**UNITED STATES NUCLEAR REGULATORY COMMISSION**
**PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION**
**SEPTEMBER 2021 PWR – FORM A**

**DO NOT BEGIN THIS EXAMINATION UNTIL DIRECTED TO DO SO.**

**Please Print:**

Name: _____

Docket No.: 55-_____

Facility: _____

Start Time: _____ Stop Time: _____

**Instructions to Examinee:**

This examination applies to a typical U.S. pressurized water reactor (PWR) nuclear power plant. There are 50 multiple-choice test items to answer, each having equal point value. There are multiple forms of this examination, each containing the same test items in a random order. Answer all test items using the provided answer sheet, ensuring a single answer is marked for each test item. A score of at least 80 percent is required to pass this portion of the NRC operator licensing written examination. When you have completed the examination, sign your name under the statement at the bottom of this page. All examination materials will be collected 3 hours after the examination begins.

| KNOWLEDGE AREA | NUMBER OF TEST ITEMS | PERCENT OF TOTAL | SCORE |
|---|---|---|---|
| COMPONENTS | 22 | 44 | |
| REACTOR THEORY | 14 | 28 | |
| THERMODYNAMICS | 14 | 28 | |
| TOTALS | 50 | 100 | |

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

_____

Examinee 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. Scrap paper will be provided for calculations.

7. 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.

8. Do not make assumptions regarding conditions that are not specified in the question unless they occur as a consequence of other conditions that are stated in the question. For example, you should not assume operator actions have been taken. Also, this examination tests knowledge of general fundamentals, therefore do not make assumptions based on specific plant procedures.

9. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.

10. 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.

11. 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.

12. 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.

13. 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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

$\lambda_{eff} = 0.1\ \text{sec}^{-1}$ (for $\rho > 0$)

$DRW \propto \varphi^2_{tip} / \varphi^2_{avg}$

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

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

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

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

$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

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

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

$P = I^2R$

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

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

Thermal Efficiency = Net Work Out/Energy In

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

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

$g_c = 32.2$ lbm-ft/lbf-sec$^2$

## CONVERSIONS

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

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

1 Btu = 778 ft-lbf

°C = $(5/9)(°F - 32)$

°F = $(9/5)(°C) + 32$

1 kg = 2.21 lbm

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

1 $gal_{water}$ = 8.35 lbm

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

QUESTION: 1

An AC motor-driven centrifugal pump was just started. During the start, motor current remained peaked for 6 seconds before decreasing to standard running current. Normally, the starting current peak lasts about 4 seconds.

Which one of the following could have caused the extended starting current peak?

A. The pump shaft was seized and did not turn.

B. The pump was initially rotating slowly in the reverse direction.

C. The pump discharge check valve was stuck closed and did not open.

D. The pump was initially air bound, and then primed itself after 6 seconds of operation.

QUESTION: 2

The power range nuclear instruments have been adjusted to 100 percent based on a heat balance calculation. Which one of the following will result in indicated reactor power being lower than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 20°F higher than actual feedwater temperature.

B. The reactor coolant pump heat input term was omitted from the heat balance calculation.

C. The feedwater flow rate used in the heat balance calculation was 10 percent higher than actual feedwater flow rate.

D. The steam pressure used in the heat balance calculation was 50 psi lower than actual steam pressure.

QUESTION: 3

Refer to the drawing of a section of 6-inch diameter pipe containing subcooled water flowing left to right at 100 gpm (see figure below). The pipe is frictionless, and no heat transfer is occurring. Point A is 10 feet higher in elevation than point B.

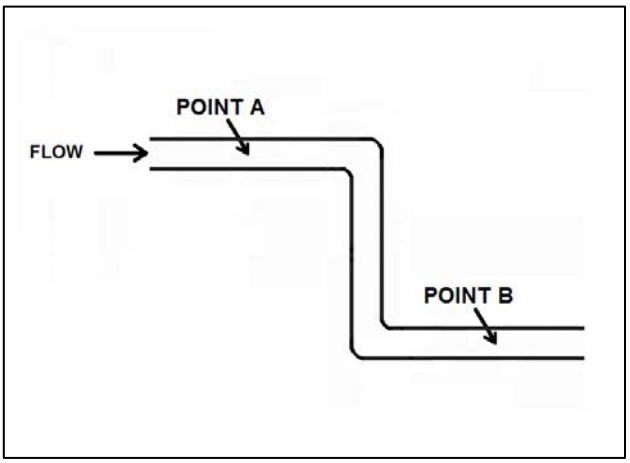
Compared to the enthalpy at point B, the enthalpy at point A is…

A. smaller, because some of the water's potential energy is converted to enthalpy as it flows to point B.

B. greater, because some of the water's enthalpy is converted to kinetic energy as it flows to point B.

C. the same, because the pipe is frictionless and no heat transfer is occurring.

D. the same, because the total energy of the water does not change from point A to point B.



QUESTION: 4

Given the following indications for an open 4,160 VAC breaker:

The local OPEN/CLOSED mechanical flag indicates OPEN.
A breaker overcurrent trip flag is actuated on one phase.
The line-side voltmeter indicates 4,160 VAC.
The load-side voltmeter indicates 0 VAC.

Assuming no operator actions were taken since the breaker opened, which one of the following could have caused the breaker to open?

A. A ground fault caused an automatic breaker trip.

B. A loss of control power caused an automatic breaker trip.

C. An operator opened the breaker locally.

D. An operator opened the breaker from a remote location.

QUESTION: 5

A mixed-bed ion exchanger is being used to process reactor coolant. The ion exchanger has been in service for 6 months at 100 percent power. A temperature controller malfunction causes the ion exchanger influent temperature to exceed the resin's maximum temperature limit before being manually restored to normal. Ion exchanger water chemistry analyses are being performed to check for resin decomposition.

Which one of the following water chemistry test results would indicate that significant resin decomposition has occurred?

A. A significant decrease in the ion exchanger's effluent conductivity.

B. A significant increase in the ion exchanger's effluent radioactivity.

C. A significant increase in the ion exchanger's decontamination factor.

D. A significant increase in the ion exchanger's effluent dissolved gases.

QUESTION: 6

A positive displacement pump (PDP) is operating in an open system. PDP parameters are as follows:

| | | |
|---|---|---|
| PDP speed | = | 1,000 rpm |
| PDP discharge pressure | = | 2,000 psig |
| PDP suction pressure | = | 50 psig |
| PDP flow rate | = | 150 gpm |

Which one of the following changes will cause PDP flow rate to exceed 200 gpm?

A. A second identical discharge path is opened.

B. PDP speed is increased to 1,500 rpm.

C. PDP suction pressure is increased to 120 psig.

D. Downstream system pressure is decreased to 1,000 psig.

QUESTION: 7

Given:

- Reactors A and B are identical except that reactor A has an effective delayed neutron fraction of 0.0068 and reactor B has an effective delayed neutron fraction of 0.0052.
- Reactor A has a stable period of 45 seconds and reactor B has a stable period of 42 seconds.
- Both reactors are initially operating at $1.0 \times 10^{-8}$ percent power.

The reactor that is supercritical by the greater amount of positive reactivity is reactor _____; and the first reactor to reach $1.0 \times 10^{-1}$ percent power will be reactor _____.

A A; A

B. A; B

C. B; A

D. B; B

QUESTION: 8

Which one of the following is a characteristic of a delayed neutron?

A. It is emitted with an average kinetic energy of 2.0 MeV.

B. It is in thermal equilibrium with the surrounding atoms.

C. It is produced in less than one percent of all fissions.

D. It is released an average of $1.0 \times 10^{-4}$ seconds after a fission.

QUESTION: 9

A nuclear power plant was operating at steady-state 100 percent power when a loss of offsite power occurred, resulting in a reactor trip and a loss of forced reactor coolant circulation. Two hours later, reactor coolant system (RCS) hot leg temperature is greater than cold leg temperature and steam generator (SG) levels are stable.

Which one of the following combinations of parameter trends, observed two hours after the trip, indicates that natural circulation is <u>not</u> occurring? (CET = core exit thermocouples)

| | RCS Hot Leg <u>Temperature</u> | RCS Cold Leg <u>Temperature</u> | SG <u>Pressures</u> | RCS CET <u>Subcooling</u> |
|---|---|---|---|---|
| A. | Stable | Decreasing | Decreasing | Stable |
| B. | Stable | Stable | Decreasing | Decreasing |
| C. | Decreasing | Decreasing | Decreasing | Increasing |
| D. | Decreasing | Stable | Stable | Increasing |

QUESTION: 10

Subcooled water is flowing through a throttled valve in an open system. The initial steady-state conditions for the throttled valve are as follows:

Inlet pressure = 60 psia
Outlet pressure = 44 psia
Flow rate = 800 gpm

After four hours, the current steady-state conditions for the throttled valve are as follows:

Inlet pressure = 62 psia
Outlet pressure = 40 psia
Flow rate = 600 gpm

Which one of the following could be responsible for the difference between the initial and current steady-state conditions for the throttled valve?

A. The throttled valve was opened more.

B. The throttled valve was closed more.

C. Another valve, located upstream of the throttled valve, was partially closed.

D. Another valve, located downstream of the throttled valve, was partially closed.

QUESTION: 11

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

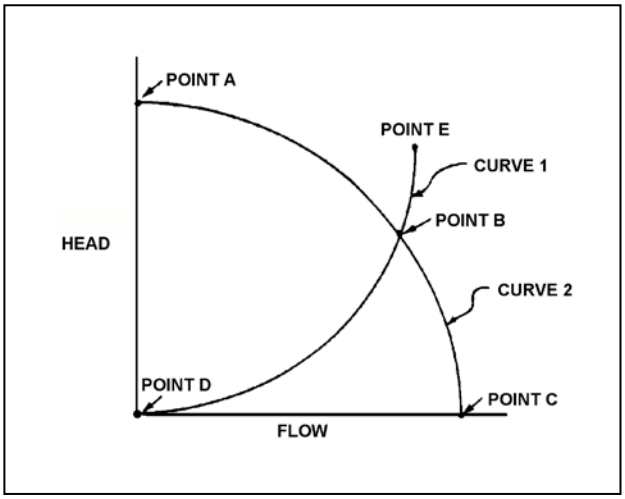
A centrifugal pump is initially operating at point B. If the pump speed is reduced by one-half, the new operating point will be located on curve _____ closer to point _____.

A. 1; D

B. 2; A

C. 1; E

D. 2; C



QUESTION: 12

Refer to the drawing of an operating service water heat exchanger (see figure below).

Given:

Service water inlet temperature = 140°F
Service water outlet temperature = 90°F
Cooling water inlet temperature = 70°F
Cooling water outlet temperature = 95°F
Specific heat for both fluids = 1.0 Btu-°F/lbm

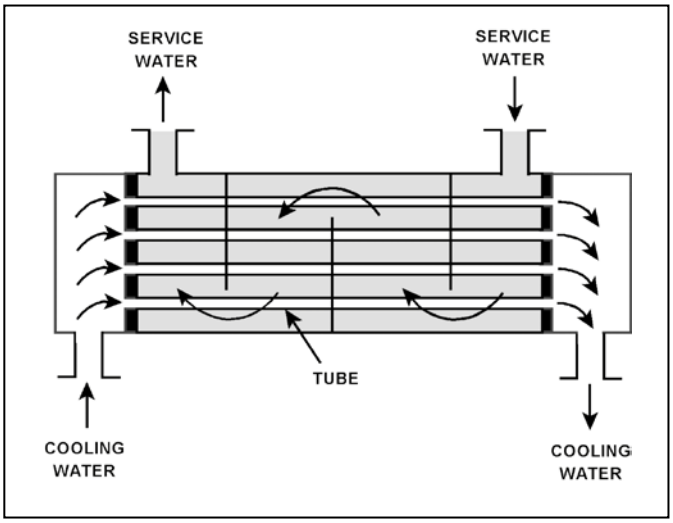
Which one of the following conclusions can be drawn from the given information?

A. The cooling water mass flow rate is twice the service water mass flow rate.

B. The service water mass flow rate is twice the cooling water mass flow rate.

C. The cooling water heat transfer rate is twice the service water heat transfer rate.

D. The service water heat transfer rate is twice the cooling water heat transfer rate.



QUESTION: 13

A reactor near the end of a fuel cycle has been shut down from 100 percent power, and cooled down to 140°F over three days. During the cooldown, reactor coolant boron concentration was increased by 100 ppm.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

| | | |
|---|---|---|
| Xenon | = | ( ) 2.5 %ΔK/K |
| Moderator temperature | = | ( ) 0.5 %ΔK/K |
| Power defect | = | ( ) 1.5 %ΔK/K |
| Control rods | = | ( ) 7.0 %ΔK/K |
| Boron | = | ( ) 1.0 %ΔK/K |

A. -8.5 %ΔK/K

B. -6.5 %ΔK/K

C. -3.5 %ΔK/K

D. -1.5 %ΔK/K

QUESTION: 14

Refer to the drawing of a differential pressure (D/P) level detection system for a pressurizer at normal operating temperature and pressure (see figure below).

A nuclear power plant uses several differential pressure detectors like the one below to provide multiple channels of pressurizer water level indication. A hot channel was calibrated when the pressurizer was at normal operating temperature. A cold channel was calibrated when the pressurizer was at 160°F.

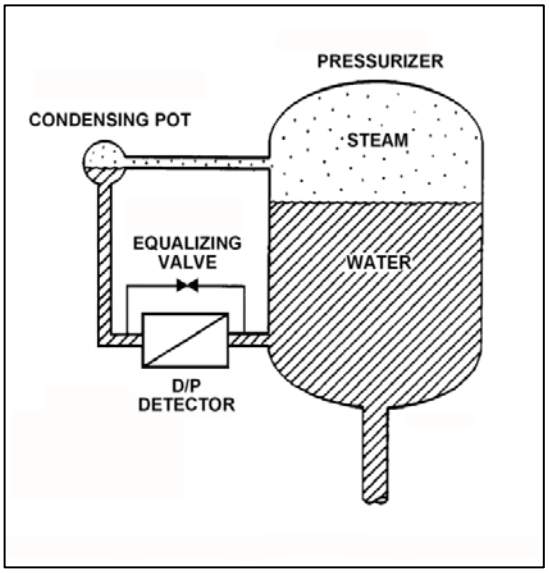
How will the level indications on the two channels compare when the pressurizer is at normal operating temperature?

A. The cold channel will indicate higher than the hot channel, due to the difference in reference leg water density at the two calibration temperatures.

B. The cold channel will indicate lower than the hot channel, due to the difference in reference leg water density at the two calibration temperatures.

C. The cold channel will indicate higher than the hot channel, due to the difference in pressurizer water density at the two calibration temperatures.

D. The cold channel will indicate lower than the hot channel, due to the difference in pressurizer water density at the two calibration temperatures.



QUESTION: 15

Refer to the figure below for the following question. The axes on each graph have linear scales.

Initially, a reactor is critical in the source range. At 0 seconds, a constant-rate addition of positive reactivity commences. Assume that reactor power remains below the point of adding heat for the entire time interval shown.

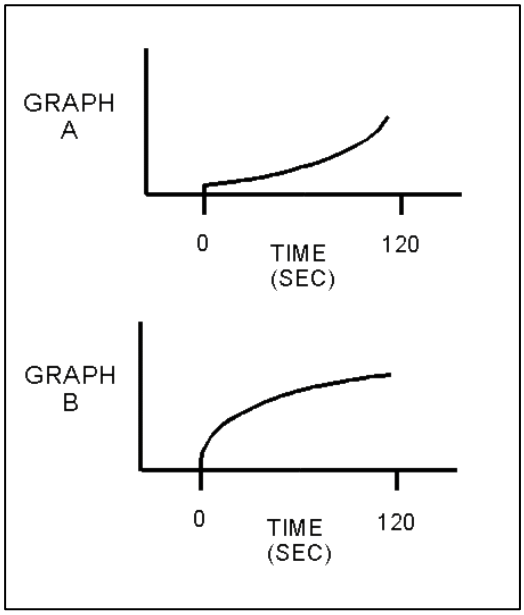
The general response of startup rate to this event is shown on graph _____; and the general response of reactor power to this event is shown on graph _____. (Note: Either graph may be chosen once, twice, or not at all.)

A. A; A

B. A; B

C. B; A

D. B; B



QUESTION: 16

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

The purpose of square root compensation in this flow measuring instrument is to convert _____ into _____.

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

QUESTION: 17

A steam generator transient causes main steam pressure to decrease although the actual steam mass flow rate to the main turbine remains constant. If the main steam flow instrument is <u>not</u> density compensated, indicated steam mass flow rate will...

A. decrease, due to the decreased density of the steam.

B. decrease, due to the decreased velocity of the steam.

C. increase, due to the increased density of the steam.

D. increase, due to the increased velocity of the steam.

QUESTION: 18

Initially, a reactor is operating at 100 percent power with equilibrium xenon-135 concentration. Then a reactor trip occurs. During the first hour following the reactor trip, the change in xenon-135 concentration is primarily being caused by the...

A. decreased removal rate of xenon-135.

B. decreased production rate of xenon-135.

C. increased removal rate of xenon-135.

D. increased production rate of xenon-135.

QUESTION: 19

An open vessel contains 1.0 pound-mass of water at 206°F and standard 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 percent of the water mass will vaporize.

C. The water density will decrease by approximately 3 percent.

D. The water will become superheated by approximately 3°F.

QUESTION: 20

A reactor was restarted following a refueling outage and is currently at the point of adding heat. Which one of the following describes the change in axial power distribution as reactor power is increased to 5 percent by control rod withdrawal?

A. Shifts toward the bottom of the core.

B. Shifts toward the top of the core.

C. Shifts from the center of the core toward the top and bottom of the core.

D. Shifts from the top and bottom of the core toward the center of the core.

QUESTION: 21

A greater overall nuclear power plant thermal efficiency can be achieved if the feedwater entering the steam generators (SGs) is _____; and the pressure difference between the SGs and the main condenser is as _____ as possible.

A. close to saturation; great

B. close to saturation; small

C. as subcooled as practical; great

D. as subcooled as practical; small

QUESTION: 22

A temperature controller uses a bistable that turns on to energize a set of heaters when the controlled temperature decreases to 40°F. The bistable turns off to deenergize the heaters when the controlled temperature increases to 45°F.

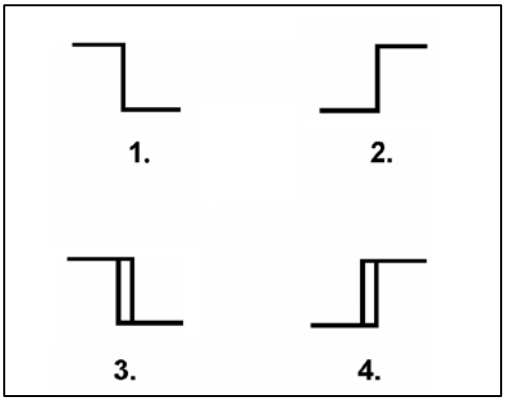
Which one of the following bistable symbols indicates the characteristics of the bistable described above?

A. 1.

B. 2.

C. 3.

D. 4.



QUESTION: 23

A Geiger-Mueller detector with a pancake probe is being used to monitor workers leaving a radiologically controlled area for contamination. The probe is sensitive to alpha, beta, and gamma radiation. The background count rate is 20 cpm. As one worker's shoe is scanned, the count rate increases to 1,000 cpm.

Given the following separate actions:

- When a sheet of paper is placed between the probe and the shoe, the count rate decreases to 600 cpm.
- When a sheet of aluminum foil is placed between the probe and the shoe, the count rate decreases to 200 cpm.

Which one of the following describes the type(s) of radiation being emitted by the contamination?

A. Beta only

B. Alpha and beta only

C. Beta and gamma only

D. Alpha, beta, and gamma

QUESTION: 24

A reactor startup is in progress. The reactor is subcritical in the source range with a 0 DPM startup rate indication. Assuming the reactor remains subcritical, a short control rod <u>withdrawal</u> will cause the reactor startup rate indication to become positive, and then...

A. decrease, and stabilize at a negative 1/3 DPM.

B. decrease, and stabilize at 0 DPM.

C. stabilize until the point of adding heat (POAH) is reached; then decrease to 0 DPM.

D. increase continuously until the POAH is reached; then decrease to 0 DPM.

QUESTION: 25

Refer to the drawing of a flow control valve (see figure below) that is located in the makeup water supply line to a water storage tank.

The flow control valve is positioned by a level controller that can maintain a stable tank water level anywhere between 10 percent above and 10 percent below the controller setpoint. The level controller receives input from a direct-acting level detector.

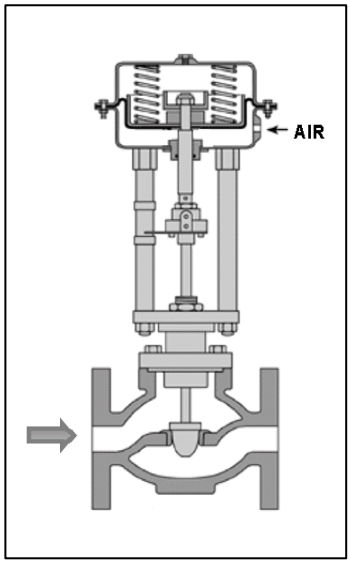
Which one of the following describes the characteristics of the tank level controller?

A. Direct-acting with proportional only control.

B. Direct-acting with proportional-integral control.

C. Reverse-acting with proportional only control.

D. Reverse-acting with proportional-integral control.



QUESTION: 26

Initially, a reactor is operating at steady-state 50 percent power, when control rods are inserted a short distance. Assume that main turbine-generator load remains constant and the reactor does not trip.

In response to the control rod insertion, reactor power will initially 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: 27

Refer to the drawing of a pool boiling curve (see figure below).

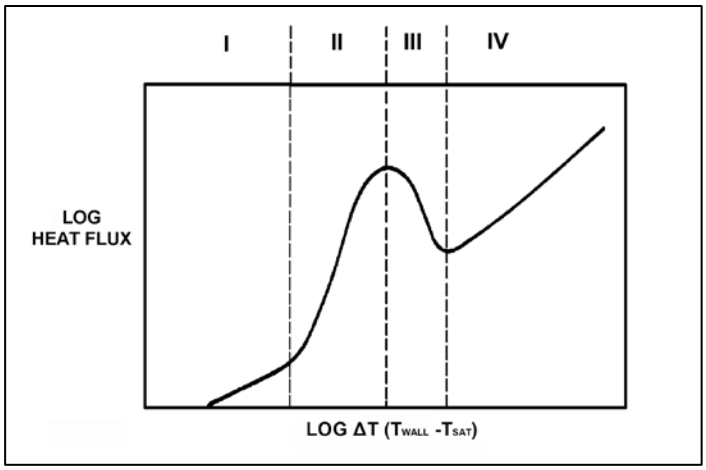
Which one of the following describes the conditions in a fuel assembly that is experiencing region IV heat transfer?

A. Saturated nucleate boiling.

B. Subcooled nucleate boiling.

C. Complete steam blanketing of the fuel rod surface.

D. Alternate wetting and drying of the fuel rod surface.



QUESTION: 28

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

- Reactor power is 50 percent.
- Average reactor coolant temperature is 570°F.
- Reactor coolant boron concentration is 400 ppm.

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

- Reactor power is 80 percent.
- Average reactor coolant temperature is 582°F.
- Reactor coolant boron concentration is 400 ppm.

When compared to the initial differential boron worth (DBW) in ΔK/K/ppm, the current DBW is…

A. more negative, because a 1°F increase in reactor coolant temperature will remove more boron-10 atoms from the core.

B. more negative, because a 1 ppm increase in reactor coolant boron concentration will add more boron-10 atoms to the core.

C. less negative, because a 1°F increase in reactor coolant temperature will remove fewer boron-10 atoms from the core.

D. less negative, because a 1 ppm increase in reactor coolant boron concentration will add fewer boron-10 atoms to the core.

QUESTION: 29

Saturated steam at 900 psia enters a high pressure (HP) turbine and exhausts at 200 psia. The HP turbine exhaust passes through a 100 percent efficient moisture separator (with no heat gain or loss) before it enters a low pressure (LP) turbine. What is the enthalpy of the 200 psia steam entering the LP turbine?

A. 1,028 Btu/lbm

B. 1,076 Btu/lbm

C. 1,107 Btu/lbm

D. 1,199 Btu/lbm

QUESTION: 30

An AC motor-driven radial-flow centrifugal pump is being used to fill a vented 30-foot water storage tank. The pump is located at the base of the tank, and discharges through a penetration at the bottom of the tank. Assume the pump is operating with constant inlet water pressure and inlet water temperature.

As the tank water level increases from 10 to 20 feet, the pump motor current will…

A. decrease, because the pump head will decrease.

B. increase, because the pump head will increase.

C. decrease, because the pump flow rate will decrease.

D. increase, because the pump flow rate will increase.

QUESTION: 31

A positive displacement pump is operating in a water system. How can the net positive suction head requirement ($NPSH_R$) for the pump be determined?

A. The value can be calculated with the aid of steam and water property tables if the pump volumetric flow rate is known.

B. The value can be calculated with the aid of steam and water property tables if the pump inlet water pressure and temperature are known.

C. The value can be found on a pump performance curve provided by the pump vendor if the pump volumetric flow rate is known.

D. The value can be found on a pump performance curve provided by the pump vendor if the pump inlet water pressure and temperature are known.

QUESTION: 32

Following a reactor shutdown from three months of operation at 100 percent power, the core decay heat production rate will depend on the...

A. amount of fuel that has been depleted.

B. decay rate of the fission product poisons.

C. time elapsed since $K_{eff}$ decreased below 1.0.

D. decay rate of the photoneutron source.

QUESTION: 33

During a fuel cycle, plutonium isotopes are produced with delayed neutron fractions that are _____ than the delayed neutron fractions for uranium isotopes, thereby causing reactor power transients to be _____ near the end of a fuel cycle.

A. larger; slower

B. larger; faster

C. smaller; slower

D. smaller; faster

QUESTION: 34

Refer to the drawing of a water storage tank and level control system (see figure below) that have just been returned to service following replacement of the drain valve actuator. Unfortunately, the original direct-acting actuator was mistakenly replaced with a reverse-acting actuator.

Given:

- The drain valve will now fail open if operating air pressure is lost.
- The level control system uses a direct-acting proportional-integral level controller with a setpoint of 15 feet.
- The level controller receives input from a direct-acting level sensor.
- The level controller is currently in manual control, with an operator maintaining the tank water level at 14 feet.
- Tank inlet and outlet flow rates are currently equal with the drain valve 50 percent open.

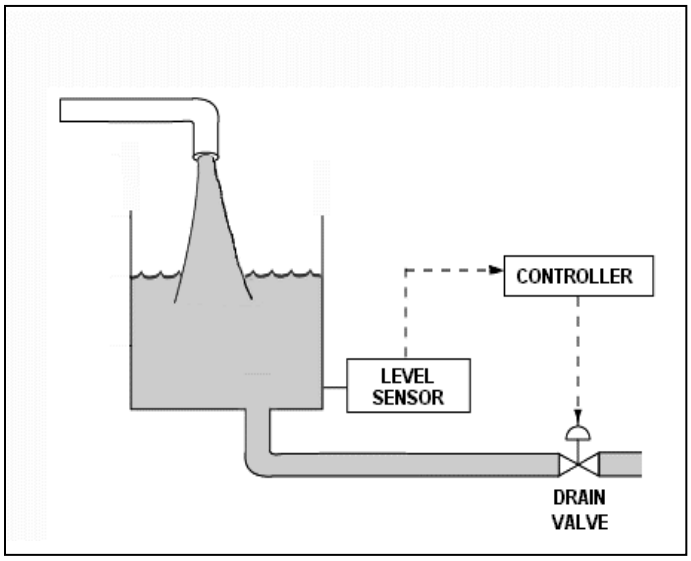
If the level controller is shifted to automatic control, the tank water level will…

A. stabilize at 15 feet.

B. stabilize at the level sensor penetration.

C. increase until the tank overflows.

D. decrease until the tank nearly empties.



QUESTION: 35

A reactor is operating at 80 percent power near the middle of a fuel cycle. The control rods are nearly fully withdrawn and in manual control. Core axial power distribution is peaked below the core midplane.

Which one of the following will increase the core maximum axial peaking (or hot channel) factor? (Assume no operator action is taken unless stated, and that main turbine load and core xenon distribution do not change unless stated.)

A. Turbine load/reactor power is reduced by 10 percent.

B. The controlling bank of control rods is withdrawn 4 inches.

C. Reactor coolant system boron concentration is reduced by 15 ppm.

D. A fully withdrawn control rod located at the edge of the core drops to the bottom of the core.

QUESTION: 36

The function of high-voltage disconnect switches is to provide _____ electrical isolation of equipment during _____ conditions.

A. manual; no-load

B. manual; overload

C. automatic; no-load

D. automatic; overload

QUESTION: 37

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 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 pump configurations will supply the highest makeup flow rate to the system if system pressure is 500 psig?

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)

QUESTION: 38

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

A. Increased main condenser vacuum.

B. Increased conductivity of the condensate.

C. Decreased condensate pump available net positive suction head.

D. Decreased condensate pump flow rate.

QUESTION: 39

Prolonged exposure of a reactor vessel (RV) to a fast neutron flux will cause the RV nil-ductility transition temperature to...

A. decrease, due to the propagation of existing flaws in the RV wall.

B. increase, due to the propagation of existing flaws in the RV wall.

C. decrease, due to changes in the material properties of the RV wall.

D. increase, due to changes in the material properties of the RV wall.

QUESTION: 40

Following a 7 day shutdown, a reactor startup is performed and the reactor is taken to 100 percent power over a 16-hour period. After reaching 100 percent power, what type of reactivity addition will be needed to compensate for xenon-135 changes over the next 24 hours?

A. Negative only

B. Negative, then positive

C. Positive only

D. Positive, then negative

QUESTION: 41

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

A. 2 psig, 12 inches Hg absolute, 8 psia

B. 2 psig, 18 inches Hg absolute, 8 psia

C. 12 psia, 20 inches Hg absolute, 2 psig

D. 12 psia, 30 inches Hg absolute, 2 psig

QUESTION: 42

For proper operation of a thermocouple circuit, the reference junction temperature…

A. must be less than the measuring junction temperature.

B. must be greater than the measuring junction temperature.

C. may be less than, greater than, or equal to the measuring junction temperature.

D. may be less than or greater than, but not equal to, the measuring junction temperature.

QUESTION: 43

Refer to the graph of critical boron concentration versus core burnup for a reactor following a refueling outage (See figure below.).

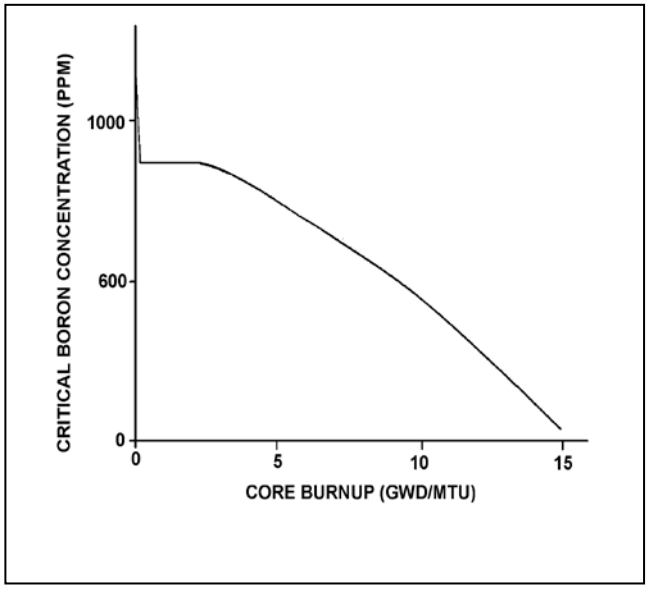
Which one of the following is primarily responsible for the shape of the curve from the middle of core life to the end of core life?

A. Fuel depletion

B. Fission product buildup

C. Burnable poison burnout

D. Conversion of U-238 to Pu-239



QUESTION: 44

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

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

A. Increase the flow rate of reactor coolant being processed from 75 gpm to 100 gpm.

B. Decrease the flow rate of reactor coolant being processed from 75 gpm to 50 gpm.

C. Increase the temperature of the reactor coolant being processed from 95°F to 105°F.

D. Decrease the temperature of the reactor coolant being processed from 105°F to 95°F.

QUESTION: 45

The number of starts for an electric motor in a given period of time should be limited because overheating of the _____ can occur due to the _____ counter electromotive force produced at low rotor speeds.

A. windings; low

B. windings; high

C. commutator and/or slip rings; low

D. commutator and/or slip rings; high

QUESTION: 46

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

A. Provides a means of measuring core flow rate.

B. Prevents boron precipitation in the core baffle area.

C. Prevents excessive reactor vessel wall differential temperature.

D. Provides cooling to various reactor vessel internal components.

QUESTION: 47

Dry saturated main steam at 1,000 psia is leaking past the valve disk in a closed main steamline safety valve to standard atmospheric pressure. Just downstream of the valve disk, the leaked steam will be _____; and have a_____ temperature than the 1,000 psia main steam.

A. saturated; lower

B. saturated; higher

C. superheated; lower

D. superheated; higher

QUESTION: 48

Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully open and has a 10-second stroke time. Limit switch LS2 has failed open.

**Note:** Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts are shown open/closed according to the standard convention for control circuit drawings.

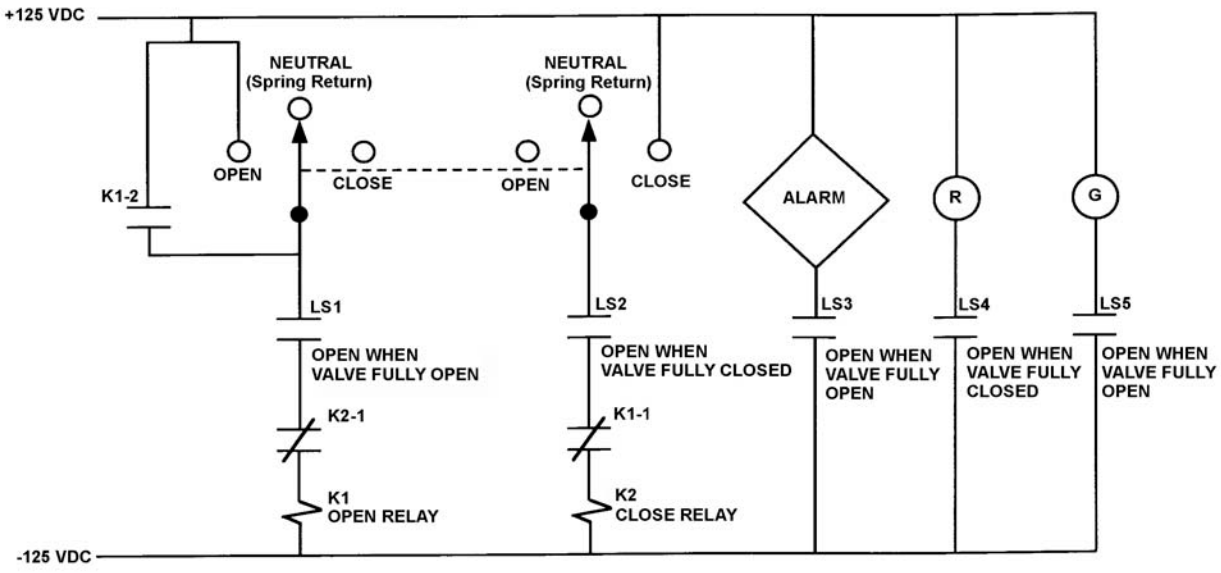
Which one of the following describes the valve response if the control switch is taken to the CLOSE position for 2 seconds and then released?

A. The valve will <u>not</u> move.

B. The valve will close fully.

C. The valve will begin to close and then stop moving.

D. The valve will begin to close and then open fully.




VALVE MOTOR CONTROL CIRCUIT

QUESTION: 49

Which one of the following describes a situation where an increase in moderator temperature can add positive reactivity?

A. At low moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

B. At low moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

C. At high moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

D. At high moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

QUESTION: 50

A completely full water storage tank is being hydrostatically tested to 200 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 10 gpm. The tank is protected by two relief valves that discharge to the atmosphere. The relief valves have the following characteristics:

- Relief valve A opening setpoint is 200 psig with an accumulation of 2.0 percent.
- Relief valve B opening setpoint is 200 psig with an accumulation of 3.0 percent.
- Each valve has linear flow rate characteristics and a maximum discharge flow rate of 8 gpm.

The PDP is inadvertently left running when tank pressure reaches 200 psig.

With the PDP running continuously, what will the discharge flow rates of the relief valves be when tank pressure stabilizes?

| | Relief Valve A | Relief Valve B |
|---|---|---|
| A. | 2 gpm | 8 gpm |
| B. | 4 gpm | 6 gpm |
| C. | 6 gpm | 4 gpm |
| D. | 8 gpm | 2 gpm |

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

NRC GENERIC FUNDAMENTALS EXAMINATION
SEPTEMBER 2021 – PWR

| FORM A | | | | FORM B | | | |
|---|---|---|---|---|---|---|---|
| NO. | ANS. | NO. | ANS. | NO. | ANS. | NO. | ANS. |
| 1 | B | 26 | D | 1 | B | 26 | C |
| 2 | A | 27 | C | 2 | B | 27 | B |
| 3 | A | 28 | D | 3 | A | 28 | A |
| 4 | A | 29 | D | 4 | A | 29 | D |
| 5 | B | 30 | C | 5 | A | 30 | C |
| 6 | B | 31 | C | 6 | B | 31 | C |
| 7 | B | 32 | C | 7 | A | 32 | C |
| 8 | C | 33 | D | 8 | A | 33 | D |
| 9 | B | 34 | D | 9 | A | 34 | C |
| 10 | B | 35 | C | 10 | D | 35 | A |
| 11 | A | 36 | A | 11 | D | 36 | B |
| 12 | A | 37 | B | 12 | B | 37 | D |
| 13 | C | 38 | B | 13 | C | 38 | A |
| 14 | D | 39 | D | 14 | D | 39 | D |
| 15 | A | 40 | C | 15 | B | 40 | B |
| 16 | D | 41 | B | 16 | B | 41 | C |
| 17 | D | 42 | C | 17 | B | 42 | B |
| 18 | A | 43 | A | 18 | C | 43 | C |
| 19 | A | 44 | D | 19 | C | 44 | D |
| 20 | B | 45 | A | 20 | A | 45 | A |
| 21 | A | 46 | D | 21 | C | 46 | D |
| 22 | C | 47 | C | 22 | B | 47 | A |
| 23 | D | 48 | A | 23 | C | 48 | C |
| 24 | B | 49 | B | 24 | D | 49 | D |
| 25 | C | 50 | C | 25 | A | 50 | D |