

**UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2013 — FORM A**

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item. Each test item has equal point value. A score of at least 80 percent is required to pass this portion of the NRC operator licensing written examination. All examination materials will be collected 3 hours after the examination begins. This examination applies to a typical U.S. boiling water reactor (BWR) nuclear power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 22		
REACTOR THEORY	23 - 36		
THERMODYNAMICS	37 - 50		
TOTALS	50		

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

Applicant's Signature

RULES AND INSTRUCTIONS FOR THE NRC GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

NOTE: The term "control rod" refers to the length of neutron absorber material that can be positioned by the operator to change core reactivity.

NOTE: Numerical answers are rounded to the nearest whole number unless otherwise indicated.

1. Print your name in the blank provided on the cover sheet of the examination.
2. Fill in your individual docket number.
3. Fill in the name of your facility.
4. Fill in your start and stop times at the appropriate times.
5. Two aids are provided for your use during the examination:
 - (1) An Equations and Conversions Sheet contained within the examination copy, and
 - (2) Steam tables and Mollier Diagram provided by your proctor.
6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.
7. Scrap paper will be provided for calculations.
8. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.
9. Restroom trips are limited. Only **one** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside the examination room.
10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination. Either pencil or pen may be used.
11. Turn in your examination materials, answer sheet on top, followed by the examination copy and the examination aids, e.g., steam tables, handouts, and scrap paper.
12. After turning in your examination materials, leave the examination area as defined by the proctor. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS SHEET

EQUATIONS

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

$$A = A_0e^{-\lambda t}$$

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

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

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

$$CR_1(1 - K_{\text{eff}_1}) = CR_2(1 - K_{\text{eff}_2})$$

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

$$1/M = CR_1/CR_x$$

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

$$A = \pi r^2$$

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

$$F = PA$$

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

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

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

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

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

$$P = IE$$

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

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

$$P_T = \sqrt{3}IEpf$$

$$\ell^* = 1.0 \times 10^{-4} \text{ sec}$$

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

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

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

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

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

$$P = P_0e^{t/\tau}$$

$$g = 32.2 \text{ ft/sec}^2$$

$$P = P_010^{\text{SUR}(t)}$$

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

CONVERSIONS

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

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

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

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

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

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

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

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

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 1

A completely full water storage tank is being hydrostatically tested to 100 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 10 gpm. The tank is protected by a safety valve and a relief valve; both valves discharge to the atmosphere. Each valve has an opening setpoint of 105 psig and a maximum rated discharge flow rate of 6 gpm. The PDP is inadvertently left running when tank pressure reaches 100 psig.

With the PDP still running, tank pressure will stabilize _____ 105 psig; and the greater mass flow rate will be coming from the _____ valve.

- A. at; safety
- B. above; safety
- C. at; relief
- D. above; relief

QUESTION: 2

During a local inspection of a manually operated 12-inch gate valve, the valve stem is observed to extend outward from the valve handwheel by 1 inch. The entire external valve stem is threaded, except for a 1-inch section that becomes smooth just before the valve stem enters the packing gland. Which one of the following describes the position of the gate valve?

- A. The valve is fully open or nearly fully open.
- B. The valve is fully closed or nearly fully closed.
- C. The valve may be in any position because it is a rising stem gate valve.
- D. The valve may be in any position because it is a non-rising stem gate valve.

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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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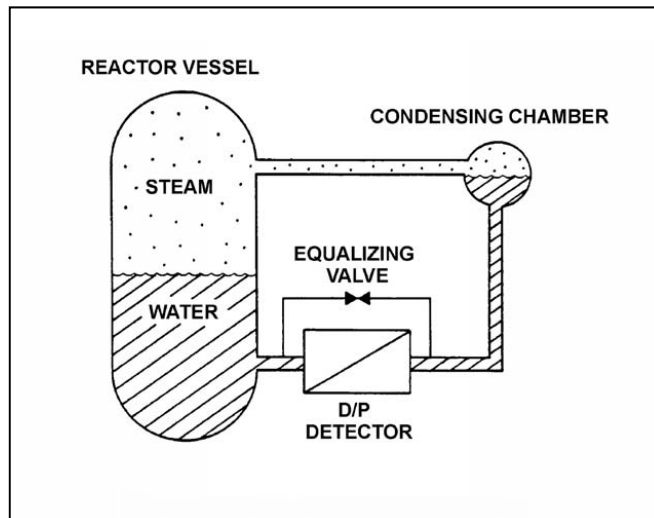
QUESTION: 4

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

With the reactor containing saturated water at 536°F, reactor vessel level indication is 40 feet. Assume that reference leg level and temperature do not change. Also, ignore the effect of steam density changes on level indication.

With no change in actual reactor vessel level, what will level indication be at 300°F (saturated)?

- A. 32.7 feet
- B. 35.8 feet
- C. 45.2 feet
- D. 48.9 feet



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QUESTION: 5

If the pressure sensed by a bourdon tube increases, the curvature of the detector will _____ because the greater force is being applied to the _____ curve of the detector.

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

QUESTION: 6

The pressure within a cooling water system is 100 psig, as indicated by a bourdon tube pressure detector. The cooling water system and the detector are located inside a reactor containment building. The pressure detector case is vented to the containment building, which is currently at atmospheric pressure.

If a steam line rupture raises the containment building pressure by 20 psi, the cooling water system pressure indication will... (Disregard any temperature effect on the detector.)

- A. decrease to 80 psig.
- B. decrease by a small, but indeterminate amount.
- C. increase to 120 psig.
- D. increase by a small, but indeterminate amount.

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QUESTION: 7

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

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

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

QUESTION: 8

A proportional controller is being used to control the water level in a tank. When the tank water level matches the controller setpoint of 20 feet, the controller output is 50 percent.

Tank water level is currently stable at 25 feet with the controller output at 75 percent.

What is the tank water level proportional band for this controller?

- A. 10 to 30 feet
- B. 10 to 40 feet
- C. 20 to 30 feet
- D. 20 to 40 feet

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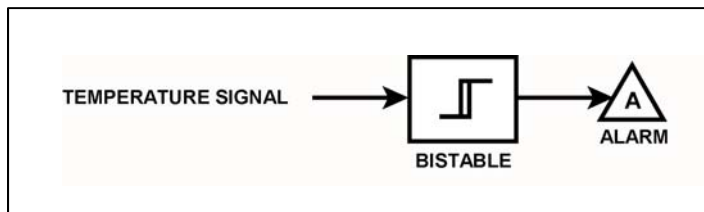
QUESTION: 9

Refer to the drawing of a temperature 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 deadband, or neutral zone.

If the current temperature is 150°F, which one of the following describes the alarm circuit 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.



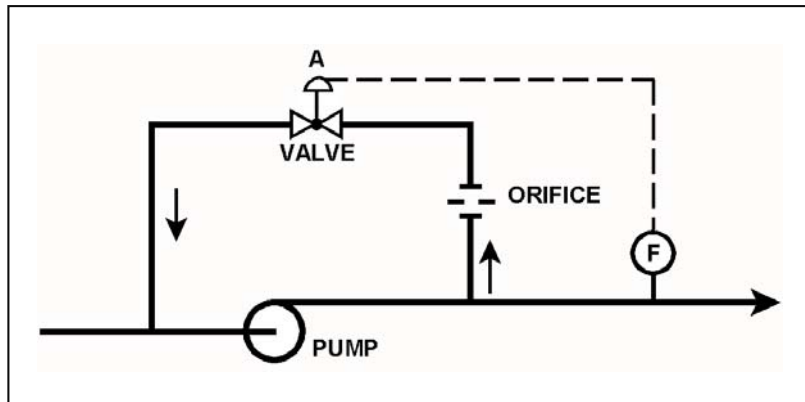
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QUESTION: 10

Refer to the drawing of a pump with recirculation line (see figure below).

Which one of the following describes the response of the pump if a complete flow blockage occurs in the discharge line just downstream of the flow transmitter?

- A. The pump will overheat after a relatively short period of time, due to a loss of both main flow and recirculation flow.
- B. The pump will overheat after a relatively long period of time, due to a loss of main flow only.
- C. The pump will overheat after a relatively long period of time, due to a loss of recirculation flow only.
- D. The pump will be able to operate under these conditions indefinitely, due to sustained main flow.



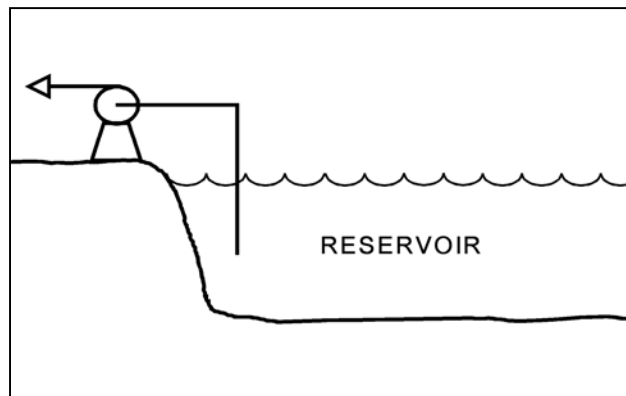
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QUESTION: 11

Refer to the drawing of a centrifugal pump taking suction from a reservoir (see figure below).

The pump is located on shore, with the eye of the pump 4 feet higher than the reservoir water level. The pump's suction line extends 4 feet below the surface of the reservoir. Which one of the following modifications would decrease the pump's available net positive suction head? (Assume the reservoir is at a uniform temperature and ignore any changes in suction line head loss due to friction.)

- A. Raise the pump and suction line by 2 feet.
- B. Lower the pump and suction line by 2 feet.
- C. Lengthen the suction line to take a suction from 2 feet deeper.
- D. Shorten the suction line to take a suction from 2 feet shallower.



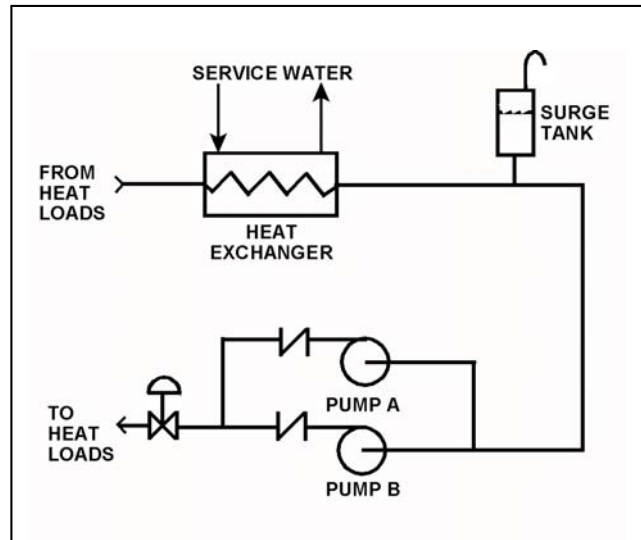
**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 12

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 percent 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 further away from runout conditions? (Assume that satisfactory available net positive suction head is maintained at all times.)

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



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QUESTION: 13

A centrifugal pump is operating in parallel with a positive displacement pump in an open water system. Each pump has the same maximum design pressure.

If pump discharge pressure increases to the maximum design pressure of each pump, the centrifugal pump will be operating at _____ flow; and the positive displacement pump will be operating near _____ flow.

- A. minimum; minimum
- B. minimum; maximum rated
- C. maximum rated; minimum
- D. maximum rated; maximum rated

QUESTION: 14

Which one of the following is a characteristic of a typical AC induction motor that causes starting current to be greater than running current?

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

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QUESTION: 15

Two identical 1,000 MW generators are operating in parallel, supplying all the loads on an 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>
28 KV	28 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 electrical current indication for generator B will...

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

QUESTION: 16

Which one of the following describes the proper sequence for placing a steam (shell) and water (tube) heat exchanger into service?

- A. The water side is valved in before the steam side to minimize thermal shock.
- B. The water side is valved in before the steam side to ensure adequate venting.
- C. The steam side is valved in before the water side to minimize scale buildup on the heat exchanger tubes.
- D. The steam side is valved in before the water side to ensure that the cooldown rate does not exceed 100°F/hr.

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QUESTION: 17

Given the following parameter values for a feedwater heater:

Feedwater inlet temperature = 320°F
Feedwater inlet pressure = 1,000 psia
Feedwater mass flow rate = 1.0×10^6 lbm/hr
Extraction steam pressure = 500 psia

Assume that the extraction steam enters the heater as a dry saturated vapor and leaves the heater as a saturated liquid at 500 psia.

Which one of the following is the approximate mass flow rate of extraction steam required to increase feedwater temperature to 380°F?

- A. 5.2×10^4 lbm/hr
- B. 7.9×10^4 lbm/hr
- C. 8.4×10^4 lbm/hr
- D. 8.9×10^4 lbm/hr

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QUESTION: 18

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

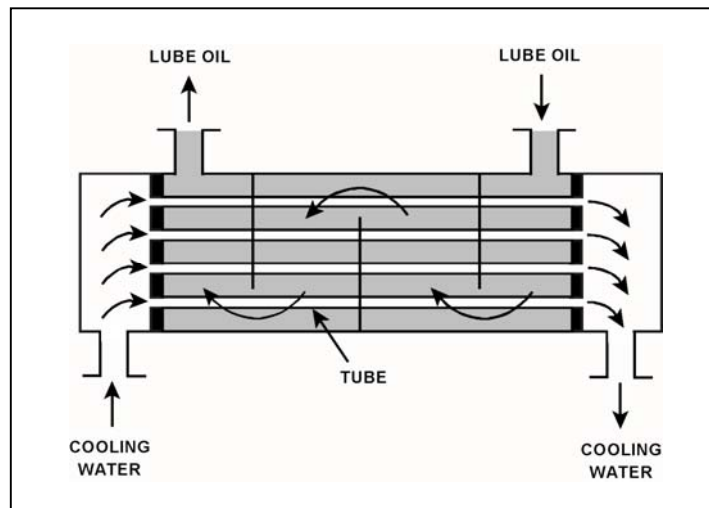
The heat exchanger was initially placed in continuous service 6 months ago. During the 6-month period of operation, mineral deposits have accumulated inside the heat exchanger tubes.

The following parameters are currently stable at their initial values:

- Lube oil mass flow rate
- Lube oil inlet temperature
- Lube oil outlet temperature
- Cooling water inlet temperature

Compared to their initial values, the current cooling water outlet temperature is _____; and the current cooling water mass flow rate is _____.

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



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QUESTION: 19

Channeling in a demineralizer is undesirable because the...

- A. ability of the resin bed to remove undesirable ions will decrease and cause outlet conductivity to increase.
- B. ability of the resin bed to remove suspended solids will decrease and cause outlet pH to increase.
- C. resulting high velocity fluid flow will cause agitation of the resin beads and the release of unwanted ions.
- D. resulting high velocity fluid flow can cause significant damage to resin retention elements.

QUESTION: 20

How does demineralizer differential pressure indicate the condition of a demineralizer resin bed?

- A. Low differential pressure indicates flow blockage in the demineralizer.
- B. Low differential pressure indicates that the demineralizer resin bed is exhausted.
- C. High differential pressure indicates flow blockage in the demineralizer.
- D. High differential pressure indicates that the demineralizer resin bed is exhausted.

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QUESTION: 21

Which one of the following will provide the first motor protection against electrical damage caused by gradual bearing degradation?

- A. Thermal overload device
- B. Overcurrent trip relay
- C. Underfrequency relay
- D. Undervoltage device

QUESTION: 22

If a main generator output breaker is closed when the generator output voltage is 90 degrees out of phase with the power grid voltage, the main generator will experience a _____ stress; if the breaker remains closed and no additional operator action is taken, the main generator voltage will _____ with the grid voltage.

- A. minor; remain out of phase
- B. minor; become locked into phase
- C. potentially damaging; remain out of phase
- D. potentially damaging; become locked into phase

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QUESTION: 23

The ideal neutron moderator has a _____ microscopic scattering cross section for thermal neutrons and a _____ density.

- A. small; low
- B. small; high
- C. large; low
- D. large; high

QUESTION: 24

A reactor is initially operating at steady-state 60 percent power near the end of a fuel cycle 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 _____; and compared to the initial core K_{eff} , the new core K_{eff} is _____.

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

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QUESTION: 25

Reactors A and B are identical except that the reactors are operating at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical with neutron flux level stable in the source range.

Given:

$$\text{Reactor A } K_{\text{eff}} = 0.999$$

$$\text{Reactor B } K_{\text{eff}} = 0.998$$

If positive 0.003 $\Delta K/K$ is suddenly added to each reactor, how will the resulting stable periods compare? (Consider only the reactor response while power is below the point of adding heat.)

- A. Reactor A stable period will be shorter.
- B. Reactor B stable period will be shorter.
- C. Reactors A and B will have the same stable period because both reactors will remain subcritical.
- D. Reactors A and B will have the same stable period because both reactors received the same amount of positive reactivity.

QUESTION: 26

A reactor is operating at 100 percent power immediately following a refueling outage. In comparison to the moderator temperature coefficient (MTC) just prior to the refueling outage, the current MTC is...

- A. more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.
- B. less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.
- C. more negative at all coolant temperatures.
- D. less negative at all coolant temperatures.

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QUESTION: 27

Which one of the following will cause the void coefficient to become less negative? (Consider only the direct effects of the indicated changes.)

- A. Core void fraction increases.
- B. Fuel temperature decreases.
- C. Gadolinium burns out.
- D. Control rods are partially inserted.

QUESTION: 28

A control rod is initially at position 16. When the control rod is moved to position 22, it is being...

- A. inserted 18 inches.
- B. withdrawn 18 inches.
- C. inserted 36 inches.
- D. withdrawn 36 inches.

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QUESTION: 29

Which one of the following statements describes how changes in core parameters affect control rod worth (CRW)?

- A. CRW increases with an increase in void fraction.
- B. CRW increases with an increase in fast neutron flux.
- C. CRW decreases when approaching the end of a fuel cycle.
- D. CRW decreases when the temperature of the fuel decreases.

QUESTION: 30

A reactor has been operating at a constant 50 percent power level for 15 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

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

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QUESTION: 31

A reactor has been operating at 100 percent power for 2 months when a reactor scram occurs. Four hours later, the reactor is stable at 10 percent power.

Which one of the following operator actions is required to maintain reactor power at 10 percent over the next 18 hours?

- A. Add positive reactivity during the entire period.
- B. Add negative reactivity during the entire period.
- C. Add positive reactivity at first, and then negative reactivity.
- D. Add negative reactivity at first, and then positive reactivity.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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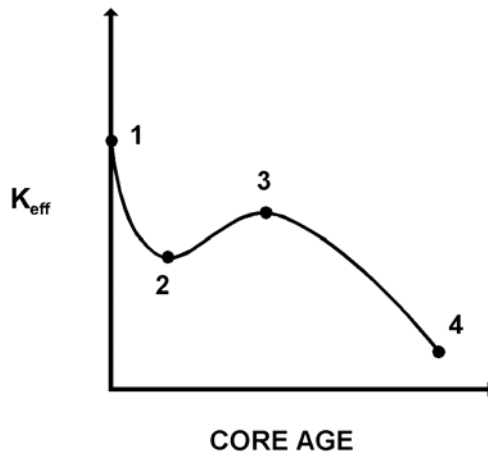
QUESTION: 32

Refer to the curve of K_{eff} versus core age for an operating reactor (see figure below).

The reactor has been operating at 100 percent power for several weeks and is currently operating between points 2 and 3 on the curve.

Assuming reactor recirculation flow rate remains the same, what incremental control rod operation(s) will be needed to maintain 100 percent power until point 3 is reached?

- A. Withdrawal for the entire period.
- B. Withdrawal at first, then insertion.
- C. Insertion for the entire period.
- D. Insertion at first, then withdrawal.



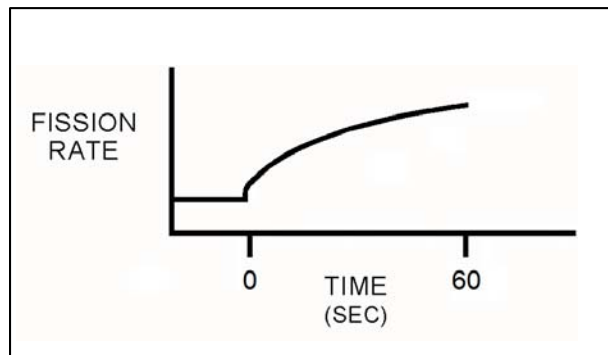
**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 33

Refer to the drawing that shows a graph of fission rate versus time (see figure below). Both axes have linear scales.

Which one of the following events, initiated at 0 seconds, could cause the reactor response shown on the graph?

- A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range and remains subcritical for the duration of the 60-second interval shown.
- B. A step addition of positive reactivity to a reactor that is initially critical in the source range and remains below the point of adding heat for the duration of the 60-second interval shown.
- C. A continuous addition of positive reactivity at a constant rate to a reactor that is initially subcritical in the source range and remains subcritical for the duration of the 60-second interval shown.
- D. A continuous addition of positive reactivity at a constant rate to a reactor that is initially critical in the source range and remains below the point of adding heat for the duration of the 60-second interval shown.



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QUESTION: 34

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron-induced fission?

- A. 10 percent
- B. 20 percent
- C. 80 percent
- D. 100 percent

QUESTION: 35

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable positive 60-second reactor period. One minute later (well before reaching the point of adding heat), the operator inserts the same control rod for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the insertion, when will the reactor period become negative?

- A. Immediately when the control rod insertion is initiated.
- B. After the control rod passes through the critical rod height.
- C. Just as the control rod passes through the critical rod height.
- D. Prior to the control rod passing through the critical rod height.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 36

A reactor is critical and a reactor coolant heatup is in progress with coolant temperature currently at 140°F. If the point of adding heat is initially 0.1 percent reactor power, and reactor power is held constant at 1.0 percent during the heatup, which one of the following describes the coolant heatup rate (HUR) from 140°F to 200°F?

- A. HUR will initially decrease and then increase.
- B. HUR will slowly decrease during the entire period.
- C. HUR will slowly increase during the entire period.
- D. HUR will remain the same during the entire period.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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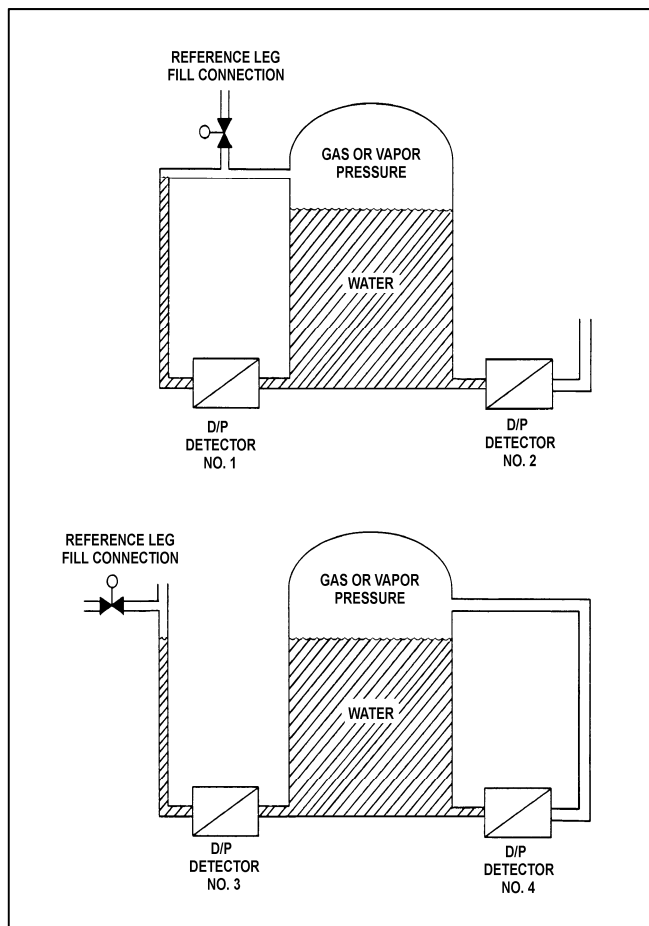
QUESTION: 37

Refer to the drawing of two water storage tanks with four differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are being maintained at 2 psig overpressure, 60°F, and the same constant water level. The tanks are located within a sealed containment structure that is being maintained at standard atmospheric pressure. All level detectors have been calibrated and are producing the same level indication.

If a ventilation malfunction causes the containment structure pressure to decrease to 12 psia, which detectors will produce the lowest level indications?

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



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QUESTION: 38

An open vessel contains 2.0 lbm of water at 200°F and standard atmospheric pressure. Which one of the following will be caused by the addition of 16.0 Btu to the water?

- A. The water temperature will increase, and all of the water will boil off.
- B. The water temperature will increase, and none of the water will boil off.
- C. The water temperature will rise to 212°F, and some of the water will boil off.
- D. The water temperature will rise to 216°F, and some of the water will boil off.

QUESTION: 39

A nuclear power plant is operating at 90 percent of rated power. Main condenser pressure is 1.69 psia and hotwell condensate temperature is 120°F.

Which one of the following describes the effect of a 5 percent decrease in cooling water flow rate through the main condenser on steam cycle thermal efficiency?

- A. Efficiency will increase, because condensate depression will decrease.
- B. Efficiency will increase, because the work output of the main turbine will increase.
- C. Efficiency will decrease, because condensate depression will increase.
- D. Efficiency will decrease, because the work output of the main turbine will decrease.

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QUESTION: 40

A nuclear power plant is operating steady-state at 85 percent power when the extraction steam to a high pressure feedwater heater is isolated. Which one of the following describes the initial effect on main generator output (MW)? (Assume no operator action and no reactor protection actuation.)

- A. Increases, because the steam cycle thermal efficiency initially increases.
- B. Decreases, because the steam cycle thermal efficiency initially decreases.
- C. Increases, because the steam flow rate through the main turbine initially increases.
- D. Decreases, because the steam flow rate through the main turbine initially decreases.

QUESTION: 41

Which one of the following components of a centrifugal pump has the specific primary function of converting the kinetic energy of a fluid into pressure?

- A. Volute
- B. Impeller
- C. Pump shaft
- D. Discharge nozzle

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 42

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

Discharge pressure at 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 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 CP and one PDP in series (CP supplying PDP)

**USNRC GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2013 BWR — FORM A**

QUESTION: 43

Which one of the following describes a heat transfer flow path in which conduction is the dominant mode of heat transfer?

- A. From the fuel rods to the core barrel during core uncover.
- B. From the main turbine exhaust steam to the atmosphere via main condenser cooling water and a cooling tower during normal operation.
- C. From the fuel rods to the steam outlet of the reactor vessel during a station blackout.
- D. From a fuel pellet to the fuel cladding via the fuel rod fill gas during normal operation.

QUESTION: 44

Which one of the following is indicated by a rapid increase in the temperature difference between the fuel cladding and the bulk coolant?

- A. Bulk boiling is occurring.
- B. Nucleate boiling is occurring.
- C. Critical heat flux is increasing.
- D. Departure from nucleate boiling is occurring.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2013 BWR — FORM A**

QUESTION: 45

Which one of the following actions will initially reduce core inlet subcooling in a reactor operating at power?

- A. Isolate steam to one feedwater heater.
- B. Increase core recirculation mass flow rate.
- C. Decrease the mass ratio of saturated water-to-saturated steam returning to the downcomer.
- D. Increase the mass ratio of saturated water-to-saturated steam returning to the downcomer.

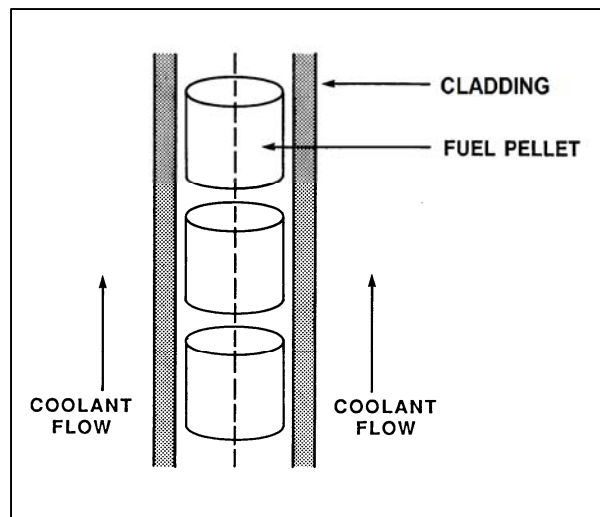
**USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 46

Refer to the drawing of a fuel rod and adjacent coolant flow channel (see figure below).

With a power plant operating at steady-state 100 percent reactor power at the beginning of a fuel cycle, which one of the following has the greater temperature difference?

- A. Coolant laminar layer
- B. Cladding corrosion film
- C. Zircaloy cladding
- D. Pellet-to-cladding gap



**USNRC GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2013 BWR — FORM A**

QUESTION: 47

A nuclear power plant is operating at 90 percent power near the end of a fuel cycle when a turbine control system malfunction opens the turbine control valves an additional 5 percent. Assuming the reactor does not scram immediately, the critical power ratio will initially _____ due to a(n) _____ latent heat of vaporization for the reactor coolant.

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

QUESTION: 48

The fuel thermal time constant specifies the amount of time required for...

- A. a fuel bundle to achieve equilibrium temperature following a power change.
- B. a fuel pellet to achieve equilibrium temperature following a power change.
- C. the fuel centerline temperature to undergo most of its total change following a power change.
- D. the fuel cladding temperature to undergo most of its total change following a power change.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2013 BWR — FORM A**

QUESTION: 49

If fuel pellet densification occurs in a fuel rod producing a constant power output, the average linear heat generation rate in the fuel rod will _____ because pellet densification causes fuel pellets to _____.

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

QUESTION: 50

Which one of the following will apply a compressive stress to the outside wall of the reactor vessel?

- A. Neutron embrittlement of the reactor vessel.
- B. Increasing reactor pressure.
- C. Performing a reactor cooldown.
- D. Performing a reactor heatup.

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

**DECEMBER 2013 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING 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	B	26	40	C
2	16	B	27	41	B
3	17	B	28	42	B
4	18	D	29	43	C
5	19	C	30	44	D
6	20	A	31	45	C
7	21	D	32	46	C
8	22	A	33	47	A
9	23	C	34	48	C
10	24	B	35	49	D
11	25	A	36	50	B
12	26	A	37	1	C
13	27	B	38	2	B
14	28	A	39	3	D
15	29	A	40	4	C
16	30	A	41	5	A
17	31	C	42	6	B
18	32	B	43	7	D
19	33	A	44	8	D
20	34	C	45	9	C
21	35	A	46	10	D
22	36	D	47	11	A
23	37	D	48	12	D
24	38	B	49	13	D
25	39	A	50	14	C