

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

**Please Print**

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

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

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

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

**INSTRUCTIONS TO APPLICANT**

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item. Each test item has equal point value. A score of at least 80% is required to pass this portion of the NRC operator licensing written examination. All examination papers will be collected 3.0 hours after the examination starts. This examination applies to a typical pressurized water reactor (PWR) nuclear power plant.

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

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

\_\_\_\_\_  
Applicant's Signature

**RULES AND GUIDELINES FOR THE NRC  
GENERIC FUNDAMENTALS EXAMINATION**

During the administration of this examination the following rules apply:

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

1. Print your name in the blank provided on the cover sheet of the examination.
2. Fill in 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**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

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

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

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

**CONVERSIONS**

---

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

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

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

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

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

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

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

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

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

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QUESTION: 1

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 will 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; 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

Which one of the following valves is used to control the direction of fluid flow and prevent backflow in a system?

- A. Gate valve
- B. Relief valve
- C. Globe valve
- D. Check valve

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QUESTION: 3

If the steam pressure input to a density-compensated steam flow instrument fails low, the indicated flow rate will...

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

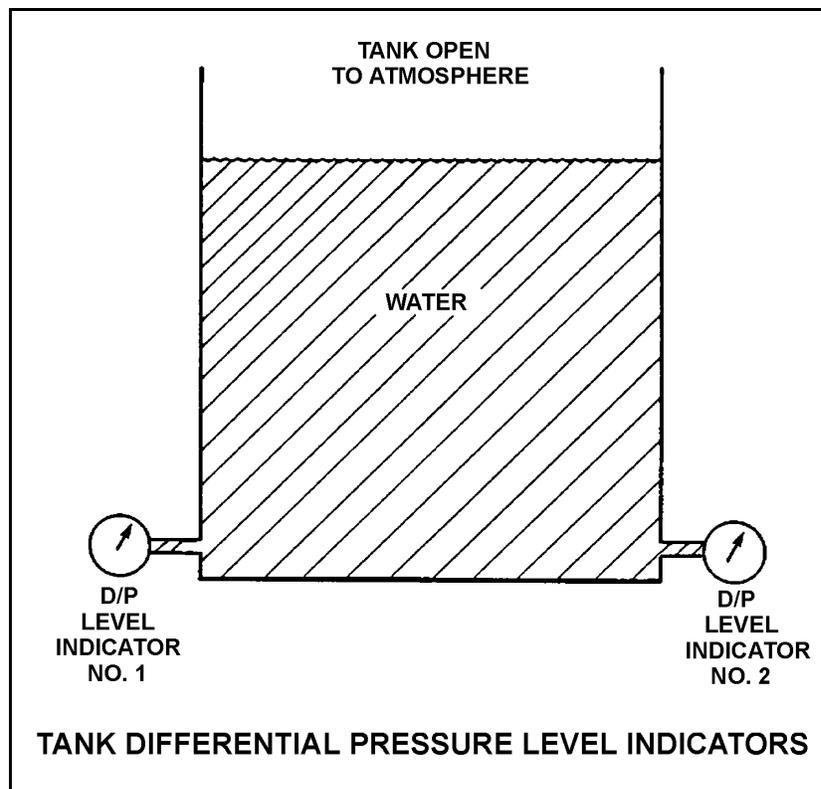
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QUESTION: 4

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

Indicator 1 was calibrated at a tank water temperature of 120°F and indicator 2 was calibrated at 180°F. If tank water temperature is currently 150°F, then indicator...

- A. 1 will read greater than indicator 2, and indicator 1 will read greater than actual water level.
- B. 1 will read greater than indicator 2, and indicator 1 will read less than actual water level.
- C. 2 will read greater than indicator 1, and indicator 2 will read greater than actual water level.
- D. 2 will read greater than indicator 1, and indicator 2 will read less than actual water level.



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QUESTION: 5

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

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

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

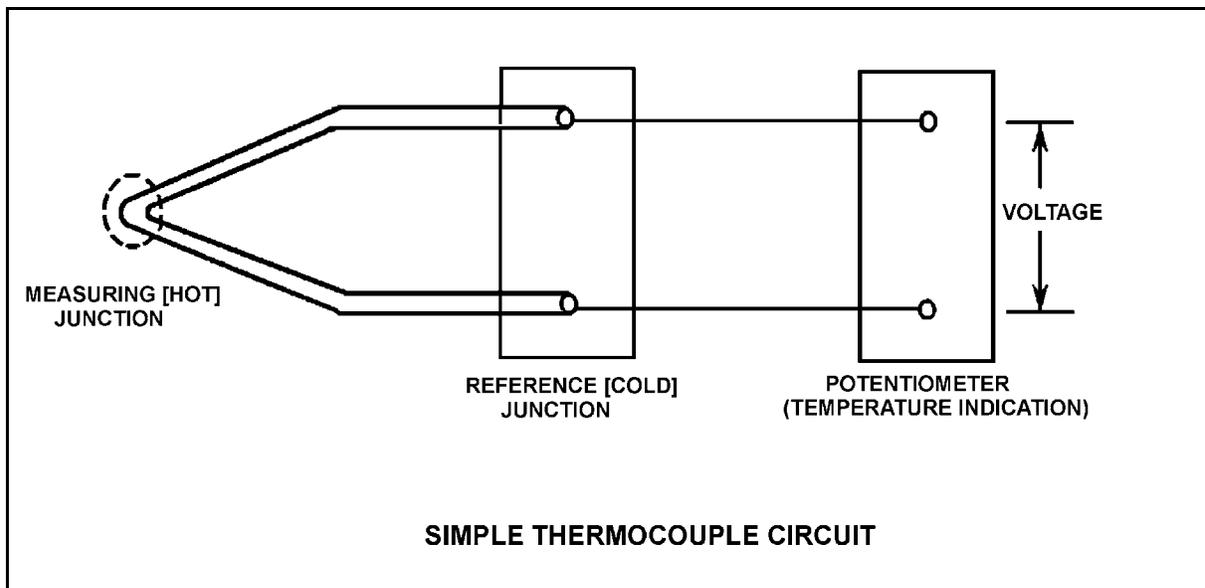
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QUESTION: 6

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

Given that the temperatures at the measuring and reference junctions remain constant, if a ventilation system malfunction causes the temperature of the temperature indication panel to increase by  $10^{\circ}\text{F}$ , indicated temperature will...

- A. not be affected.
- B. increase by  $10^{\circ}\text{F}$ .
- C. decrease by  $10^{\circ}\text{F}$ .
- D. change in an unpredictable manner.



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QUESTION: 7

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

- A. increase, until an upper limit is reached or the turbine trips on overspeed.
- B. decrease, until the mismatch with the turbine speed demand signal is nulled.
- C. increase, until the mismatch with the turbine speed demand signal is nulled.
- D. decrease, until a lower limit is reached or turbine steam flow is isolated.

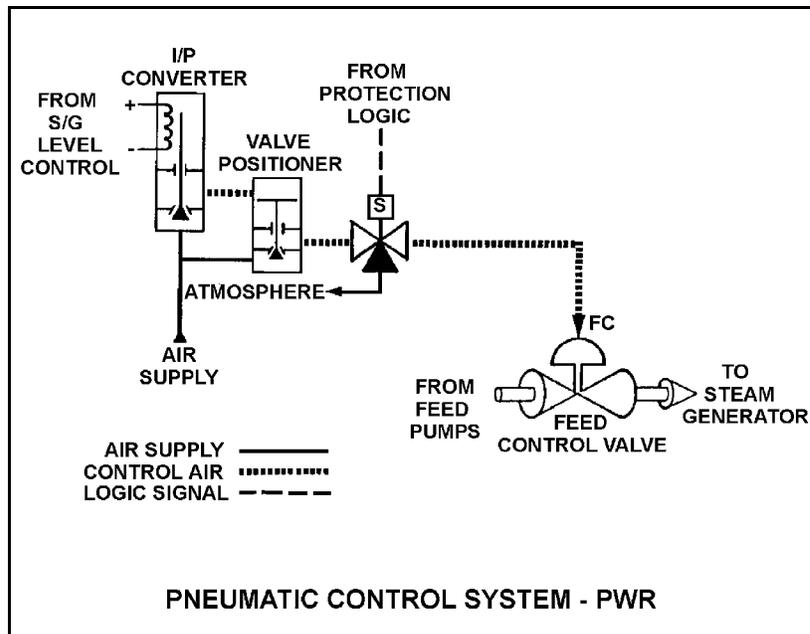
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QUESTION: 8

Refer to the drawing of a pneumatic control system (see figure below).

The purpose of the valve positioner is to convert...

- A. a small control air pressure into a proportionally larger air pressure to adjust valve position.
- B. a large control air pressure into a proportionally smaller air pressure to adjust valve position.
- C. pneumatic force into mechanical force to adjust valve position.
- D. mechanical force into pneumatic force to adjust valve position.



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QUESTION: 9

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

- A. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller set point, at which time the output signal stops increasing.
- 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.

QUESTION: 10

A nuclear power plant is operating at full power when a 200 gpm reactor coolant leak occurs, which results in a reactor trip and initiation of emergency coolant injection. Reactor coolant system pressure stabilizes at 1,000 psia and all injection pumps are operating with their pump recirculation lines isolated. The shutoff heads for the pumps are as follows:

High pressure injection (HPI) pumps: 2,500 psia  
Low pressure injection (LPI) pumps: 200 psia

Which pumps must be stopped quickly and why?

- A. HPI pumps to prevent pump overheating caused by low flow.
- B. LPI pumps to prevent pump overheating caused by low flow.
- C. HPI pumps to prevent motor overheating caused by high flow.
- D. LPI pumps to prevent motor overheating caused by high flow.

QUESTION: 11



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QUESTION: 12

Which one of the following describes a reason for designing centrifugal pumps with suction nozzles that are larger than their discharge nozzles?

- A. Increases total pump head by increasing the velocity head at the suction of the pump.
- B. Increases the differential pressure across the pump by decreasing pump head loss.
- C. Increases pump available net positive suction head by decreasing head loss at the pump suction.
- D. Increases pump capacity by decreasing turbulence at the suction of the pump.

QUESTION: 13

An ideal (no slip) reciprocating positive displacement pump is operating to provide makeup water to a reactor coolant system that is being maintained at 2,200 psig. The discharge valve of the pump was found to be throttled to 80% open.

If the valve is subsequently fully opened, pump flow rate will \_\_\_\_\_ and pump head will \_\_\_\_\_.

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

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QUESTION: 14

A main generator that is connected to an infinite power grid has the following indications:

100 MWe  
0 MVAR  
2,900 amps  
20,000 Vac

If main generator excitation is reduced slightly, amps will \_\_\_\_\_ and MWe will \_\_\_\_\_.

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

QUESTION: 15

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

- A. The rotor does not develop maximum induced current flow until it has achieved synchronous 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 field induces an opposing voltage in the stator that is proportional to rotor speed.

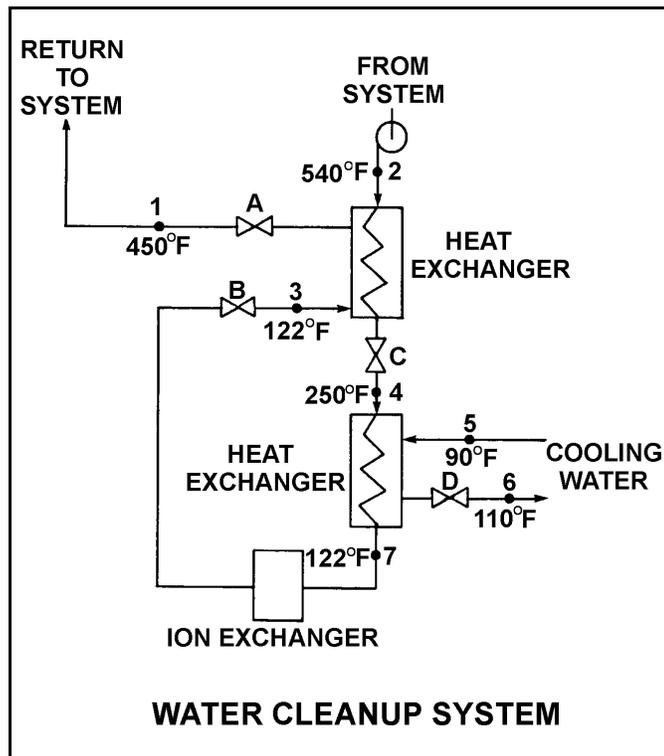
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QUESTION: 16

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

All valves are identical and are initially 50% open. To raise the temperature at point 4, the operator can adjust valve \_\_\_\_\_ in the \_\_\_\_\_ direction.

- A. A; shut
- B. B; shut
- C. C; open
- D. D; open



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QUESTION: 17

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

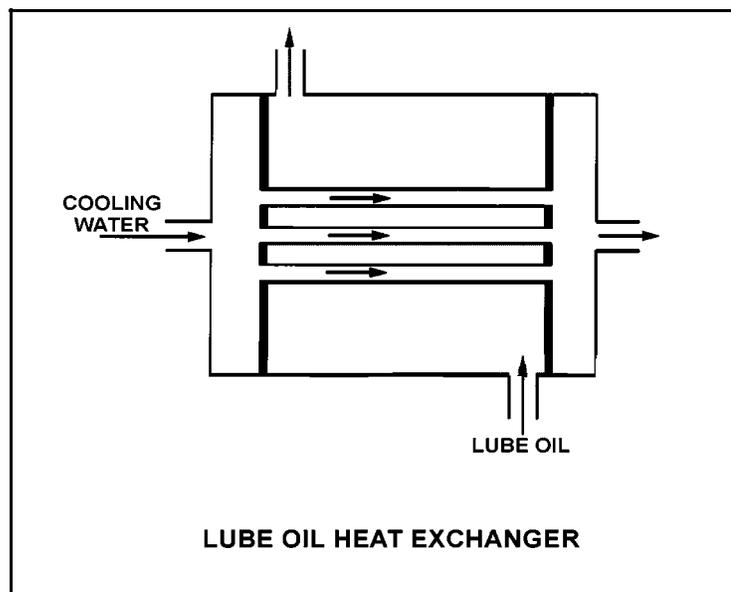
Given the following initial parameters:

Cooling water inlet temperature ( $T_{cw-in}$ ) = 75°F  
Cooling water outlet temperature ( $T_{cw-out}$ ) = 95°F  
Oil inlet temperature ( $T_{oil-in}$ ) = 150°F  
Oil outlet temperature ( $T_{oil-out}$ ) = 120°F

Air introduction to the heat exchanger results in some of the heat exchanger tubes becoming uncovered. As a result,  $T_{cw-out}$  decreases to 91°F. Assume the inlet temperatures, mass flow rates, and specific heats of both fluids remain the same.

Which one of the following will be the new approximate temperature of the oil exiting the heat exchanger ( $T_{oil-out}$ )?

- A. 126°F
- B. 130°F
- C. 134°F
- D. 138°F



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QUESTION: 18

A condensate demineralizer differential pressure (D/P) gauge indicates 4.0 psid at 50% flow rate. Which one of the following combinations of condensate flow and demineralizer D/P observed at various power levels indicates an increase in the accumulation of insoluble corrosion products in the demineralizer?

|    | <u>CONDENSATE<br/>FLOW</u> | <u>DEMINERALIZER<br/>D/P (PSID)</u> |
|----|----------------------------|-------------------------------------|
| A. | 25%                        | 1.0                                 |
| B. | 60%                        | 6.5                                 |
| C. | 75%                        | 9.0                                 |
| D. | 100%                       | 15.5                                |

QUESTION: 19

The decontamination factor (or demineralization factor) of a condensate demineralizer has just been determined to be 5.0, 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. 0.4  $\mu\text{mho/cm}$
- B. 4.0  $\mu\text{mho/cm}$
- C. 10.0  $\mu\text{mho/cm}$
- D. 100.0  $\mu\text{mho/cm}$

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QUESTION: 20

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.

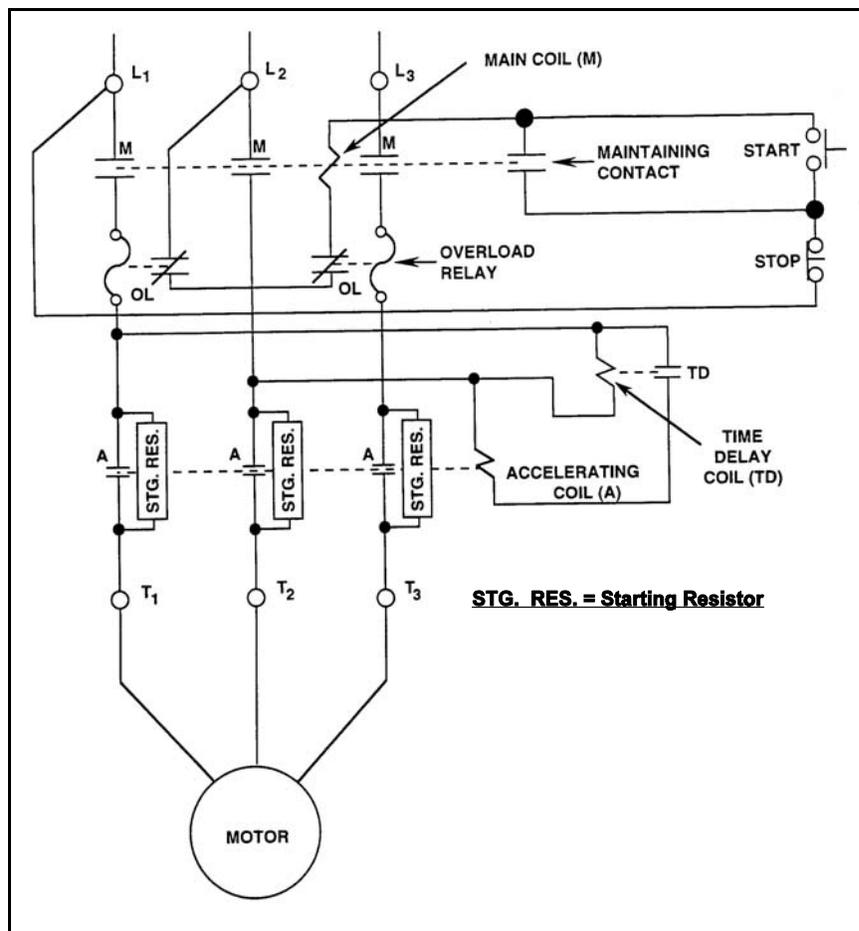
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QUESTION: 21

Refer to the drawing of a motor and its control circuit (see figure below). (Note: Relay contacts follow the standard convention for control circuit drawings.)

How are the starting resistors employed before and after the motor is energized?

- A. Inserted before the motor is energized; simultaneously bypassed after the motor gains speed.
- B. Inserted before the motor is energized; sequentially bypassed as the motor gains speed.
- C. Bypassed before the motor is energized; simultaneously inserted after the motor gains speed.
- D. Bypassed before the motor is energized; sequentially inserted as the motor gains speed.



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QUESTION: 22

Which one of the following describes a characteristic of high voltage electrical disconnects?

- A. They close automatically requiring no operator action.
- B. They should not be used to interrupt a circuit under load.
- C. They require a remote means of indication to determine actual position.
- D. They should be connected so that they ground the supply bus prior to opening a circuit.

QUESTION: 23

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to...

- A. leak out of the core while slowing down.
- B. be captured by a U-238 nucleus at a resonance energy.
- C. be captured by a Xe-135 nucleus.
- D. cause thermal fission of a U-235 nucleus.

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QUESTION: 24

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

Which one of the following will decrease core  $K_{\text{eff}}$ ?

- A. An unrodded spent fuel assembly is removed from the core.
- B. Refueling water temperature is increased to 105°F.
- C. A depleted neutron source is removed from the core.
- D. Refueling water boron concentration is decreased by 5 ppm.

QUESTION: 25

A nuclear reactor is shutdown with a  $K_{\text{eff}}$  of 0.96 and a stable source range indication of 50 counts per second (cps) when a reactor startup is commenced. Which one of the following will be the stable source range indication when  $K_{\text{eff}}$  reaches 0.995?

- A. 400 cps
- B. 800 cps
- C. 4,000 cps
- D. 8,000 cps

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QUESTION: 26

Which one of the following will result in a less negative fuel temperature coefficient? (Consider only the direct effect of the change in the listed parameters.)

- A. Increase in fuel burnup.
- B. Decrease in fuel temperature.
- C. Increase in void fraction.
- D. Decrease in moderator temperature.

QUESTION: 27

A nuclear reactor is operating at full power following a refueling outage. Compared to the moderator temperature coefficient (MTC) just prior to the refueling, the current MTC is...

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

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QUESTION: 28

A nuclear power plant is operating at 80% power with manual rod control. It has been determined that power distribution is excessive in the lower half of the core.

Which one of the following will shift power distribution toward the upper half of the core? (Assume no additional operator actions.)

- A. Increasing power to 90%.
- B. Withdrawing control rods.
- C. Borating the reactor coolant system.
- D. Diluting the reactor coolant system.

QUESTION: 29

Why are control rod insertion limits established for power operation?

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

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QUESTION: 30

A nuclear power plant has been operating at 100% power for several months. Which one of the following describes the relative contributions of beta decay and neutron capture to Xe-135 removal from the reactor core?

- A. Primary - neutron capture; secondary - beta decay.
- B. Primary - beta decay; secondary - neutron capture.
- C. Beta decay and neutron capture contribute equally.
- D. Not enough information is given to make a comparison.

QUESTION: 31

A nuclear reactor had been operating at 70% power for two weeks when power was increased to 100% over a 2-hour period. To offset Xe-135 reactivity changes during the next 12 hours, which one of the following incremental control rod manipulations will be required?

- A. Withdraw rods slowly during the entire period.
- B. Withdraw rods slowly at first, then insert rods slowly.
- C. Insert rods slowly during the entire period.
- D. Insert rods slowly at first, then withdraw rods slowly.

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QUESTION: 32

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

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

QUESTION: 33

A nuclear reactor is critical below the point of adding heat (POAH). The operator adds enough reactivity to attain a startup rate of 0.5 decades per minute. Which one of the following will decrease first when the reactor reaches the POAH?

- A. Pressurizer level
- B. Reactor coolant temperature
- C. Reactor power
- D. Startup rate

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QUESTION: 34

A refueling outage has just been completed in which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to mark the beginning of the sixth fuel cycle and reactor power is being increased to 100%.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100% power?

- A. U-235 and U-238
- B. U-238 and Pu-239
- C. U-235 and Pu-239
- D. U-235 and Pu-241

QUESTION: 35

A nuclear 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 1.0 dpm startup rate (SUR). One minute later (prior to reaching the point of adding heat), the operator inserts the same control rod for 25 seconds.

During the insertion, when will the SUR 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.

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QUESTION: 36

A nuclear reactor was shut down one week ago following several months of operation at 100% power. Reactor coolant is being maintained at 500°F and all reactor coolant pumps are operating.

The principle source of heat input to the reactor coolant is from...

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

QUESTION: 37

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

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

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QUESTION: 38

An open vessel contains one pound-mass of water at 206°F and atmospheric pressure. Which one of the following will be caused by the addition of 3.0 Btu to the water?

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

QUESTION: 39

Given the following:

- A nuclear power plant is operating near rated power.
- The main turbine is comprised of a single unit with no reheat.
- Main turbine inlet steam conditions are 900 psia and 100% quality.
- Ideal steam expansion is occurring in the main turbine.
- Main condenser pressure is 1.0 psia.

Which one of the following is the approximate main condenser specific heat rejection needed to establish condensate depression at 4°F?

- A. 716 Btu/lbm
- B. 782 Btu/lbm
- C. 856 Btu/lbm
- D. 1,132 Btu/lbm

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QUESTION: 40

A nuclear power plant is operating at 90% 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% decrease in cooling water flow rate through the main condenser?

- A. Overall steam cycle efficiency will increase because the work output of the turbine will increase.
- B. Overall steam cycle efficiency will increase because condensate depression will decrease.
- C. Overall steam cycle efficiency will decrease because the work output of the turbine will decrease.
- D. Overall steam cycle efficiency will decrease because condensate depression will increase.

QUESTION: 41

Turbine X and turbine Y are ideal steam turbines that exhaust to a condenser at 1.0 psia. Turbine X is driven by saturated steam (100% quality) at 900 psia. Turbine Y is driven by superheated steam at 500 psia and 620°F.

The greatest amount of work is being performed by turbine \_\_\_\_\_, and the greatest moisture content exists in the exhaust of turbine \_\_\_\_\_.

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

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QUESTION: 42

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

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

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

QUESTION: 43

Main steam is flowing through a venturi in a main steamline. A main steamline break downstream of the venturi causes the main steam mass flow rate through the venturi to increase. Soon, the steam reaches sonic velocity in the throat of the venturi.

How will the main steam mass flow rate through the venturi be affected as the steam pressure downstream of the venturi continues to decrease?

- A. It will continue to increase at a rate that is dependent on the steam velocity in the throat of the venturi.
- B. It will continue to increase at a rate that is dependent on the differential pressure across the venturi.
- C. It will not continue to increase because the steam velocity cannot increase above sonic velocity in the throat of the venturi.
- D. It will not continue to increase because the differential pressure across the venturi cannot increase further once the steam reaches sonic velocity in the throat of the venturi.

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

QUESTION: 44

A nuclear power plant is operating at 60% power. Which one of the following is the primary heat transfer mechanism responsible for the transfer of heat from the surface of the steam generator tubes to the feedwater?

- A. Radiolysis
- B. Radiation
- C. Conduction
- D. Convection

QUESTION: 45

Following a nuclear reactor accident, transition boiling is occurring near the top of one fuel assembly coolant channel. At the coolant channel elevation where the onset of transition boiling is occurring, coolant flow is changing from \_\_\_\_\_ flow to \_\_\_\_\_ flow.

- A. annular; slug
- B. annular; vapor
- C. bubbly; slug
- D. bubbly; vapor

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

QUESTION: 46

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

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

QUESTION: 47

Adequate core bypass flow is needed to...

- A. prevent stratification of reactor coolant inside the reactor vessel.
- B. provide reactor coolant pump minimum flow requirements.
- C. cool excore nuclear instrument detectors.
- D. equalize temperature between the vessel and upper vessel head.

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

QUESTION: 48

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

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

QUESTION: 49

A PWR core consists of 50,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal energy. If the nuclear heat flux hot channel factor,  $F_Q(z)$ , (also called the total core peaking factor) is 2.0, what is the maximum local linear power density being produced in the core?

- A. 4.5 kW/ft
- B. 6.0 kW/ft
- C. 9.0 kW/ft
- D. 12.0 kW/ft

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

QUESTION: 50

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The tests determined that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 72°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

- A. The test results are credible and the reactor vessel is more likely to experience brittle fracture now than after the previous refueling shutdown.
- B. The test results are credible and the reactor vessel is less likely to experience brittle fracture now than after the previous refueling shutdown.
- C. The test results are questionable because the specimen NDT temperature would not increase during the described 18-month period of operation.
- D. The test results are questionable because the specimen NDT temperature would increase by less than indicated during the described 18-month period of operation.

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

DECEMBER 2004 NRC GENERIC FUNDAMENTALS EXAMINATION  
PRESSURIZED WATER REACTOR - ANSWER KEY

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