**UNITED STATES NUCLEAR REGULATORY COMMISSION**
**PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION**
**JUNE 2016 – FORM A**

**Please Print**

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

**INSTRUCTIONS TO EXAMINEE**

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. 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.

_____

Examinee'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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

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

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

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

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

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

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

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

1 Btu $= 778$ ft-lbf

$℃ = (5/9)(°F - 32)$

$°F = (9/5)(℃) + 32$

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

Subcooled water was initially flowing through a throttled valve with the following parameters:

Inlet pressure = 70 psia
Outlet pressure = 60 psia
Flow rate = 600 gpm

The valve was then opened fully, and the following parameters currently exist:

Inlet pressure = 60 psia
Outlet pressure = 55 psia

What is the current flow rate through the fully open valve?

A. 424 gpm

B. 848 gpm

C. 1,200 gpm

D. Cannot be determined without additional information.

QUESTION: 2

After manually positioning a typical motor-operated valve, the valve actuator motor is reengaged by...

A. taking the manual declutch lever to the disengage position.

B. taking the manual declutch lever to the engage position.

C. racking in the valve actuator motor breaker.

D. energizing the valve actuator motor.

QUESTION: 3

A main steam flow rate measuring instrument uses a steam pressure input to produce main steam mass flow rate indication. Assuming steam volumetric flow rate does not change, a steam pressure decrease will cause indicated steam mass flow rate to...

A. increase, because the density of the steam has increased.

B. decrease, because the density of the steam has decreased.

C. remain the same, because steam pressure does not affect the mass flow rate of steam.

D. remain the same, because the steam pressure input compensates for changes in steam pressure.

QUESTION: 4

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide flow rate indication. Water enters and leaves the venturi at 70°F, 120 psig, and 20 ft/sec. Water velocity at the throat of the venturi is 45 ft/sec. Assume water is incompressible and the venturi experiences no unrecoverable head loss.

What is the approximate pressure of the water at the throat of the venturi?

A. 109 psig

B. 98 psig

C. 86 psig

D. 71 psig

QUESTION: 5

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

With the pressurizer containing saturated water and steam at 2,250 psia, pressurizer level indication is 20 feet. Assume that reference leg level and temperature do not change. Also, ignore the effect of steam density changes on level indication.

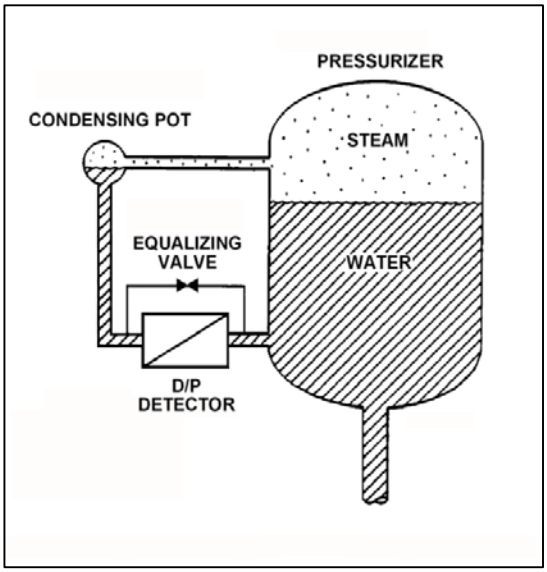
With no change in actual pressurizer level, what will level indication be at 600 psia (saturated)?

A. 14.9 feet

B. 18.3 feet

C. 22.4 feet

D. 26.8 feet



QUESTION: 6

A gas-filled radiation detector is operating in the proportional region with a count rate indication of $1.0 \times 10^5$ cpm in a constant radiation field. The detector does <u>not</u> have pulse height discrimination circuitry.

If the detector's operating voltage is increased by 20 percent while remaining in the proportional region, the total number of ions resulting from a single ionization within the detector will _____; and the detector count rate indication will _____.

A. increase; increase

B. increase; remain the same

C. remain the same; increase

D. remain the same; remain the same

QUESTION: 7

Refer to the drawing of a lube oil temperature control system (see figure below).

The temperature controller is a direct-acting proportional-only controller with a gain of 2.0. All system temperatures are initially stable with the temperature control valve (TCV) 40 percent open.

A sudden increase in the lube oil heat load causes the controller to open the TCV farther. Eventually, all system temperatures stabilize with the final TCV position at 50 percent open.

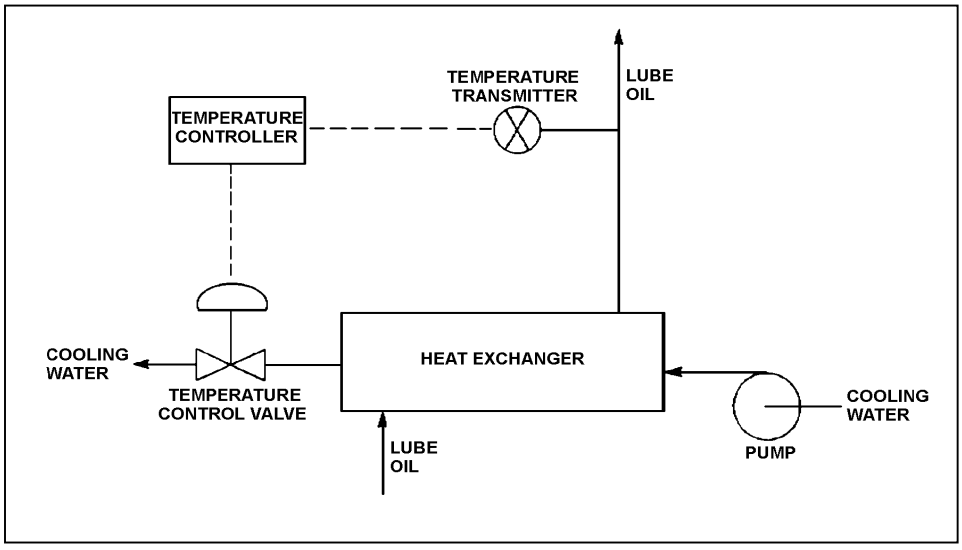
If the controller's gain was 1.5 rather than 2.0 when the increase in lube oil heat load occurred, the final TCV position would be _____; and the TCV would require _____ time to reach its final position.

A. the same; less

B. the same; more

C. less than 50 percent open; less

D. more than 50 percent open; more



QUESTION: 8

The water level in a water storage tank is being controlled by an automatic bistable level controller. If water level increases to 70 percent, the controller bistable turns off to open a tank drain valve. When water level decreases to 60 percent, the controller bistable turns on to close the drain valve.

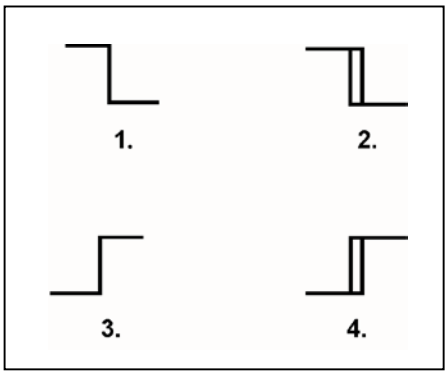
Which one of the following bistable symbols indicates the characteristics of the bistable used in the level controller?

A. 1.

B. 2.

C. 3.

D. 4.



QUESTION: 9

A proportional-derivative controller senses an increase in the controlled parameter above the controller setpoint. The derivative function causes the controller output signal to...

A. increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes constant.

B. remain directly proportional to the difference between the controlled parameter and the controller setpoint.

C. increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes zero.

D. change at a rate that is directly proportional to the rate of change of the controlled parameter.

QUESTION: 10

Which one of the following is an effective method for ensuring that a centrifugal pump remains primed and does <u>not</u> become gas bound during pump operation <u>and</u> after pump shutdown?

A. Install the pump below the level of the suction supply.

B. Install a check valve in the discharge piping of the pump.

C. Install an orifice plate in the discharge piping of the pump.

D. Install a pump recirculation line from the pump discharge piping to the pump suction piping.

QUESTION: 11

A centrifugal pump is used to provide makeup water to a vented storage tank that is 30 feet high. The pump is located at the base of the tank. The pump can be aligned to fill the tank via a top connection or a bottom connection using piping of equal lengths and diameters.

With the tank half full, the operating pump will have the lowest discharge pressure if the pump is aligned to fill the tank via the _____ connection; and the tank will require the longest amount of time to become completely full if the pump is aligned to fill the tank via the _____ connection.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

QUESTION: 12

A motor-driven centrifugal pump is operating normally in a closed cooling water system. When the pump discharge flow control valve is opened further, the pump is unable to provide the desired volumetric flow rate due to cavitation. Which one of the following will enable a higher pump volumetric flow rate before cavitation occurs?

A. Remove the existing motor and install a motor with a lower horsepower rating.

B. Remove the existing motor and install a motor with a higher horsepower rating.

C. Remove the existing pump and install a same-capacity pump with a lower minimum net positive suction head requirement.

D. Remove the existing pump and install a same-capacity pump with a higher minimum net positive suction head requirement.

QUESTION: 13

Which one of the following conditions will result in the greatest increase in volumetric flow rate from a positive displacement pump operating at 300 rpm and a discharge pressure of 100 psig?

A. Increasing pump speed to 700 rpm.

B. Decreasing pump discharge pressure to 30 psig.

C. Starting a second identical positive displacement pump in series with the first.

D. Starting a second identical positive displacement pump in parallel with the first.

QUESTION: 14

A fault on the offsite AC electrical distribution system caused a sustained 30 percent voltage reduction on all phases of the onsite three-phase AC electrical distribution system. As a result, several operating three-phase AC induction motors in the plant experienced automatic breaker trips.

Which one of the following could be responsible for the automatic breaker trips?

A. Excessive motor current leading to breaker trips from thermal overload.

B. Excessive motor current leading to breaker trips from instantaneous overcurrent.

C. Insufficient breaker control power leading to breaker trips from trip mechanism malfunctions.

D. Insufficient breaker control power leading to breaker trips from closing mechanism malfunctions.

QUESTION: 15

Two identical AC induction motors are connected to identical radial-flow centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for pump A is fully open and the discharge valve for pump B is fully closed. Each pump is currently off.

If the pumps are started under these conditions, the shorter time period required to reach a stable running current will be experienced by the motor for pump _____; and the higher stable running current will be experienced by the motor for pump _____.

A. A; A

B. A; B

C. B; A

D. B; B

QUESTION: 16

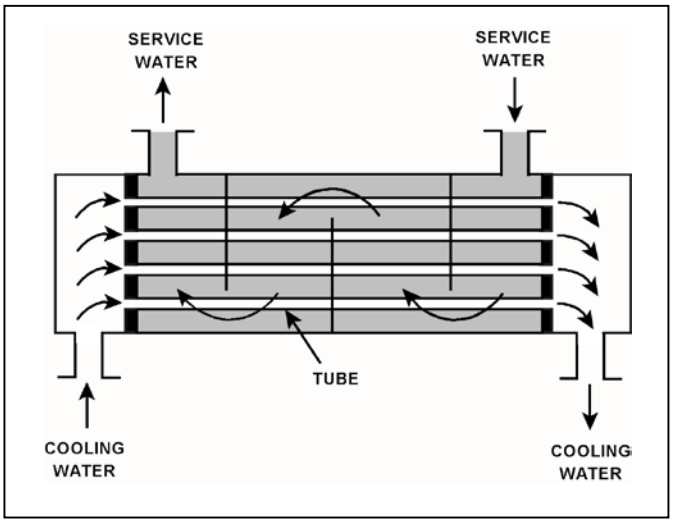
Refer to the drawing of a heat exchanger (see figure below).

The heat exchanger is in service with the following inlet temperatures:

Service water inlet temperature = 130°F
Cooling water inlet temperature = 70°F

Assume that both fluids have the same specific heat, and that cooling water mass flow rate is greater than service water mass flow rate. Which one of the following pairs of heat exchanger outlet temperatures is possible?

| | Service Water Outlet Temp. | Cooling Water Outlet Temp. |
|---|---|---|
| A. | 120°F | 90°F |
| B. | 110°F | 95°F |
| C. | 100°F | 100°F |
| D. | 90°F | 105°F |



QUESTION: 17

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

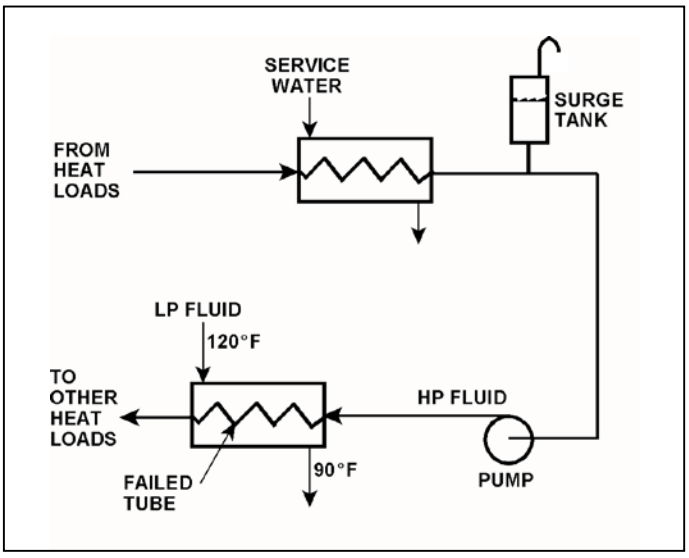
Which one of the following will occur as a result of the indicated tube failure in the heat exchanger?

A. High pressure (HP) fluid inventory increases.

B. Pressure in the low pressure (LP) system decreases.

C. Temperature in the low pressure (LP) system increases.

D. Level in the surge tank decreases.



QUESTION: 18

What percentage of ionic impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 1.0?

A. 100 percent

B. 99 percent

C. 1 percent

D. 0 percent

QUESTION: 19

Prior to a scheduled nuclear power plant shutdown, the reactor coolant system was chemically shocked to induce a crud burst. What effect will the crud burst have on the in-service reactor coolant letdown ion exchangers?

A. Decreased ion exchanger outlet conductivity.

B. Decreased pressure drop across the ion exchangers.

C. Increased flow rate through the ion exchangers.

D. Increased radiation levels around the ion exchangers.

QUESTION: 20

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

**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.

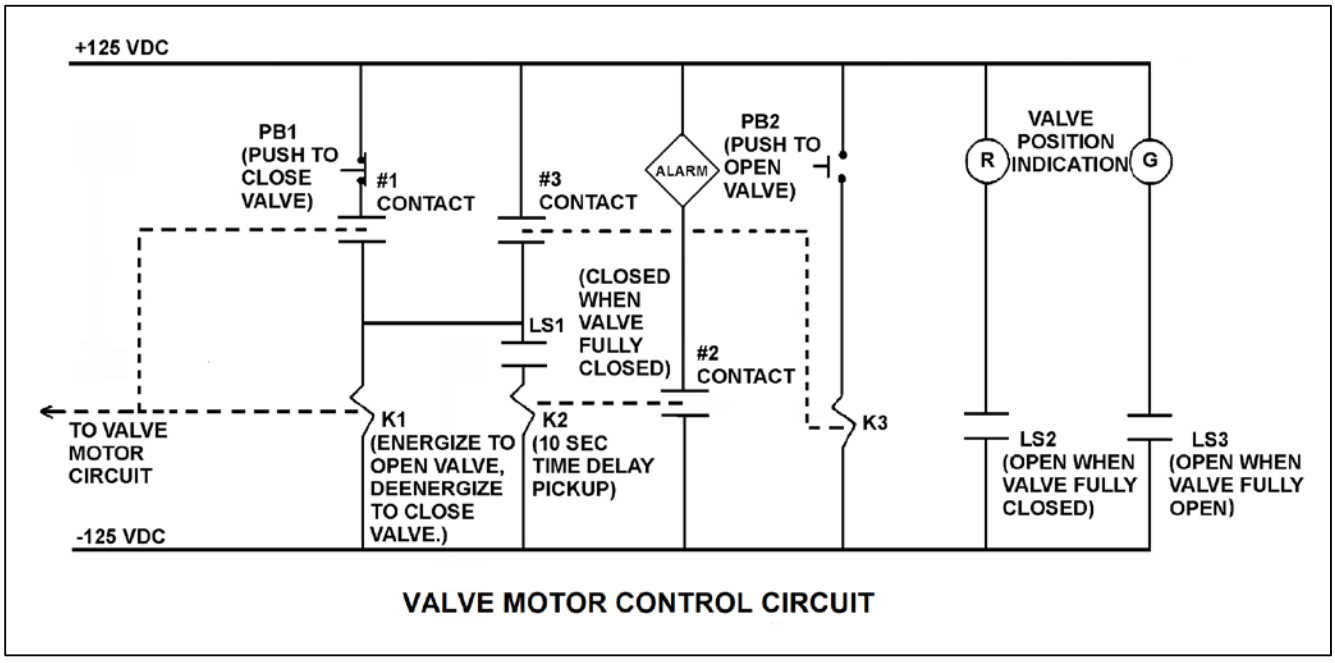
Pushbutton PB2 has been momentarily depressed and then released, and the valve is currently at mid-stroke and moving to the open position. Under these conditions, which one of the following describes the position of contacts #1, #2, and #3?

A. #1 closed; #2 open; #3 open

B. #1 open; #2 closed; #3 closed

C. #1 open; #2 closed; #3 open

D. #1 closed; #2 open; #3 closed




**VALVE MOTOR CONTROL CIRCUIT**

QUESTION: 21

The main generator output breaker was just closed to connect the main generator to the main transformer. Just before the breaker was closed, the following parameter values existed:

| Main Generator | Main Transformer |
|---|---|
| 20,060 volts | 20,020 volts |
| 60.1 Hz | 59.9 Hz |

With no additional operator action, the main generator stabilized as follows:

25 MW
15 MVAR (out)

Now consider the following alternate set of parameters values:

| Main Generator | Main Transformer |
|---|---|
| 20,040 volts | 20,020 volts |
| 60.0 Hz | 59.9 Hz |

If the alternate set of parameter values existed just before the main generator output breaker was closed, the resulting main generator MW value would be _____; and the resulting main generator MVAR (out) value would be _____.

A. smaller; larger

B. smaller; smaller

C. larger; larger

D. larger; smaller

QUESTION: 22

The following indications are observed in the control room for a normally-open motor control center (MCC) breaker that directly starts/stops a 480 VAC motor:

Red position indicating light is lit.
Green position indicating light is out.
Motor load current indicates 0 amps.
MCC voltage indicates 480 volts.

What is the condition of the breaker?

A. Open and racked in

B. Closed and racked in

C. Open and racked to the TEST position

D. Closed and racked to the TEST position

QUESTION: 23

In a comparison between a prompt neutron and a delayed neutron produced from the same fission event, the delayed neutron requires _____ collisions in the moderator to become thermal; and is _____ likely to cause fission of a U-238 nucleus. (Assume that both neutrons remain in the core.)

A. more; more

B. more; less

C. fewer; more

D. fewer; less

QUESTION: 24

With a reactor initially operating at steady-state 85 percent power with manual rod control, the operator borates the reactor coolant system an additional 10 ppm. During the boration, the available shutdown margin will...

A. decrease and stabilize at a lower value.

B. initially decrease, then increase to the original value as coolant temperature changes.

C. increase and stabilize at a higher value.

D. initially increase, then decrease to the original value as coolant temperature changes.

QUESTION: 25

Which one of the following is the neutron source that produces the greatest neutron flux for the first few days following a reactor trip from extended high power operations?

A. Spontaneous neutron emission from control rods.

B. Photo-neutron reactions in the moderator.

C. Spontaneous fission in the fuel.

D. Alpha-neutron reactions in the fuel.

QUESTION: 26

Refer to the curve of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (eV) resonance peak in U-238 for a reactor operating at 50 percent power (see figure below).

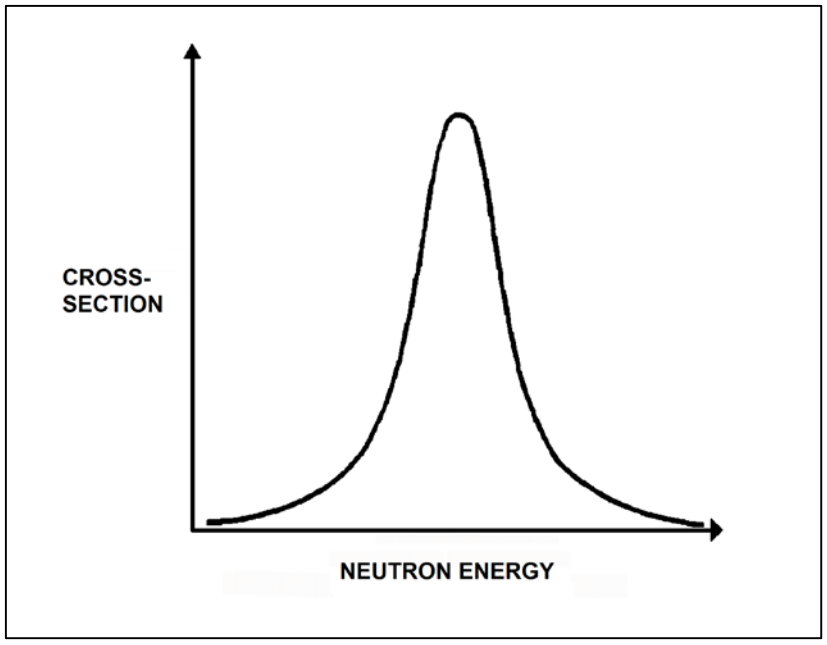
If fuel temperature decreases by 50°F, the area under the curve will _____; and positive reactivity will be added to the core because _____.

A. decrease; fewer neutrons will be absorbed by U-238 overall

B. decrease; fewer 6.7 eV neutrons will be absorbed by U-238 at the resonance energy

C. remain the same; fewer neutrons will be absorbed by U-238 overall

D. remain the same; fewer 6.7 eV neutrons will be absorbed by U-238 at the resonance energy



QUESTION: 27

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

A. higher; smaller

B. higher; greater

C. lower; smaller

D. lower; greater

QUESTION: 28

Which one of the following includes two reasons for control rod bank/group overlap?

A. Provides a more uniform differential rod worth, and minimizes axial neutron flux peaking.

B. Provides a more uniform differential rod worth, and allows dampening of xenon-induced neutron flux oscillations.

C. Ensures that all rods remain within the allowable tolerance between their individual position indicators and their group counters, and ensures rod insertion limits are <u>not</u> exceeded.

D. Ensures that all rods remain within their allowable tolerance between individual position indicators and their group counters, and provides a more uniform axial flux distribution.

QUESTION: 29

If core quadrant power distribution (sometimes called quadrant power tilt or azimuthal tilt) is maintained within design limits, which one of the following conditions is most likely?

A. Axial power distribution is within design limits.

B. Radial power distribution is within design limits.

C. Nuclear instrumentation is indicating within design accuracy.

D. Departure from nucleate boiling ratio is within design limits.

QUESTION: 30

A reactor is initially operating at 50 percent of rated power with equilibrium xenon-135. Power is then increased to 100 percent over a one-hour period and average reactor coolant temperature is adjusted to 588°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 8 hours after the power change is completed?

A. Greater than 588°F and decreasing slowly

B. Greater than 588°F and increasing slowly

C. Less than 588°F and decreasing slowly

D. Less than 588°F and increasing slowly

QUESTION: 31

A reactor was operating at 100 percent power for 8 weeks when a reactor trip occurred. The reactor was critical 6 hours later and power was increased to 100 percent over the next 6 hours.

What was the status of xenon-135 concentration when power reached 100 percent?

A. Increasing toward an equilibrium value.

B. Burning out faster than it is being produced.

C. Increasing toward a peak value.

D. At equilibrium.

QUESTION: 32

A major reason for installing burnable poisons in a reactor is to…

A. decrease the amount of fuel required to produce a given amount of heat.

B. decrease the amount of fuel required to produce a given duration of plant operation.

C. allow more fuel to be loaded to prolong a fuel cycle.

D. absorb neutrons that would otherwise be lost from the core.

QUESTION: 33

During a reactor startup, the first reactivity addition caused the stable source range count rate to increase from 20 cps to 40 cps. The second reactivity addition caused the stable count rate to increase from 40 cps to 160 cps.

Which one of the following statements accurately compares the two reactivity additions?

A. The first reactivity addition was larger.

B. The second reactivity addition was larger.

C. The first and second reactivity additions were equal.

D. There is <u>not</u> enough information given to compare the reactivity values.

QUESTION: 34

Reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle, while reactor B is operating near the end of a fuel cycle. Both reactors have the same slightly positive value for $K_{eff}$.

If both reactors pass through $1.0 \times 10^{-6}$ percent reactor power at the same time, which reactor, if any, will reach the point of adding heat (POAH) first, and why?

A. Reactor A, because it has the greater startup rate.

B. Reactor B, because it has the greater startup rate.

C. Both reactors will reach the POAH at the same time, because they both have the same value for startup rate.

D. Both reactors will reach the POAH at the same time, because they are both supercritical by the same amount of positive reactivity.

QUESTION: 35

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent control rod withdrawal that adds positive 0.32 %ΔK/K to the reactor.

Given:

- All control rod motion has stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.02 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.005.

What is the power level increase required to offset the reactivity added by the control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

A. 1.6 percent

B. 6.4 percent

C. 16 percent

D. 64 percent

QUESTION: 36

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor trip occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn, but all others fully insert.

Five minutes after the trip, when compared to reactor B the fission rate in reactor A will be _____; and the startup rate in reactor A will be _____.

A. the same; more negative

B. the same; the same

C. smaller; more negative

D. smaller; the same

QUESTION: 37

An enclosed water storage tank is pressurized with nitrogen to prevent air inleakage. Tank pressure is allowed to vary as water level changes. A differential pressure detector is used to measure the tank level.

To achieve the most accurate level measurement, the low pressure side of the detector should sense which one of the following?

A. The pressure at the midline of the tank.

B. The pressure of the atmosphere surrounding the tank.

C. The pressure of a column of water external to the tank.

D. The pressure of the gas space at the top of the tank.

QUESTION: 38

Any vapor having a temperature above saturation temperature is a...

A. saturated vapor.

B. superheated vapor.

C. dry saturated vapor.

D. wet saturated vapor.

QUESTION: 39

A reactor is operating with the following reactor coolant system (RCS) parameters:

RCS pressure = 2,235 psig
RCS hot leg temperature = 600EF
RCS cold leg temperature = 580EF
RCS mass flow rate = $1.0 \times 10^8$ lbm/hr

What is the approximate thermal power output of the reactor in megawatts (MW)?

A. 124 MW

B. 587 MW

C. 821 MW

D. 2,798 MW

QUESTION: 40

A nuclear power plant is operating at 100 percent power. As main steam escapes to atmosphere via a main steam flange leak, which one of the following steam parameters will increase?

A. Enthalpy

B. Pressure

C. Specific volume

D. Temperature

QUESTION: 41

A nuclear power plant has a thermal power rating of 3,200 MW. When the plant operates at 100 percent power, the main generator produces 1,200 MW at a 0.95 power factor. Plant modifications are planned that will upgrade the feedwater heaters and moisture separator/reheaters without changing the plant's thermal power rating. If the plant modifications improve plant thermal efficiency by 2 percent, what will be the resulting main generator electrical output at 100 percent reactor power with the same power factor?

A. 1,204 MW

B. 1,224 MW

C. 1,244 MW

D. 1,264 MW

QUESTION: 42

Refer to the drawing of a venturi in a main steam line (see figure below). The venturi inlet and outlet pipe diameters are equal.

A main steam line 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.

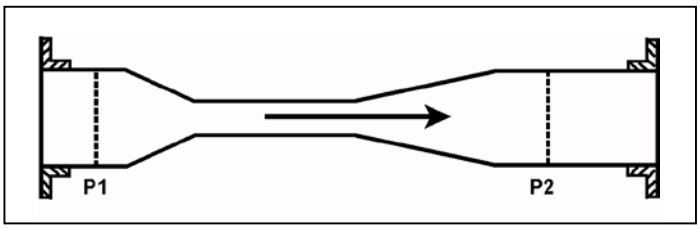
How will the main steam mass flow rate through the venturi be affected as the steam pressure downstream of the venturi continues to decrease?

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 (P1 - P2) across the venturi.

C. It will <u>not</u> continue to increase because the steam velocity <u>cannot</u> increase above sonic velocity in the throat of the venturi.

D. It will <u>not</u> continue to increase because the differential pressure (P1 - P2) across the venturi <u>cannot</u> increase further once the steam reaches sonic velocity in the throat of the venturi.



QUESTION: 43

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

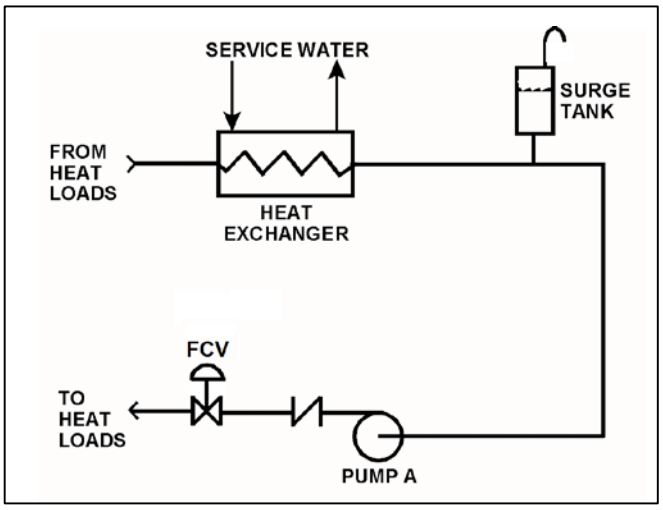
Which one of the following will increase the mass flow rate in the system with a corresponding increase in the total system head loss?

A. Shifting operating pump A to a higher speed.

B. Positioning the flow control valve (FCV) more open.

C. Replacing a 20 foot length of 10-inch diameter pipe with a 10 foot length of 10-inch diameter pipe.

D. Replacing a 20 foot length of 10-inch diameter pipe with a 20 foot length of 12-inch diameter pipe.



QUESTION: 44

Which one of the following pairs of fluids undergoing heat transfer in identical heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient?

A. Oil to water.

B. Steam to water.

C. Air to water.

D. Water to water.

QUESTION: 45

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

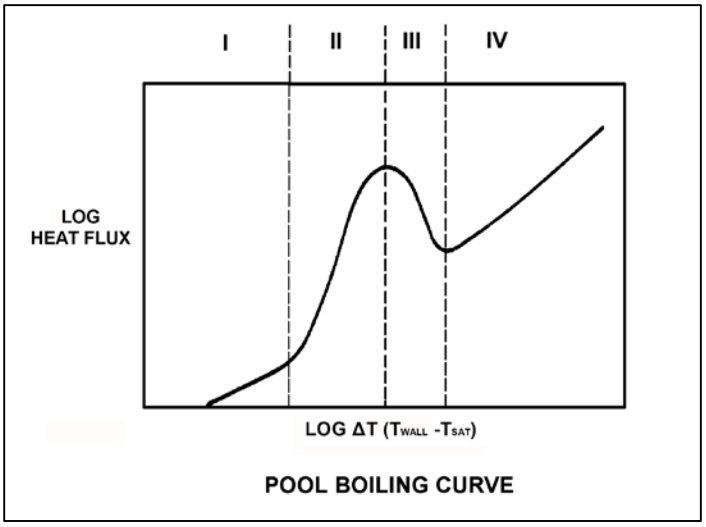
Which region of the curve contains the operating point at which the hottest locations of a reactor normally operate to transfer heat from the fuel cladding to the coolant at 100 percent power?

A. Region I

B. Region II

C. Region III

D. Region IV



QUESTION: 46

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

A. Complete steam blanketing of the fuel rod surface.

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

C. Saturated nucleate boiling.

D. Subcooled nucleate boiling.

QUESTION: 47

A reactor is shut down at normal operating temperature and pressure with all reactor coolant pumps stopped. Stable natural circulation cooling is in progress with a minimum of 50°F subcooling. Which one of the following, if increased, will <u>not</u> affect natural circulation flow rate?

A. Reactor coolant pressure

B. Time after reactor trip

C. Feedwater flow rate

D. Steam generator pressure

QUESTION: 48

A reactor coolant system natural circulation cooldown is in progress with steam release from the steam generator (SG) atmospheric steam relief valves (operated in manual control). Assume feedwater flow rate, SG relief valve position, and core decay heat level are constant.

If high point voiding interrupts natural circulation, SG levels will gradually _____; and core exit thermocouple indications will gradually _____.

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

QUESTION: 49

A reactor is operating at steady-state 80 percent power with all control rods fully withdrawn and in manual control. Compared to a 50 percent insertion of one control rod, a 50 percent insertion of a group (or bank) of control rods will cause a _____ increase in the maximum axial peaking factor and a _____ increase in the maximum radial peaking factor. (Assume reactor power remains constant.)

A. smaller; larger

B. smaller; smaller

C. larger; larger

D. larger; smaller

QUESTION: 50

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. A compressive stress across the vessel wall rather than a tensile stress.

B. A high reactor coolant temperature rather than a low reactor coolant temperature.

C. Performing a 50°F/hr cooldown at 1,600 psia rather than a 50°F/hr cooldown at 1,200 psia.

D. Changing the reactor vessel manufacturing process to increase toughness while maintaining the same yield strength.

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

JUNE 2016 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

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