- D. heat transfer through a vapor blanket that covers the fuel cladding.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 90

During a 60EF/hour reactor coolant system (RCS) cooldown and depressurization with natural circulation, RCS subcooling will be minimum in the:

- A. reactor vessel head.
- B. RCS loop hot leg.
- C. RCS loop cold leg.
- D. reactor core.

QUESTION: 91

Single-phase coolant flow resistance (head loss) in a reactor core is 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
FEBRUARY 2003 PWR--FORM A**

QUESTION: 92

Which one of the following describes a function of core bypass flow?

- A. Prevents excessive reactor vessel wall differential temperature
- B. Prevents boron precipitation in the core baffle area
- C. Provides a means of measuring core flow
- D. Provides cooling to various reactor vessel internal components

QUESTION: 93

A reactor is operating at 100% power when a loss of offsite power occurs resulting in a reactor trip and a loss of forced reactor coolant circulation. Reactor coolant system (RCS) hot leg temperature is greater than cold leg temperature and steam generator (S/G) levels are stable.

Which one of the following combinations of parameter trends, occurring 30 minutes after the trip, indicates that natural circulation is occurring? (CET = core exit thermocouple)

| | <u>RCS HOT LEG TEMPERATURE</u> | <u>RCS COLD LEG TEMPERATURE</u> | <u>S/G PRESSURES</u> | <u>RCS CET SUBCOOLING</u> |
|----|------------------------------------|-------------------------------------|--------------------------|-------------------------------|
| A. | Decreasing | Stable | Stable | Increasing |
| B. | Increasing | Decreasing | Increasing | Decreasing |
| C. | Decreasing | Decreasing | Decreasing | Decreasing |
| D. | Increasing | Increasing | Decreasing | Increasing |

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 94

A reactor has experienced a loss of coolant accident. Inadequate core cooling has resulted in the following core temperatures one hour into the accident:

- 90% of the fuel clad has remained below 1800EF
- 10% of the fuel clad has exceeded 1800EF
- 5% of the fuel clad has exceeded 2000EF
- 0.5% of the fuel clad has reached 2200EF
- 0.0% of the fuel clad has exceeded 2200EF
- Peak centerline fuel temperature is 4650EF

Which one of the following is an adverse consequence that will occur if the above fuel and clad temperatures remain constant for 24 additional hours followed by the injection of emergency cooling water directly to the top of the core?

- A. Explosive hydrogen concentration inside the reactor vessel
- B. Explosive hydrogen concentration inside the reactor containment building
- C. Release of radioactive fission products due to melting of fuel pellets and fuel clad
- D. Release of radioactive fission products due to rupture of fuel clad

QUESTION: 95

Which one of the following describes the fuel-to-coolant thermal conductivity at the end of core life (EOL) as compared to the beginning of core life (BOL)?

- A. Smaller at EOL due to fuel pellet densification
- B. Smaller at EOL due to contamination of fill gas with fission product gases
- C. Larger at EOL due to greater temperature difference between fuel pellets and coolant
- D. Larger at EOL due to reduction in gap between fuel pellets and clad

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 96

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

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

QUESTION: 97

The reference temperature for nil-ductility transition (RT_{NDT}) is the temperature above which:

- A. a large compressive stress can result in brittle fracture.
- B. a metal exhibits more ductile tendencies.
- C. the probability of brittle fracture increases.
- D. no appreciable deformation occurs prior to failure.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 98

A reactor is shutdown with the shutdown cooling system maintaining reactor coolant temperature at 240EF immediately following an uncontrolled cooldown from 500EF. If reactor coolant temperature is held constant at 240EF, which one of the following describes the change in tensile stress on the inner wall of the reactor vessel (RV) over the next few hours?

- A. Decreases, because the temperature gradient across the RV wall will decrease.
- B. Increases, because the temperature gradient across the RV wall will decrease.
- C. Decreases, because the inner RV wall temperature will approach the nil-ductility transition temperature.
- D. Increases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

QUESTION: 99

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

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

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2003 PWR--FORM A**

QUESTION: 100

A plant is shut down with the reactor coolant system at 1200 psia and 350EF. Which one of the following would be most likely to cause pressurized thermal shock of the reactor vessel?

- A. A rapid depressurization followed by a rapid heatup
- B. A rapid depressurization followed by a rapid cooldown
- C. A rapid cooldown followed by a rapid pressurization
- D. A rapid heatup followed by a rapid pressurization

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

**FEBRUARY 2003 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY**

| FORM | | ANS | FORM | | ANS | FORM | | ANS | FORM | | ANS |
|------|----|-----|------|----|-----|------|-----|-----|------|----|-----|
| A | B | | A | B | | A | B | | A | B | |
| 1 | 29 | A | 26 | 54 | D | 51 | 79 | C | 76 | 4 | D |
| 2 | 30 | B | 27 | 55 | C | 52 | 80 | C | 77 | 5 | C |
| 3 | 31 | B | 28 | 56 | B | 53 | 81 | A | 78 | 6 | C |
| 4 | 32 | A | 29 | 57 | A | 54 | 82 | D | 79 | 7 | D |
| 5 | 33 | A | 30 | 58 | C | 55 | 83 | B | 80 | 8 | C |
| 6 | 34 | C | 31 | 59 | B | 56 | 84 | A | 81 | 9 | A |
| 7 | 35 | D | 32 | 60 | A | 57 | 85 | D | 82 | 10 | A |
| 8 | 36 | A | 33 | 61 | A | 58 | 86 | C | 83 | 11 | B |
| 9 | 37 | C | 34 | 62 | B | 59 | 87 | C | 84 | 12 | B |
| 10 | 38 | D | 35 | 63 | A | 60 | 88 | B | 85 | 13 | D |
| 11 | 39 | C | 36 | 64 | B | 61 | 89 | A | 86 | 14 | A |
| 12 | 40 | D | 37 | 65 | C | 62 | 90 | C | 87 | 15 | D |
| 13 | 41 | D | 38 | 66 | B | 63 | 91 | A | 88 | 16 | C |
| 14 | 42 | D | 39 | 67 | A | 64 | 92 | B | 89 | 17 | D |
| 15 | 43 | C | 40 | 68 | A | 65 | 93 | D | 90 | 18 | A |
| 16 | 44 | D | 41 | 69 | B | 66 | 94 | B | 91 | 19 | C |
| 17 | 45 | D | 42 | 70 | B | 67 | 95 | A | 92 | 20 | D |
| 18 | 46 | B | 43 | 71 | B | 68 | 96 | A | 93 | 21 | A |
| 19 | 47 | A | 44 | 72 | A | 69 | 97 | D | 94 | 22 | D |
| 20 | 48 | D | 45 | 73 | B | 70 | 98 | D | 95 | 23 | D |
| 21 | 49 | C | 46 | 74 | D | 71 | 99 | B | 96 | 24 | B |
| 22 | 50 | C | 47 | 75 | B | 72 | 100 | B | 97 | 25 | B |
| 23 | 51 | B | 48 | 76 | A | 73 | 1 | B | 98 | 26 | A |
| 24 | 52 | C | 49 | 77 | D | 74 | 2 | C | 99 | 27 | D |
| 25 | 53 | A | 50 | 78 | A | 75 | 3 | D | 100 | 28 | C |