TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P901

Which one of the following describes the function of a safety valve?

A.  Provide overpressure protection to limit the internal pressure in vessels

B.  Control pressure in a system to maintain optimum operational conditions

C.  Sound a warning by lifting at a predetermined value slightly higher than operating pressure

D.  Modulate open as necessary to maintain system pressure and/or temperature within normal limits

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P1802   (B1701)

A vertical safety valve has a compressed spring assembly that is applying 1,200 lbf to the top of the valve disk in opposition to system pressure.  System pressure is being exerted on the underside of the valve disk that is 3 inches in diameter.

Which one of the following is the approximate system pressure at which the safety valve will open? (Ignore any effects from atmospheric pressure.)

A.  44 psi

B.  64 psi

C.  128 psi

D.  170 psi

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P1903   (B2003)

A vertical safety valve with a 3-inch diameter disk has a compressed spring applying 1,000 lbf to the top of the valve disk in opposition to system pressure.  Which one of the following is the approximate system pressure at which the safety valve will open?  (Neglect the effect of atmospheric pressure.)

A.  35 psi

B.  111 psi

C.  142 psi

D.  444 psi
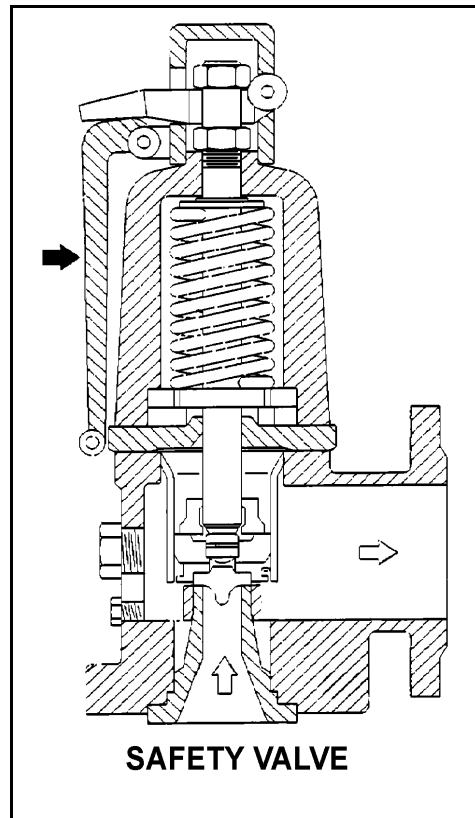
ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P2101   (B2103)

Refer to the drawing of a typical safety valve (see figure below).

The component indicated by the solid arrow is used when necessary to manually...

A.  rachet open the safety valve.

B.  pop open the safety valve.

C.  gag shut the safety valve.

D.  determine the position of the safety valve.

ANSWER:  B.

**SAFETY VALVE**

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P2301   (B2301)

A vertical safety valve has a compressed spring assembly that is applying 2,500 lbf to the top of the valve disk in opposition to system pressure.  System pressure is being exerted on the underside of the valve disk that is 5 inches in diameter.

Which one of the following is the approximate system pressure at which the safety valve will open? (Neglect the effect of atmospheric pressure.)

A.  32 psi

B.  127 psi

C.  159 psi

D.  500 psi

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P2801   (B2803)

A vertical safety valve with a 2-inch diameter disk has a compressed spring applying 2,400 lbf to the top of the valve disk in opposition to system pressure.  Which one of the following is the approximate system pressure at which the safety valve will open?

A.  95 psig

B.  191 psig

C.  382 psig

D.  764 psig

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:            P3401   (B3401)

Given the following pressure specifications for operation of a main steam safety valve (MSSV):

Setpoint pressure (MSSV starts to open):        1,200 psia
Maximum pressure (MSSV will be fully open):   1,230 psia
Reseat pressure (MSSV will be fully closed):      1,140 psia

Which one of the following is the percent blowdown for the MSSV?

A.  2.5%

B.  5.0%

C.  7.5%

D.  10.0%

ANSWER:  B.

TOPIC:            191001
KNOWLEDGE:   K1.01   [3.3/3.4]
                      K1.02   [3.0/3.3]
QID:               P4201   (B4201)

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 <u>and</u> 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

ANSWER:  B.

TOPIC:           191001
KNOWLEDGE:   K1.01   [3.3/3.4]
QID:             P4401   (B4401)

Given the following pressure specifications for a main steam safety valve (MSSV):

    Setpoint pressure (MSSV will start to open):      1,200 psia
    Maximum pressure (MSSV will be fully open):  1,242 psia
    Reseat pressure (MSSV will be fully closed):    1,152 psia

Which one of the following is the percent accumulation for this MSSV?

A.  2.5%

B.  3.0%

C.  3.5%

D.  4.0%

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
                K1.02   [3.0/3.3]
QID:            P4701   (B4701)

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 8 gpm.  The tank is protected by a relief valve <u>and</u> a safety valve; both valves discharge to the atmosphere.  Each valve has an opening setpoint of 205 psig and a maximum rated discharge flow rate of 6 gpm.  The PDP is inadvertently left running when tank pressure reaches 200 psig.

With the PDP still running, when conditions stabilize the relief valve will be _____ open; and the safety valve will be discharging approximately _____ to atmosphere.

A.  partially; 6 gpm

B.  partially; 2 gpm

C.  fully; 6 gpm

D.  fully; 2 gpm

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.01   [3.3/3.4]
                     K1.02   [3.0/3.3]
QID:            P5201   (B5201)

Refer to the drawing of two identical water storage tanks (see figure below).  Tank A is protected by a relief valve and Tank B is protected by a safety valve.  Each valve has an opening setpoint of 205 psig and a maximum rated discharge flow rate of 8 gpm.

The tanks are being hydrostatically tested to 200 psig.  Each tank is being supplied with a smooth and constant flow rate of 2 gpm from separate positive displacement pumps (PDPs).  Both PDPs are inadvertently left running when tank pressures reach 200 psig.

With the PDPs running continuously, what will be the resulting status of the relief and safety valves?

|     | Relief Valve Status | Safety Valve Status |
|-----|---------------------|---------------------|
| A.  | Partially open | Partially open |
| B.  | Partially open | Cycling between fully open and fully closed |
| C.  | Cycling between fully open and fully closed | Partially open |
| D.  | Cycling between fully open and fully closed | Cycling between fully open and fully closed |

ANSWER:  B.
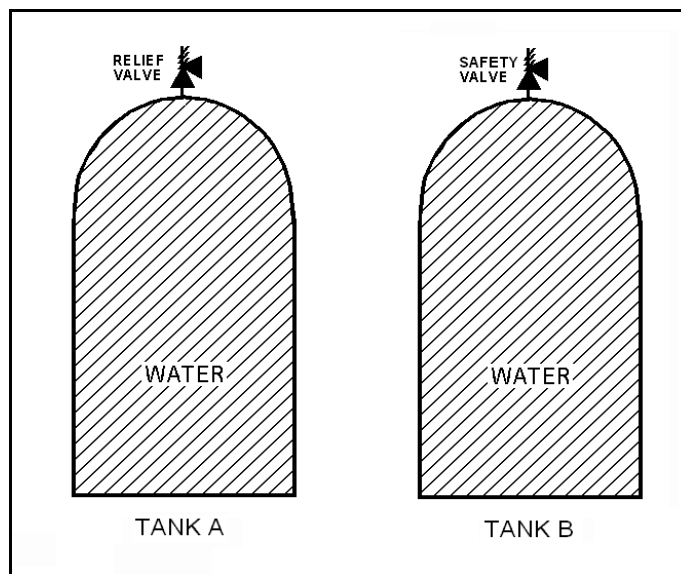
TOPIC:          191001
KNOWLEDGE:   K1.02   [3.3/3.4]
QID:            P1

The primary purpose of a pressure relief valve is to...

A.  reduce system energy.

B.  reduce system pressure.

C.  maintain system integrity.

D.  maintain system mass.

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:            P202    (B301)

The difference between the set point pressure at which a safety valve opens and the pressure at which it closes is called...

A.  blowdown.

B.  accumulation.

C.  set point tolerance.

D.  set point deviation.

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:             P501    (B201)

The difference between the setpoint pressure at which a relief valve begins to open and the pressure at which it is fully open is called...

A.  setpoint deviation.

B.  setpoint tolerance.

C.  accumulation.

D.  blowdown.

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:             P1504   (B1801)

Which one of the following is a difference between a typical relief valve and a typical safety valve?

A.  The actuator closing spring on a relief valve is in a compressed state whereas the actuator closing spring on a safety valve acts in tension.

B.  A relief valve gradually opens as pressure increases above the setpoint pressure whereas a safety valve fully opens at the setpoint pressure.

C.  Relief valves are capable of being gagged whereas safety valves are <u>not</u>.

D.  The blowdown of a relief valve is greater than the blowdown of a safety valve.

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:            P1801   (B1301)

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

Both vessels have been pressurized to 50 psig and then isolated.  Vessel A is completely filled with water at 150°F.  Vessel B is in a saturated condition with one-half steam (100% quality) and one-half water (0% quality) by volume.

If both relief valves fully open simultaneously, the faster pressure reduction will occur in vessel _____; and if both relief valves close at 40 psig, the greater mass loss will have occurred in vessel _____.

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  B.
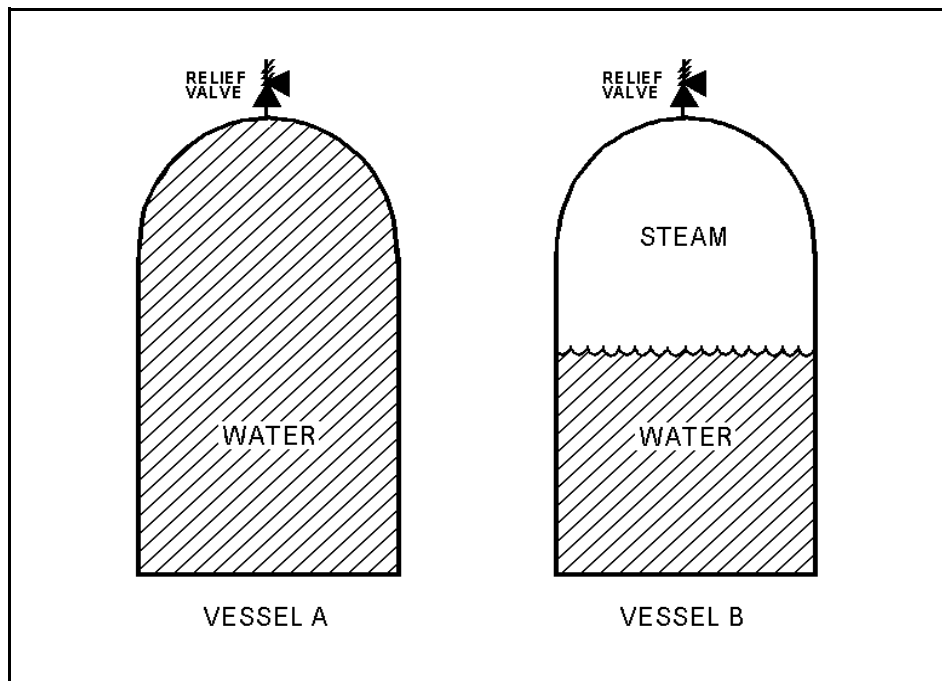
TOPIC:            191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:              P2501   (B2501)

Water storage tanks A and B are identical except that tank A receives overpressure protection from an installed relief valve, whereas tank B has an installed safety valve.  The relief valve and safety valve have the same pressure setpoint and design flow rate.

Water is continuously added to each tank at the same rate (50% of the design flow rate of the relief/safety valve).  After the tanks are completely full, tank A pressure will _____; and tank B pressure will _____.

A.  stabilize slightly above the pressure setpoint; stabilize slightly above the pressure setpoint

B.  stabilize slightly above the pressure setpoint; fluctuate within a few percent of the pressure setpoint

C.  fluctuate within a few percent of the pressure setpoint; stabilize slightly above the pressure setpoint

D.  fluctuate within a few percent of the pressure setpoint; fluctuate within a few percent of the pressure setpoint

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.0/3.3]
QID:            P2701   (B2701)

Vessels A and B are identical except that vessel A receives overpressure protection from an installed safety valve.  Vessel B has an installed relief valve.  The safety and relief valves have the same pressure setpoint and design flow rate.

Water is continuously added to each vessel at the same rate (50% of the design flow rate of the safety and relief valves).  After vessel pressure reaches the setpoint for each valve, vessel A pressure will _____ and vessel B pressure will _____.

A.  stabilize slightly above the pressure setpoint; stabilize slightly above the pressure setpoint

B.  stabilize slightly above the pressure setpoint; fluctuate within a few percent of the pressure setpoint

C.  fluctuate within a few percent of  the pressure setpoint; stabilize slightly above the pressure setpoint

D.  fluctuate within a few percent of the pressure setpoint; fluctuate within a few percent of the pressure setpoint

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.02   [3.4/3.6]
QID:             P3302   (B2)

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

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

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

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  A.
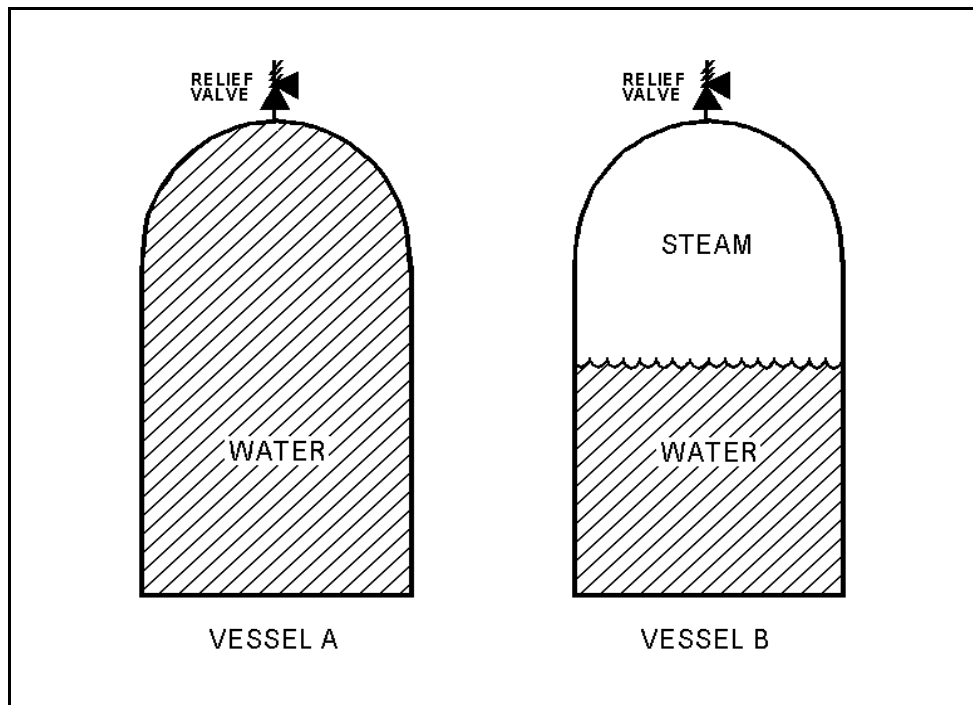
TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:             P2

When a discharge valve is opened to atmosphere, the pressure on the upstream side of the valve will...

A.  remain the same, and the pressure on the downstream side will increase.

B.  increase, and the pressure on the downstream side will remain the same.

C.  remain the same, and the pressure on the downstream side will decrease.

D.  decrease, and the pressure on the downstream side will remain the same.

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:             P602    (B2005)

When comparing a globe valve and a gate valve in the same application, the gate valve has a _____ pressure drop when fully open and is the _____ choice for throttling.

A.  higher; better

B.  lower; better

C.  higher; poorer

D.  lower; poorer

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:            P1201   (B2101)

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

If a cooling water outlet valve is partially closed from the full open position, heat exchanger cooling water pressure upstream of the valve will _____ and the temperature of the lube oil exiting the heat exchanger will _____.

A.  increase; decrease

B.  increase; increase

C.  decrease; decrease

D.  decrease; increase

ANSWER:  B.



**LUBE OIL HEAT EXCHANGER**
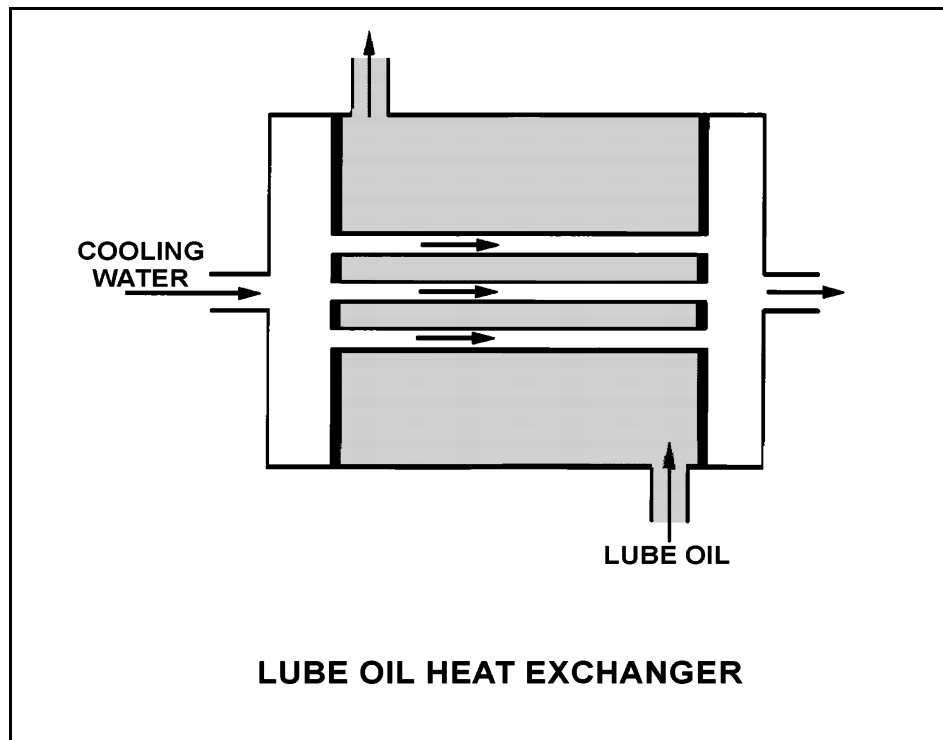
TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:             P1302   (B1505)

When comparing a 3-inch gate valve to a 3-inch globe valve in the same application in an operating cooling water system, if both valves are fully open, the gate valve produces the _____ head loss and the _____ flow rate.

A.  smaller; larger

B.  smaller; smaller

C.  larger; larger

D.  larger; smaller

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:             P2102   (B2101)

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

A.  The first 25% of valve disk travel in the open direction will produce a smaller change in flow rate than the last 25% of valve disk travel.

B.  The first 25% of valve disk travel in the open direction will produce a greater change in flow rate than the last 25% of valve disk travel.

C.  The first 25% of valve disk travel in the open direction will produce approximately the same change in flow rate as the last 25% of valve disk travel.

D.  A gate valve that has been opened to 25% of valve disk travel will result in approximately 25% of full flow rate.

ANSWER:  B.

TOPIC:              191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:                  P2302   (B2601)

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

A.  The first 25% of valve disk travel in the open direction will produce a smaller change in flow rate than the last 25% of valve disk travel.

B.  The first 25% of valve disk travel in the open direction will produce a greater change in flow rate than the last 25% of valve disk travel.

C.  The first 25% of valve disk travel in the open direction will produce approximately the same change in flow rate as the last 25% of valve disk travel.

D.  A globe valve that has been opened to 25% of valve disk travel will result in approximately 25% of full flow rate.

ANSWER:  B.

TOPIC:              191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:                  P2303   (B2303)

A control valve is most likely to experience cavitation when the valve is almost fully _____ because of a relatively _____ pressure drop across the valve seat.

A.  open; large

B.  open; small

C.  closed; large

D.  closed; small

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:            P3001   (B3002)

Which one of the following statements describes the throttling characteristics of a typical globe valve?

A.  The first third of valve disk travel in the open direction will result in approximately one-third of full flow rate.

B.  The first third of valve disk travel in the open direction will produce a smaller increase in flow rate than the last third of valve disk travel.

C.  The first third of valve disk travel in the open direction will produce a greater increase in flow rate than the last third of valve disk travel.

D.  The first two-thirds of valve disk travel in the open direction will produce approximately the same increase in flow rate as the last third of valve disk travel.

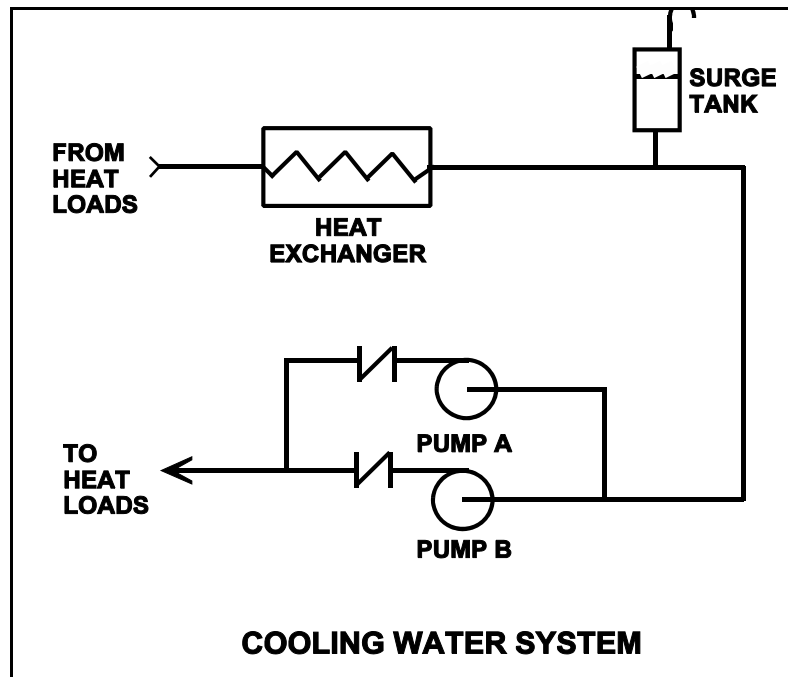ANSWER:  C.

TOPIC:              191001
KNOWLEDGE:    K1.03    [2.7/2.9]
QID:                  P3901   (B3902)

Refer to the drawing of a cooling water system in which both centrifugal pumps A and B are operating (see figure below).

An operator stops pump B, but the pump B check valve fails to close.  In comparison to normal operation with only pump A running, operation with the failed pump B check valve will result in pump A flow rate being _____ than normal; and heat exchanger flow rate being _____ than normal.

A.  higher; lower

B.  higher; higher

C.  lower; lower

D.  lower; higher

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:            P4101   (B4103)

Which one of the following types of similarly sized valves in an operating water system produces the <u>least</u> frictional head loss when fully open?

A.  Ball

B.  Globe

C.  Butterfly

D.  Swing check

ANSWER:  A.

TOPIC:            191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:              P4801   (B4802)

Refer to the centrifugal pump operating curve with two system head loss curves (see figure below). The curves apply to an open cooling water system using one single-speed centrifugal pump discharging through a typical flow control valve.  The valve is located on the discharge piping of the pump.

One of the system curves shows system head loss with the flow control valve 25% open.  The other system curve shows system head loss with the flow control valve 100% open.  The pump is operating and the valve is initially 25% open, resulting in a pump flow rate of 800 gpm.

If the flow control valve is subsequently fully opened, pump flow rate through the valve will be approximately...

A.  400 gpm.

B.  1,200 gpm.

C.  1,600 gpm.

D.  3,200 gpm.

ANSWER:  B.



PUMP HEAD

FLOW RATE

**CENTRIFUGAL PUMP CURVE**
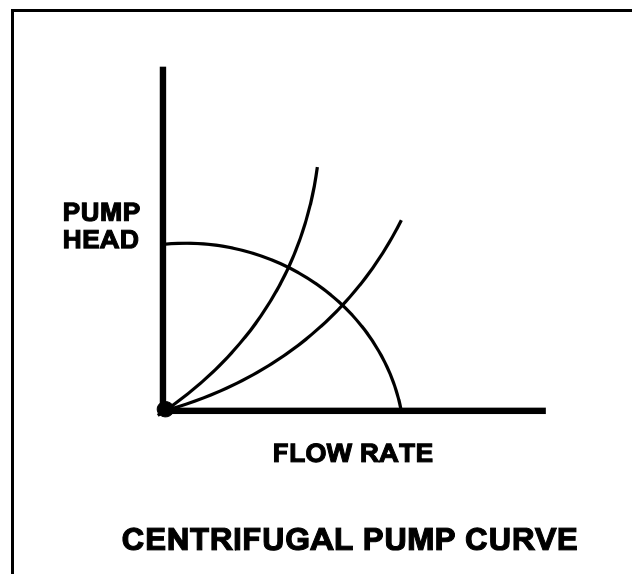
TOPIC:         191001
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:           P4901   (B4901)

Consider a 6-inch globe valve and a 6-inch gate valve in the same water system application. Typically, the valve that requires the most linear disk travel from fully closed to fully open is the _____ valve; and the valve that produces the smallest pressure drop when fully open is the _____ valve.

A.  gate; gate

B.  gate; globe

C.  globe; gate

D.  globe; globe

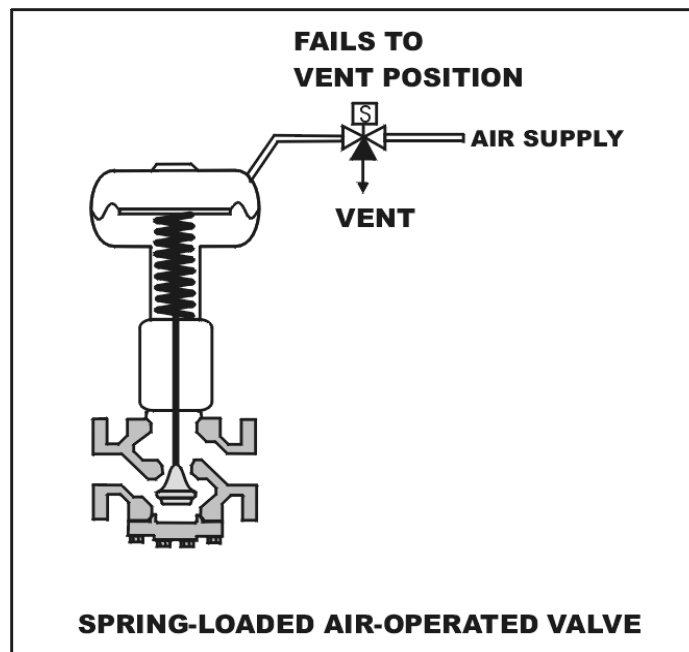ANSWER:  A.

TOPIC:         191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:           P101    (B1903)

Refer to the drawing of a spring-loaded air-operated valve (see figure below).

Upon a loss of air pressure, this valve will...

A.  go to the fully open position.

B.  remain at the current position.

C.  go to the fully closed position.

D.  go to the midposition.

ANSWER:  C.



FAILS TO
VENT POSITION

AIR SUPPLY

VENT

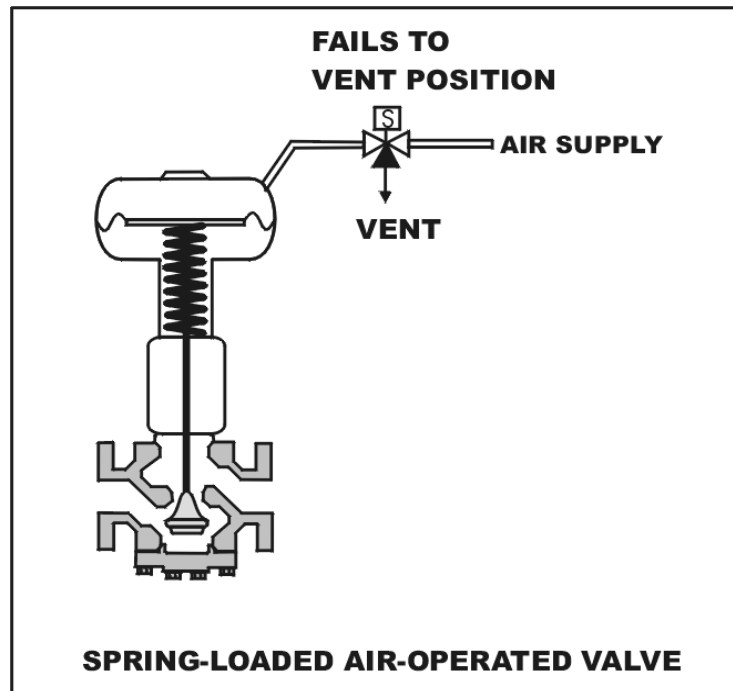SPRING-LOADED AIR-OPERATED VALVE

TOPIC:          191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:            P112    (B1401)

Using the drawing of an air-operated valve (see figure below), identify the valve position following a loss of electrical power.

A.  Midposition

B.  Closed

C.  As is

D.  Open

ANSWER:  B.

TOPIC:            191001
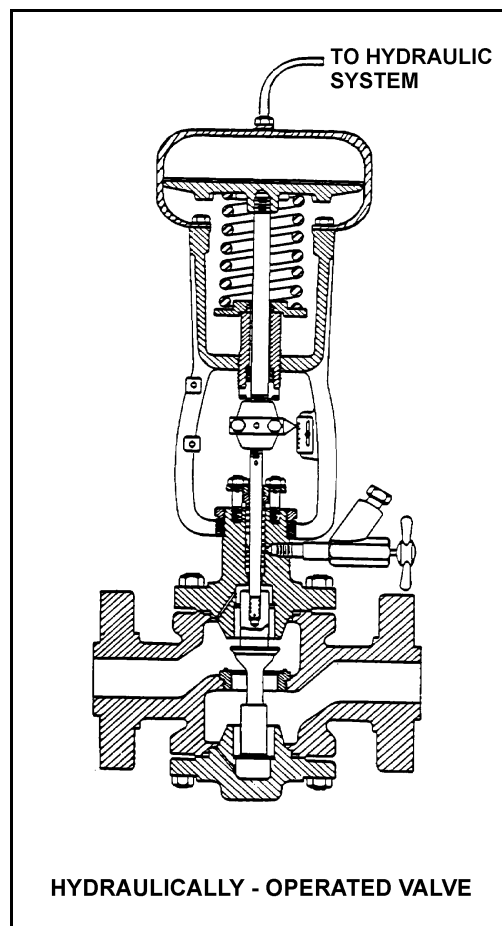KNOWLEDGE:  K1.04   [2.8/3.2]
QID:              P203    (B502)

Refer to the drawing of a hydraulically-operated valve that is shown in a throttled position (see figure below).

Select the position of this valve following a loss of hydraulic system pressure.

A.  Fully open

B.  As is

C.  Fully closed

D.  Midposition

ANSWER:  A.

TO HYDRAULIC
SYSTEM

**HYDRAULICALLY - OPERATED VALVE**

TOPIC:           191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:              P1101   (B1109)

Refer to the drawing of a spring-loaded air-operated valve shown in a throttled position (see figure below).

The figure currently depicts normal air supply pressure and an energized solenoid.  What will be the valve position following a loss of electrical power to the solenoid?

A.  As is

B.  More open

C.  More closed

D.  Varies with system flow

ANSWER:  B.



**SPRING-LOADED AIR-OPERATED VALVE**

TOPIC:          191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:            P1202   (B602)

How will a typical motor-operated valve respond to a loss of electrical power to the valve actuator?

A.  Open fully

B.  Close fully

C.  Remain as is

D.  Move to 50% open

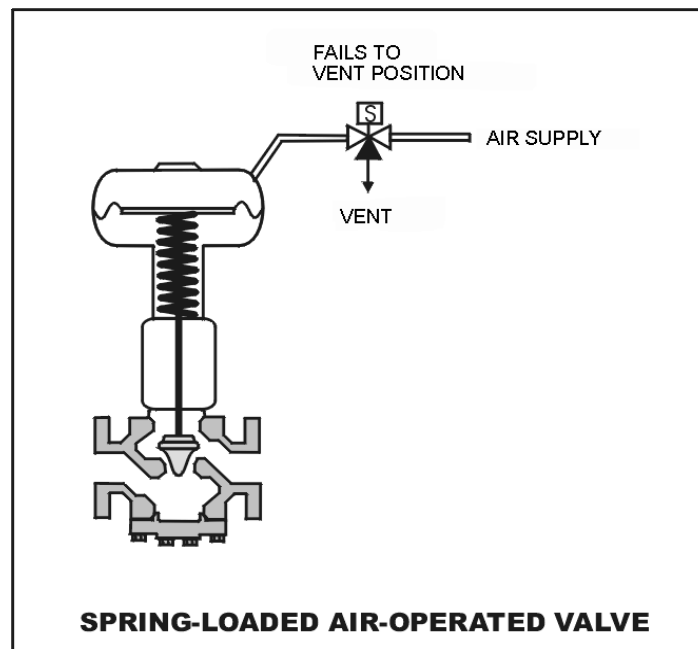ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:            P2104   (B1002)

Refer to the drawing of a spring-loaded air-operated valve shown in a throttled position (see figure below).

Which one of the following will be the valve position following a reduction in air pressure to the valve actuator caused by a leaking air connection at the valve?

A.  Original position

B.  More closed

C.  More open

D.  Varies with system flow

ANSWER:  B.



FAILS TO
VENT POSITION

AIR SUPPLY

VENT

SPRING-LOADED AIR-OPERATED VALVE
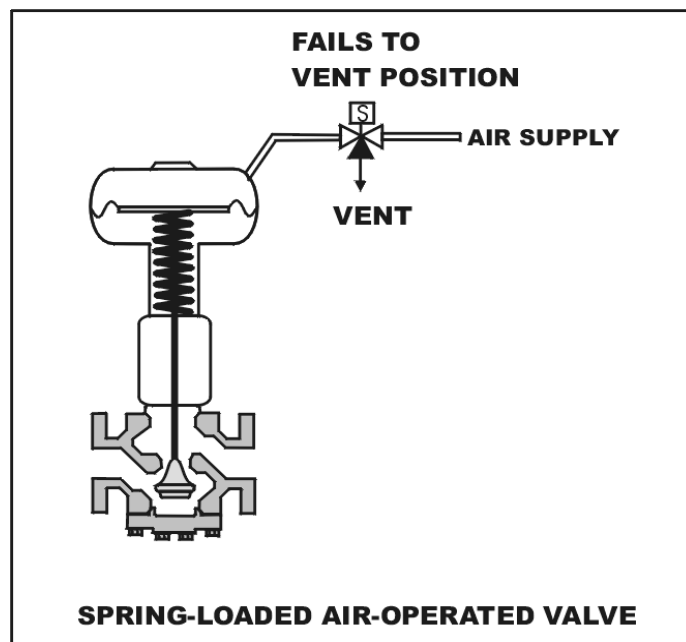
TOPIC:          191001
KNOWLEDGE:   K1.04   [2.8/3.2]
                K1.08   [3.4/3.4]
QID:            P5002   (B5002)

Refer to the drawing of a pneumatically-operated valve (see figure below).  The valve actuator may be shown with or without air pressure applied to it.

Which one of the following describes the type of valve shown, and the fail position on loss of air to the actuator?

|  | Valve Type | Fail Position |
|---|---|---|
| A. | Gate | Open |
| B. | Gate | Closed |
| C. | Globe | Open |
| D. | Globe | Closed |

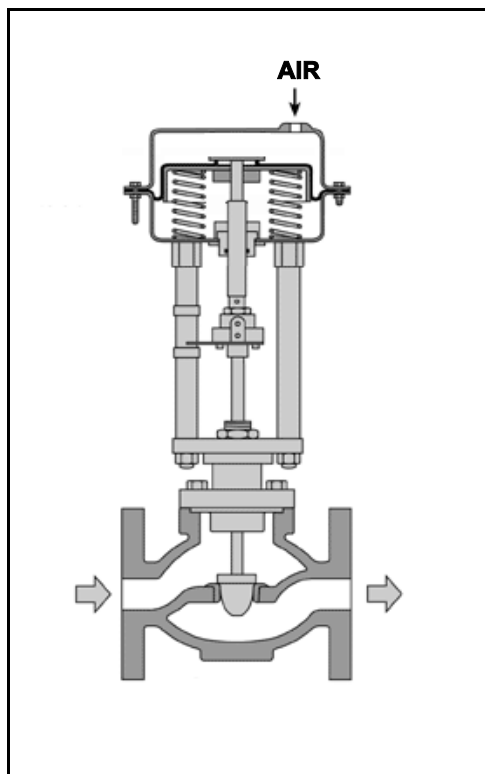ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.04   [2.8/3.2]
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P5302   (B5301)

Refer to the drawing of four air-operated valves (see figure below).  **Note:** The valve actuators may be shown with or without air pressure applied.

Given:

- The direction of system flow is from left to right when the valves are open.
- The internal components for each valve are identical except for the orientation of the valve disk and seat.
- The valve actuators exert the same force on the attached valve stem for a given applied air pressure.

If each actuator is vented, which valve disk will remain closed with the most force?

A.  A.

B.  B.

C.  C.

D.  D.

ANSWER:  C.

TOPIC:            191001
KNOWLEDGE:   K1.04   [2.8/3.2]
QID:                P5502   (B5502)

Refer to the drawing of four air-operated valves (see figure below).  **Note:** The valve actuators may be shown with or without air pressure applied.
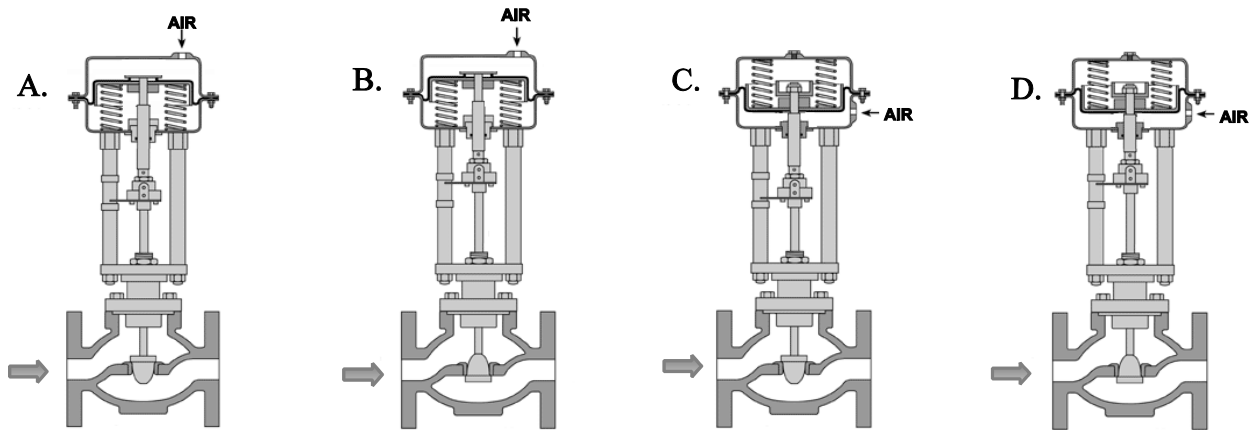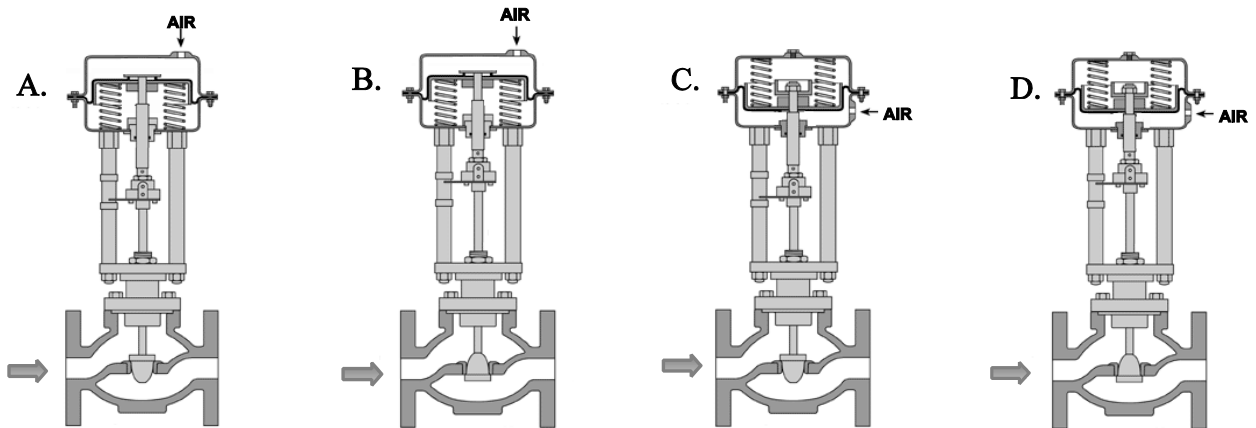
Which valves are currently shown in their failed (i.e., no air pressure applied to the actuator) positions?

A.  A and B

B.  B and C

C.  C and D

D.  D and A

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P201     (B206)

An operator attempts to close a fully-open upright manual gate valve to isolate a pump in a cooling water system that has been cooled down for maintenance.  However, the operator is unable to rotate the handwheel in the close direction.

Which one of the following could cause this condition?

A.  A hydraulic lock has developed under the valve disk.

B.  A hydraulic lock has developed in the valve bonnet between the valve disk and the packing gland.

C.  The two halves of the valve disk have expanded and are jammed against the valve seats.

D.  The valve disk has jammed against its backseat by the difference in the thermal contraction of the stem and the bonnet.

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P403     (B108)

When manually positioning a motor-operated valve, why must the operator avoid using excessive valve seating/backseating force?

A.  The valve may bind during subsequent operation.

B.  Valve stem limit switch settings may become inaccurate.

C.  The clutch may not reengage the valve motor when required.

D.  Stem position may no longer be an accurate indicator of valve position.

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P1303   (B2802)

After an adjustment of the packing gland on a valve that had a minor packing leak, the operator attempts to operate the valve but finds that the valve is stuck.  What is the most probable cause?

A.  The disk separated from the valve stem as a result of overtightening the packing.

B.  The operator placed the valve in the wrong position while adjusting the packing.

C.  Adjusting the packing overtorqued the valve in the closed direction.

D.  The operator overtightened the packing, causing the stem to bind.

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P1603   (B1003)

An adjustment has just been completed on the packing gland of an automatic valve to stop a minor stem leak.  Which one of the following can occur if the technician overtightened the packing gland?

A.  Decreased cooling flow to the valve internals

B.  Separation of the valve disk from the valve stem

C.  Misalignment of the valve position limit switches

D.  Increased stroke time from fully open to fully closed

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P1902   (B6)

Which one of the following describes the function and use of the backseat on a manual valve?

A.  Removes pressure from the packing/stuffing box and is typically used to isolate the stuffing box for valve repacking.

B.  Removes pressure from the packing/stuffing box and is typically used when needed to isolate packing leakage.

C.  Acts as a backup in case the primary seat leaks and is typically used during system isolation for personnel protection.

D.  Acts as a backup in case the primary seat leaks and is typically used when needed to prevent the primary seat from leaking excessively.

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P2503   (B2603)

When manually closing a motor-operated valve, why must the operator avoid using excessive valve seating force?

A.  The valve may bind and cause the valve motor to trip on overload during subsequent remote operation.

B.  The valve actuator clutch may be damaged and disable subsequent automatic operation.

C.  The valve stem limit switches may be damaged and cause inaccurate remote valve position indication.

D.  The valve actuator position indicator may be damaged and cause inaccurate local valve position indication.

ANSWER:  A.

TOPIC:            191001
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P3503   (B3503)

Refer to the drawing of a water supply pump with two suction sources (see figure below).  All motor-operated valves (MOVs) are currently closed.

Which one of the following MOV interlocks will permit the pump to take a suction on either the building sump or the water storage tank, while preventing the two sources from being cross-connected?

A.  Neither MOV-1 nor MOV-2 can be opened unless MOV-3 is fully closed.

B.  None of the MOVs can be opened unless at least one MOV remains fully closed.

C.  None of the MOVs can be opened unless at least two MOVs remain fully closed.

D.  Neither MOV-1 nor MOV-2 can be opened unless the other source MOV is fully closed.

ANSWER:  D.
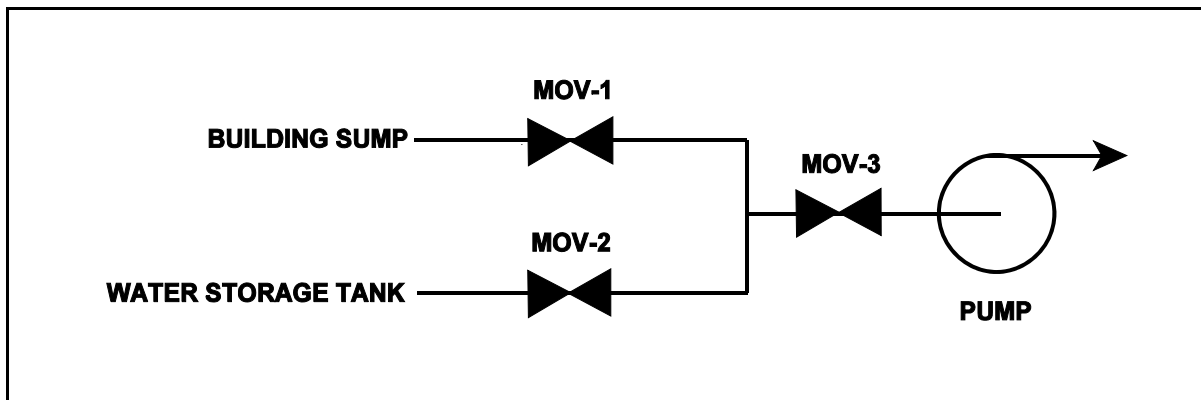
TOPIC:           191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:             P4

After manually positioning a motor-operated valve, the valve actuator is <u>reengaged</u> by actuation of the...

A.  manual declutch lever to the disengage position.

B.  manual declutch lever to the engage position.

C.  racked in limit switch when the actuator motor breaker is racked in.

D.  valve actuator motor in the open direction.

ANSWER:  D.

TOPIC:           191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:             P204    (B204)

Operation of the manual declutch lever (initially in the normal position) of a motor-operated valve _____ the motor and _____ the handwheel.

A.  disengages; engages

B.  deenergizes; engages

C.  engages; disengages

D.  reenergizes; disengages

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:             P1702   (B1605)


A typical Limitorque® motor-operated valve is installed in an emergency core cooling system (ECCS) application.  The ECCS actuation signal is designed to energize the valve motor and open the valve.  The valve is currently open, but being manually/locally closed by a technician as required by a surveillance test procedure.  The declutch lever has been operated and released, and the valve is being closed by operation of the valve handwheel.

If an ECCS actuation signal is received, how will the valve be affected?

A.  The handwheel will disengage and the valve will automatically open.

B.  The handwheel will disengage and the valve will remain in the current position.

C.  The handwheel will remain engaged and the valve will automatically open.

D.  The handwheel will remain engaged and the technician can continue to close the valve.

ANSWER:  A.


TOPIC:          191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:             P2003   (B2004)


A surveillance test procedure is being performed on a typical Limitorque® motor-operated valve (MOV) used in an emergency core cooling system (ECCS) application.  The declutch lever has been operated and released and the valve is being manually/locally opened by a technician.  The MOV breaker is closed as required by the surveillance test procedure.  During operation of the valve handwheel an ECCS actuation signal is received that normally energizes the valve motor and closes the valve.

How will the valve be affected by the actuation signal?

A.  The handwheel will disengage and the valve will automatically close.

B.  The handwheel will disengage and the valve will remain in the current position.

C.  The handwheel will remain engaged and the valve will automatically close.

D.  The handwheel will remain engaged and the technician can continue to open the valve.

ANSWER:  A.

TOPIC:             191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:               P2703   (B2704)

A typical motor-operated valve (MOV) has just been opened from the main control room, and the breaker for the MOV has been opened.  A plant operator has been directed to close the MOV locally for a surveillance test.

If the operator attempts to turn the MOV handwheel in the clockwise direction without first operating the clutch lever, which one of the following will occur?

A.  The handwheel will <u>not</u> turn, and the valve stem will <u>not</u> move.

B.  The handwheel will turn, but the valve stem will <u>not</u> move.

C.  The handwheel will turn, and the valve stem will move toward the closed position because the clutch is automatically engaged when the handwheel is turned.

D.  The handwheel will turn, and the valve stem will move toward the closed position because the clutch is automatically engaged when the breaker is opened.

ANSWER:  B.

TOPIC:             191001
KNOWLEDGE:   K1.06   [3.3/3.7]
QID:               P4002   (B4003)

Which one of the following types of similarly sized valves requires the <u>most</u> manual valve stem rotation to move the valve from fully open to fully closed?  (Assume that each valve has a non-rising stem.)

A.  Ball

B.  Gate

C.  Plug

D.  Butterfly

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P303    (B302)

A stop check valve is a type of check valve that...

A.  cannot be shut remotely.

B.  can be used to prevent flow in both directions.

C.  can be opened manually to allow flow in both directions.

D.  contains both a gate valve disk and a check valve disk.

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P503

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

A.  Safety valve

B.  Relief valve

C.  Divert valve

D.  Check valve

ANSWER:  D.

TOPIC:             191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:               P802    (B2204)

Two common types of check valves used in nuclear power plants are...

A.  globe and gate.

B.  ball and plug.

C.  swing and lift.

D.  needle and angle.

ANSWER:  C.

TOPIC:             191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:               P1003   (B2903)

A typical check valve is designed to...

A.  permit flow in only one direction.

B.  prevent system overpressure.

C.  isolate system components.

D.  perform automatic pump venting.

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P1503   (B205)

Check valves are normally used to prevent...

A.  overpressurization of nonoperating system piping and components.

B.  backflow through nonoperating components or flowpaths.

C.  pump runout by providing a constant backpressure.

D.  pump cavitation by keeping nonoperating systems filled.

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P2202   (B1102)

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

ANSWER:  D.

TOPIC:            191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P5      (B402)

To verify a manual valve in an operating system is <u>closed</u>, the operator should operate the valve handwheel in the...

A.  open direction until the valve is fully open, then close it using normal force.

B.  open direction until flow sounds are heard, then close the valve using normal force.

C.  close direction using normal force and verify there is no substantial handwheel movement.

D.  close direction until it stops, then close it an additional one-half turn using additional force if necessary.

ANSWER:  C.

TOPIC:            191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P205    (B503)

To verify the position of a <u>fully</u> <u>open</u> manual valve in an operating system, the operator should operate the valve handwheel...

A.  in the open direction until the valve is backseated one-half turn.

B.  to fully close the valve, then open the valve to the fully open position.

C.  in the closed direction, then open the valve to its previously open position.

D.  to open the valve until it touches the backseat, then close the valve to the desired position.

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P405    (B2205)

A comparison of the characteristics of gate valves and globe valves in an operating system indicates a globe valve generally has a _____ pressure drop when fully open, and is _____ commonly used for throttling system flow.

A.  smaller; less

B.  larger; more

C.  smaller; more

D.  larger; less

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P1104   (B504)

Gate valves generally are <u>not</u> used to throttle fluid flow because...

A.  gate valves introduce a large system head loss when fully open.

B.  all gate valves will experience stem leakage when partially open.

C.  the turbulent flow created by a partially opened gate valve would cause damage to the valve.

D.  the large size of the valve disk would require an oversized actuator to position the valve accurately.
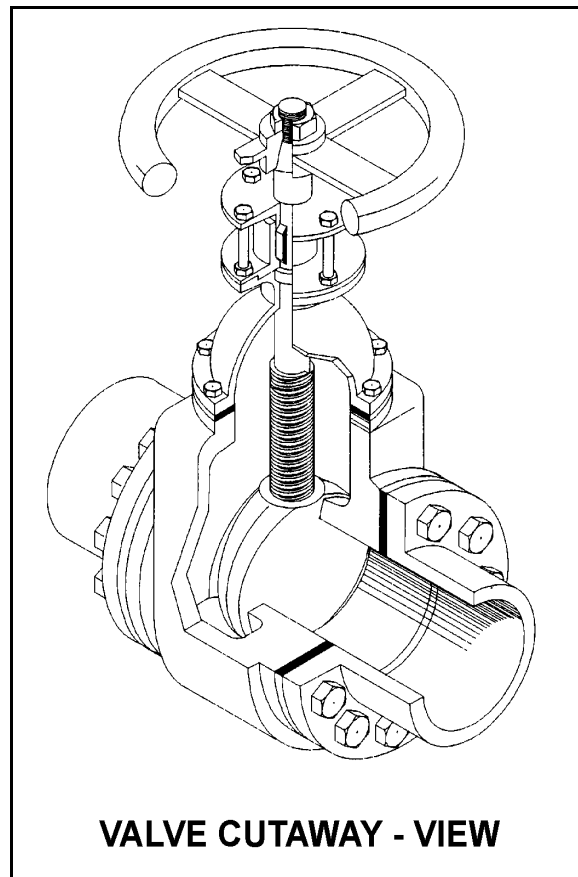
ANSWER:  C.

TOPIC:            191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P1405   (B1705)

Refer to the cutaway-view drawing of a valve (see figure below).

Which one of the following describes the type of valve shown?

A.  Rising-stem gate valve

B.  Nonrising-stem gate valve

C.  Rising-stem globe valve

D.  Nonrising-stem globe valve

ANSWER:  B.



**VALVE CUTAWAY - VIEW**

TOPIC:          191001
KNOWLEDGE:  K1.08   [3.4/3.4]
QID:              P1501   (B1805)

When comparing a 3-inch gate valve to a 3-inch globe valve in the same application in an operating cooling water system, if both valves are fully open, the globe valve produces the _____ head loss and the _____ flow rate.

A.  larger; larger

B.  larger; smaller

C.  smaller; larger

D.  smaller; smaller

ANSWER:  B.

TOPIC:          191001
KNOWLEDGE:  K1.08   [3.4/3.4]
QID:              P1602   (B1404)

Which one of the following is a generally accepted method for locally verifying that a manual valve is fully closed in a depressurized static piping system?

A.  Check a downstream flow gauge to be indicating zero flow

B.  Visually observe the valve rising-stem threads to be fully exposed

C.  Attempt to turn the valve handwheel in the close direction and verify no movement

D.  Attempt to turn the valve handwheel in the open direction and verify valve opens

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:  K1.08   [3.4/3.4]
QID:              P1604   (B1604)

Compare a typical gate valve to a typical globe valve in the same application in an operating high-pressure cooling water system.  If both valves are fully open, the gate valve will have a _____ pressure drop and is the better choice for _____ flow.

A.  higher; throttling

B.  higher; isolating

C.  lower; throttling

D.  lower; isolating

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:  K1.08   [3.4/3.4]
QID:              P1704   (B1802)

To verify a manual valve in an operating system is <u>closed</u>, the operator should observe valve position indication and operate the valve handwheel in the...

A.  open direction at least one full rotation, then close the valve using normal force.

B.  open direction until system flow is observed, then close the valve using normal force.

C.  close direction using normal force and verify there is no substantial handwheel movement.

D.  close direction using normal force, then operate the valve handwheel an additional one-quarter turn in the close direction.

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P1901   (B1305)

Which one of the following is a disadvantage associated with using a gate valve, versus a globe valve, to throttle flow in a cooling water system?

A.  The tortuous flow path through a throttled gate valve body makes flow control difficult.

B.  A gate valve will experience stem leakage unless it is fully opened and backseated.

C.  The turbulent flow created by a throttled gate valve will cause erosion damage to the valve seat.

D.  A fully open gate valve will produce a greater system head loss than a fully open globe valve.

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P2004   (B1205)

After an adjustment of the packing gland on a valve that had a minor packing leak, the operator attempts to operate the valve but finds that the valve is stuck.  What is the most probable cause?

A.  The disk separated from the valve stem as a result of overtightening the packing gland.

B.  The operator placed the valve in the wrong position for adjusting the packing gland.

C.  The valve was overtorqued in the closed direction during the packing gland adjustment.

D.  The maintenance technician overtightened the packing gland, causing the stem to bind.

ANSWER:  D.

TOPIC:　　　　191001
KNOWLEDGE:　K1.08　[3.4/3.4]
QID:　　　　　P2103　(B203)

Which one of the following is <u>not</u> a generally accepted method for locally verifying that a valve is open?

A.  Observe local flow rate instrumentation.

B.  Check the local valve position indicator indicates "open."

C.  Turn the valve operator in the "close" direction and verify that some movement occurs.

D.  Attempt to turn the valve operator in the "open" direction and verify that no movement occurs.

ANSWER:  D.

TOPIC:　　　　191001
KNOWLEDGE:　K1.08　[3.4/3.4]
QID:　　　　　P2204　(B2605)

Gate valves generally are <u>not</u> used to throttle water flow because...

A.  rapid changes in flow direction through the valve cause a large unrecoverable system head loss.

B.  gate valves experience stem leakage unless they are fully open or fully closed.

C.  the turbulent flow created by a partially opened gate valve causes excessive seat and disk wear.

D.  Flow rate through a gate valve is <u>not</u> proportional to the differential pressure across the valve.

ANSWER:  C.

TOPIC:            191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P2304   (B2305)

When comparing globe valves to gate valves, globe valves...

A.  are less effective at throttling flow.

B.  are less effective as pressure regulating valves.

C.  produce a smaller pressure decrease when fully open.

D.  require less force to open against large differential pressures.

ANSWER:  D.

TOPIC:            191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:              P2404   (B905)

When comparing gate valves to globe valves, gate valves...

A.  are more effective at throttling flow.

B.  are more effective as pressure regulating valves.

C.  produce a larger pressure decrease when fully open.

D.  require more force to open against large differential pressures.

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P2504   (B2504)

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

A.  ball; ball

B.  ball; butterfly

C.  butterfly; ball

D.  butterfly; butterfly

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P2604   (B805)

A gate valve is generally a poor choice for throttling liquid flow because...

A.  the turbulent flow created by a partially opened gate valve can cause extensive damage to the valve.

B.  the tortuous path through a gate valve body can make flow control difficult.

C.  excessive stem leakage will occur unless the gate valve is kept fully open or fully closed.

D.  the head loss from a throttled gate valve causes an unacceptable reduction in system flow rate.

ANSWER:  A.

TOPIC:              191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:                  P2804   (B1604)

In a comparison between a typical gate valve and a typical globe valve in the same application with both valves fully open, the gate valve has a _____ pressure drop and is normally used in _____ flow applications.

A.  larger; throttling

B.  larger; on/off

C.  smaller; throttling

D.  smaller; on/off

ANSWER:  D.

TOPIC:              191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:                  P2903   (B2904)

In a comparison between ball valves and butterfly valves in the same liquid process system application, the valves that typically would allow more leakage when fully closed and under high differential pressure are _____ valves, and the valves that typically would cause the higher system pressure drop when fully open are _____ valves.

A.  ball; butterfly

B.  ball; ball

C.  butterfly; butterfly

D.  butterfly; ball

ANSWER:  C.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P3304   (B3304)

A typical motor-operated valve has been returned to service following a complete maintenance overhaul of the valve and actuator.  The valve was remotely opened and closed to verify operability. The measured valve stroke time in each direction was 15 seconds, which is 25% longer than normal.

Which one of the following could have caused the increased stroke time?

A.  The valve position limit switches were removed and were <u>not</u> reinstalled.

B.  The valve torque limit switches were misadjusted to open at half their normal setpoints.

C.  The valve was packed with improved packing material having a lower friction coefficient.

D.  The valve stem packing gland was overtightened after the packing material was replaced.

ANSWER:  D.

TOPIC:          191001
KNOWLEDGE:   K1.08   [3.4/3.4]
QID:            P3804   (B3804)

In a comparison between ball valves and butterfly valves in the same liquid process system application, the valves that typically are more leak-tight when fully closed and under high differential pressure are _____ valves; and the valves that typically result in the higher system pressure drop when fully open are _____ valves.

A.  ball; butterfly

B.  ball; ball

C.  butterfly; butterfly

D.  butterfly; ball

ANSWER:  A.

TOPIC:          191001
KNOWLEDGE:   K1.11   [3.2/3.2]
QID:            P3804   ( B3804)

In a comparison between ball valves and butterfly valves in the same liquid process system application, the valves that typically are more leak-tight when fully closed and under high differential pressure are _____ valves; and the valves that typically result in the higher system pressure drop when fully open are _____ valves.

A.  ball; butterfly

B.  ball; ball

C.  butterfly; butterfly

D.  butterfly; ball

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:            P6      (B1806)

Density input is normally used in steam flow instruments to convert _____ into
_____.

A.  mass flow rate; volumetric flow rate

B.  volumetric flow rate; mass flow rate

C.  mass flow rate; differential pressure

D.  differential pressure; volumetric flow rate

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:            P305    (B2906)

If the steam pressure input to a density-compensated steam flow instrument fails high, the associated
flow rate indication will...

A.  decrease, because the density input has decreased.

B.  increase, because the density input has decreased.

C.  decrease, because the density input has increased.

D.  increase, because the density input has increased.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:             P406    (B1606)

The density compensating input to a steam flow instrument is used to convert volumetric flow rate to...

A.  velocity flow rate.

B.  gallons per minute.

C.  mass flow rate.

D.  differential flow rate.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:             P705    (B708)

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

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

A.  volumetric flow rate; mass flow rate

B.  volumetric flow rate; differential pressure

C.  differential pressure; mass flow rate

D.  differential pressure; volumetric flow rate

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:              P1212

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

A.  increase, because the density input has increased.

B.  decrease, because the density input has increased.

C.  increase, because the density input has decreased.

D.  decrease, because the density input has decreased.

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:              P2505   (B2506)

A main steam flow rate measuring instrument uses a steam pressure input to produce main steam flow rate indication in lbm/hr.  Assuming volumetric steam flow rate does <u>not</u> change, a steam pressure decrease will cause indicated steam flow rate to...

A.  decrease because the density of the main steam has decreased.

B.  increase because the specific volume of the main steam has increased.

C.  remain the same because steam pressure does <u>not</u> affect the mass flow rate of main steam.

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

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:            P3605   (B3608)

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

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

A.  volumetric flow rate; mass flow rate

B.  volumetric flow rate; differential pressure

C.  differential pressure; mass flow rate

D.  differential pressure; volumetric flow rate

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:            P4603   (B4604)

A main steam flow rate differential pressure detector was properly calibrated to produce a main steam flow rate indication of 500,000 lbm/hr with the following <u>initial</u> input conditions:

>    Detector high pressure input:      1,000 psia
>    Detector low pressure input:        950 psia

The <u>current</u> detector input conditions are as follows:

>    Detector high pressure input:      985 psia
>    Detector low pressure input:       935 psia

Assume that the detector and associated circuitry do <u>not</u> have steam density compensation.  Also assume that the main steam quality and volumetric flow rate do <u>not</u> change.

The <u>current</u> main steam flow rate indication is _____ 500,000 lbm/hr; and the <u>current</u> main steam flow rate is _____ 500,000 lbm/hr.

A.  equal to; greater than

B.  less than; greater than

C.  equal to; less than

D.  greater than; less than

ANSWER:  C.

TOPIC:              191002
KNOWLEDGE:   K1.02   [2.7/2.9]
QID:                   P4703   (B4704)

A nuclear power plant is initially operating with the following main steam parameter values:

   Main steam pressure:   1,000 psia
   Main steam flow rate:  500,000 lbm/hr

Main steam pressure decreases and stabilizes at 950 psia.

Assume 100% quality saturated steam and that main steam volumetric flow rate is the same before and after the pressure change.

Which one of the following is the approximate mass flow rate of main steam after the pressure change?

A.  528,000 lbm/hr

B.  500,000 lbm/hr

C.  472,000 lbm/hr

D.  444,000 lbm/hr

ANSWER:  C.

TOPIC:              191002
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:                   P206

The most probable cause for fluctuating indication from a liquid flow rate differential pressure detector is...

A.  gas or steam being trapped in the liquid.

B.  unequal temperature gradients in the liquid.

C.  vortexing of the liquid passing through the flow device.

D.  the valve on the high pressure sensing line being partially closed.

ANSWER:  A.

TOPIC:             191002
KNOWLEDGE:   K1.03   [2.7/2.9]
QID:                P905

A properly calibrated water flow detector is located several feet below a horizontal pipe containing the detector's sensing element.  The detector is removed for inspection and then reconnected to the sensing element with its low-pressure sensing line filled with air and its high-pressure sensing line filled with water.

If the water system is operating, indicated flow rate will be...

A.  zero.

B.  equal to actual flow rate but greater than zero.

C.  lower than actual flow rate.

D.  higher than actual flow rate.

ANSWER:  D.

TOPIC:             191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:                P8      (B607)

If the equalizing valve for a differential pressure flow detector is opened in an operating system, the associated flow indication will...

A.  increase by 50%.

B.  decrease by 50%.

C.  increase to maximum.

D.  decrease to minimum.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:  K1.04  [2.7/2.7]
QID:            P307    (B307)

Which one of the following will cause indicated volumetric flow rate to be <u>lower</u> than actual volumetric flow rate using a differential pressure flow detector that is connected to a calibrated orifice?

A.  System pressure decreases.

B.  The orifice erodes over time.

C.  Debris becomes lodged in the orifice.

D.  A leak develops in the low pressure sensing line.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:  K1.04  [2.7/2.7]
QID:            P706    (B707)

Flow rate is being measured using a differential pressure flow detector and a calibrated orifice.  If actual flow rate remains constant, which one of the following will cause indicated flow rate to be higher than actual flow rate?

A.  The flow detector equalizing valve is inadvertently opened.

B.  A leak develops in the high pressure sensing line.

C.  Debris becomes lodged in the orifice.

D.  The orifice erodes over time.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:            P1007   (B1907)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line A develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

A.  increase; larger

B.  increase; smaller

C.  decrease; larger

D.  decrease; smaller

ANSWER:  D.



PIPE ELBOW - TOP VIEW
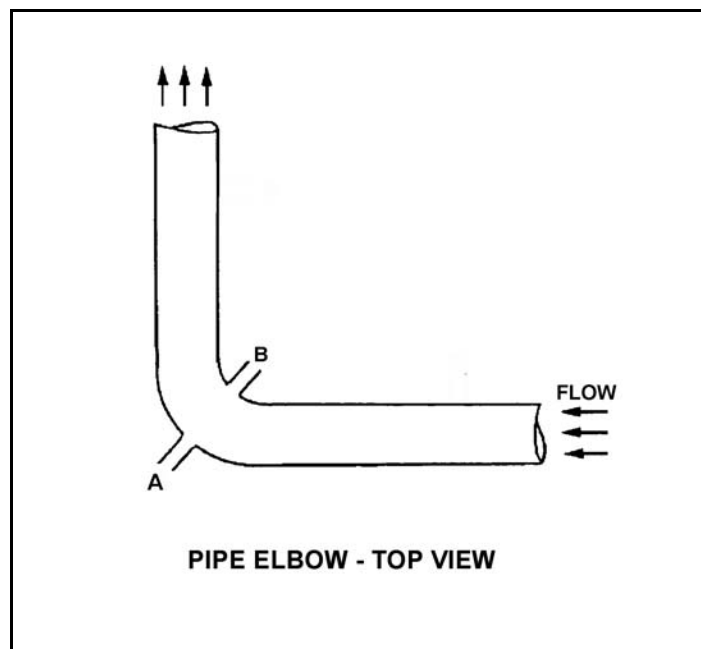
TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:             P1205   (B1506)

If the orifice in a differential pressure (D/P) flow sensor erodes such that the orifice opening becomes larger, indicated flow rate will _____ due to a _____ D/P across the orifice.

A.  increase; larger

B.  increase; smaller

C.  decrease; larger

D.  decrease; smaller

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:            P1608   (B1608)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

| DETECTOR | TAPS |
|---|---|
| X | A and D |
| Y | B and D |
| Z | C and D |

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap D ruptures?

A.  All detectors will fail low.

B.  All detectors will fail high.

C.  Two detectors will fail low and one will fail high.

D.  Two detectors will fail high and one will fail low.

ANSWER:  A.



PIPE ELBOW - TOP VIEW
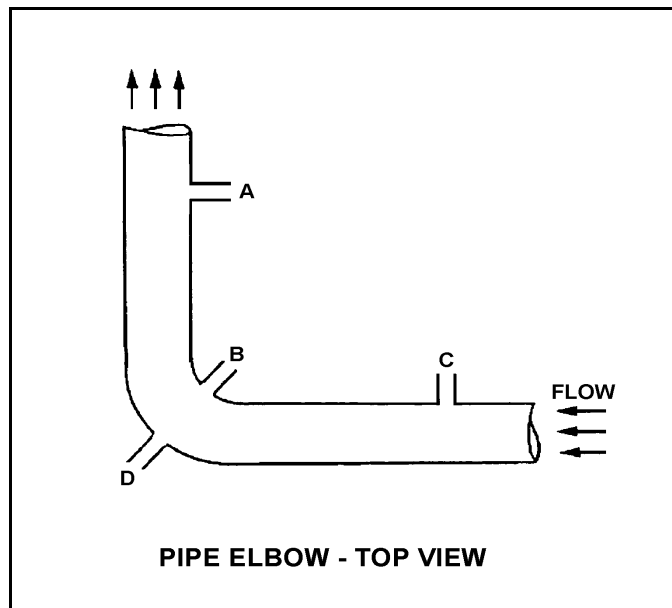
TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:             P2107   (B2209)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line B develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

A.  increase; larger

B.  increase; smaller

C.  decrease; larger

D.  decrease; smaller

ANSWER:  A.



PIPE ELBOW - TOP VIEW
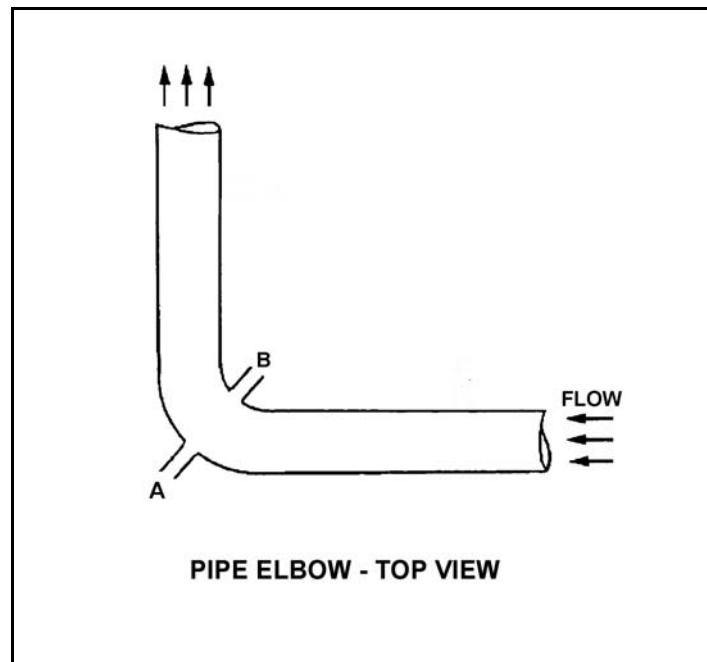
TOPIC:            191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:               P2305   (B2310)

An orifice is being used in an operating cooling water system to measure flow rate.  Which one of the following will cause the differential pressure sensed across the orifice to decrease?

A.  System pressure decreases.

B.  System flow rate decreases.

C.  Debris becomes lodged in the orifice.

D.  A leak develops in the low pressure sensing line.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:              P2307   (B2307)

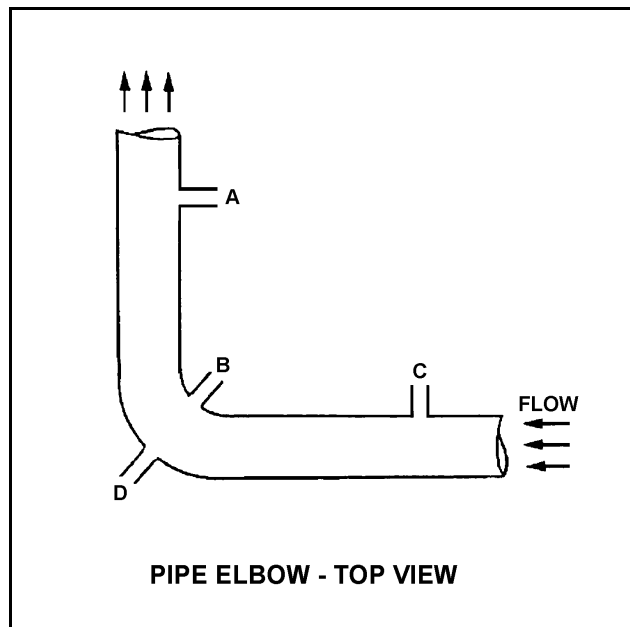Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

| DETECTOR | TAPS |
|----------|------|
| X | A and D |
| Y | B and D |
| Z | C and D |

Assume that water is incompressible and there is no head loss in this section of pipe.  How will the detectors be affected if system flow rate remains the same while system pressure increases from 1000 psig to 1200 psig?

A.  All detectors will indicate higher flow.

B.  Only two detectors will indicate higher flow.

C.  Only one detector will indicate higher flow.

D.  Detector indication will not change.

ANSWER:  D.



PIPE ELBOW - TOP VIEW

TOPIC:          191002
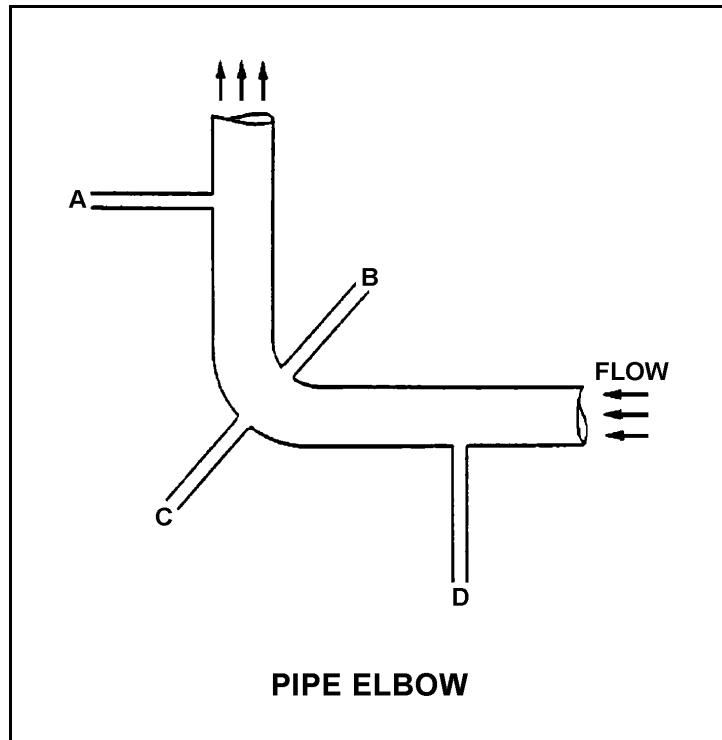KNOWLEDGE:   K1.04   [2.7/2.7]
QID:            P2807  (B1007)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following locations is the <u>highest</u> pressure sensed?  (Assume a constant pipe diameter and <u>zero</u> head loss in this section of pipe.)

A.  Point A

B.  Point B

C.  Point C

D.  Point D

ANSWER:  C.

PIPE ELBOW

TOPIC:          191002
KNOWLEDGE:   K1.04   [2.7/2.7]
QID:            P2905   (B3108)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows-type differential pressure flow detectors are connected to taps A, B, C, and D as follows:

|   DETECTOR   |   TAPS   |
|--------------|----------|
| X            | A and D  |
| Y            | B and D  |
| Z            | C and D  |

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap B experiences a significant leak?  (Assume water system pressure does <u>not</u> change.)

A.  All detectors will fail low.

B.  All detectors will fail high.

C.  Only one detector will fail, and it will fail low.

D.  Only one detector will fail, and it will fail high.

ANSWER:  D.



**PIPE ELBOW - TOP VIEW**
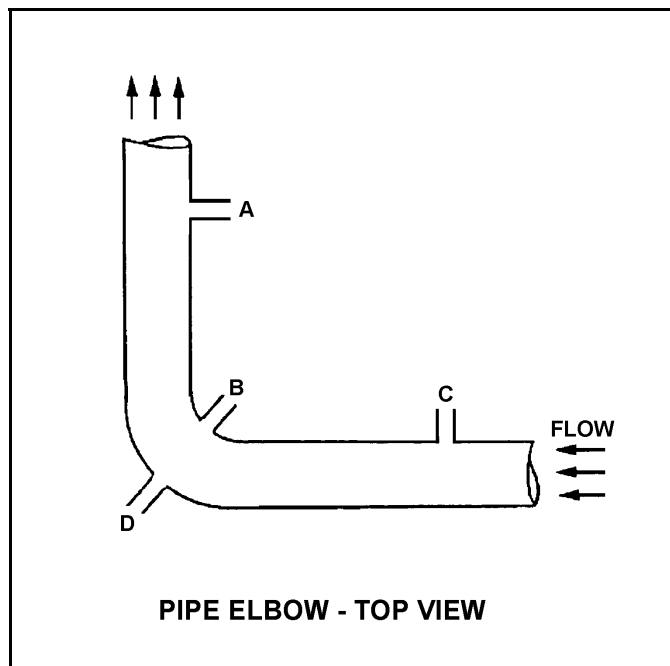
TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P9

Flow detectors (such as an orifice, flow nozzle, and venturi tube) measure flow rate using the principle that flow rate is...

A.  directly proportional to the differential pressure (D/P) squared.

B.  inversely proportional to the D/P squared.

C.  directly proportional to the square root of the D/P.

D.  inversely proportional to the square root of the D/P.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P308    (B305)

A cooling water system is operating at steady-state conditions indicating 900 gpm with 60 psid across the flow transmitter venturi.  If cooling water flow rate is increased to 1800 gpm, flow transmitter venturi delta-P will be approximately...

A.  85 psid.

B.  120 psid.

C.  175 psid.

D.  240 psid.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P607    (B608)

The flow rate of a fluid passing through a venturi can be determined by measuring the:

A.  change in the pressure of the fluid as it passes through the venturi.

B.  change in the density of the fluid as it passes through the venturi.

C.  linear displacement of a metering plug installed in the throat of the venturi.

D.  rotation of a paddle wheel type device installed in the throat of the venturi.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P707    (B706)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi.  If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be approximately...

A.   85.7 psid.

B.  122.4 psid.

C.  171.4 psid.

D.  244.8 psid.

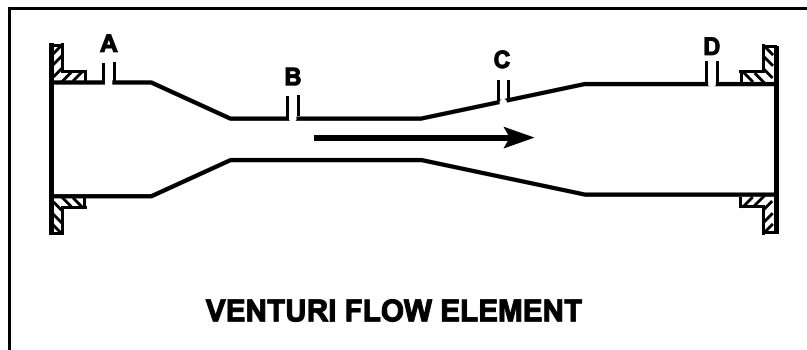ANSWER:  B.

TOPIC:           191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P807    (B807)

Refer to the drawing of a venturi flow element (see figure below) with direction of fluid flow indicated by the arrow.

Where should the high pressure tap of a differential pressure flow detector be connected?

A.  Point A

B.  Point B

C.  Point C

D.  Point D

ANSWER:  A.



VENTURI FLOW ELEMENT

TOPIC:           191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P907    (B1905)

A differential (D/P) detector is being used to measure main steam flow rate.  At a steam flow rate of
5 x 10$^6$ lbm/hr measured D/P is 40 psid.

If steam flow changes such that current D/P is 30 psid, what is the approximate current steam flow
rate?

A.  2.1 x 10$^6$ lbm/hr

B.  3.5 x 10$^6$ lbm/hr

C.  3.7 x 10$^6$ lbm/hr

D.  4.3 x 10$^6$ lbm/hr

ANSWER:  D.

TOPIC:           191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P908    (B2106)

Which one of the following flow measuring elements produces the largest unrecoverable head loss
when used in an operating fluid system?

A.  Venturi

B.  Flow nozzle

C.  Pipe elbow

D.  Orifice

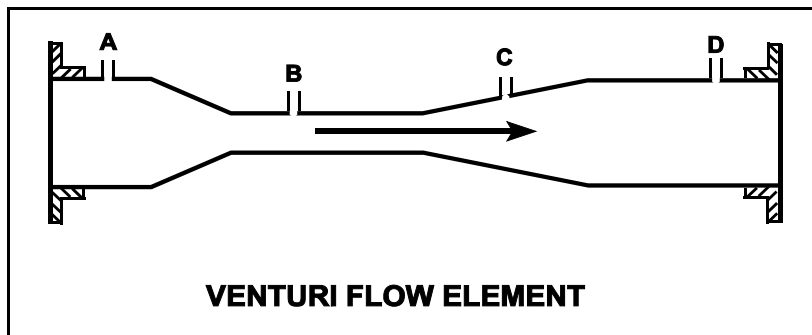ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P1106   B3306)

Refer to the drawing of a venturi flow element in an operating cooling water system (see figure below).

At what point does the lowest pressure exist?

A.  Point A

B.  Point B

C.  Point C

D.  Point D

ANSWER:  B.



**VENTURI FLOW ELEMENT**

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
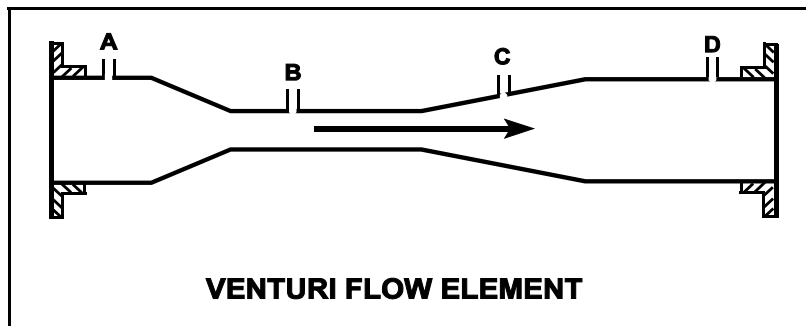QID: P1308 (B907)

Refer to the drawing of a venturi flow element for an operating cooling water system (see figure below).

The greatest differential pressure (D/P) will be sensed by a D/P flow detector if the low pressure sensing line is connected at _____ and the high pressure sensing line is connected at _____.

A. B; A

B. B; C

C. D; A

D. D; C

ANSWER: A.



**VENTURI FLOW ELEMENT**

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P1407

A cooling water system is operating at a steady-state flow rate of 500 gpm with 60 psid across the flow transmitter venturi.  If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be approximately...

A.   85 psid.

B.  120 psid.

C.  240 psid.

D.  480 psid.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P1606   (B407)

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

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

A.  remained the same; remained the same

B.  remained the same; decreased slightly

C.  decreased slightly; remained the same

D.  decreased slightly; decreased slightly

ANSWER:  C.
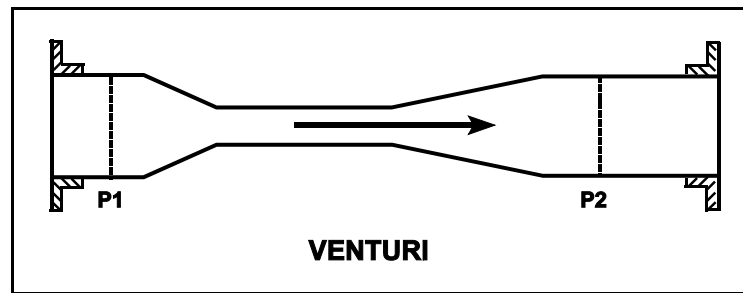


**VENTURI**

TOPIC:           191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P1808

Subcooled water is flowing through a venturi flow element.  When the water reaches the throat of the venturi, the _____ water pressure and the _____ water velocity occurs.

A.  highest; highest

B.  lowest; lowest

C.  lowest; highest

D.  highest; lowest

ANSWER:  C.

TOPIC:           191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P1873   (B1773)

Subcooled water is flowing through each of the following devices.  Which one of the devices will produce an outlet pressure that is greater than the inlet pressure?

A.  Convergent nozzle

B.  Divergent nozzle

C.  Orifice

D.  Flow restrictor

ANSWER:  B.

TOPIC:              191002
KNOWLEDGE:   K1.05   [2.6/2.8]
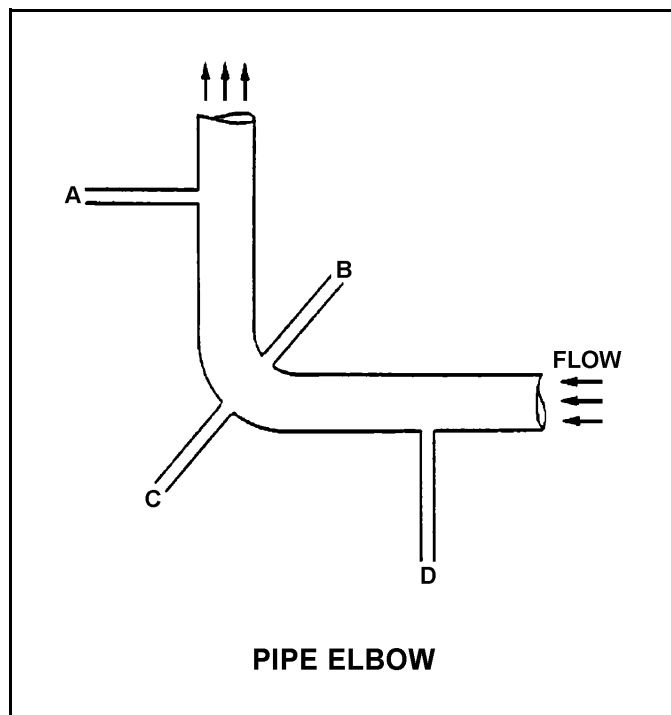QID:                  P1906   (B1408)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following pairs of connection points will the <u>greatest</u> differential pressure be sensed?  (Assume ideal fluid flow conditions.)

A.  Points A and B

B.  Points B and C

C.  Points C and D

D.  Points D and A

ANSWER:  B.



**PIPE ELBOW**

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P2306  (B2306)

A venturi is used to measure flow rate in a cooling water system.  As the water flows from the throat to the discharge of the venturi, water pressure will _____ and volumetric flow rate will _____.  (Assume water is incompressible.)

A.  increase; remain the same

B.  increase; increase

C.  decrease; remain the same

D.  decrease; decrease

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P2406  (B2206)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across a flow transmitter venturi.  If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A.  68 psid.

B.  77 psid.

C.  99 psid.

D.  127 psid.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:  K1.05   [2.6/2.8]
QID:            P2506   (B2606)

A venturi is being used to measure flow rate in a cooling water system.  As the cooling water flows from the inlet to the throat of the venturi, water pressure will _____ and volumetric flow rate will _____.  (Assume water is incompressible.)

A.  increase; remain the same

B.  increase; increase

C.  decrease; remain the same

D.  decrease; increase

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:  K1.05   [2.6/2.8]
QID:            P2507   (B2508)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe.  When the flow detector was last calibrated, the following parameters were observed:

   Upstream Pressure:     125 psig   Actual Flow Rate:     100 gpm
   Downstream Pressure: 116 psig   Indicated Flow Rate:  100 gpm

Significant erosion of the orifice has occurred since the calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 110 psig and 106 psig respectively.

What is the approximate flow rate that is currently indicated?

A.  44 gpm

B.  67 gpm

C.  81 gpm

D.  120 gpm

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P2606

A cooling water system is operating at steady-state conditions at 900 gpm with 64 psid across the flow transmitter venturi.  Cooling water flow rate changes such that venturi differential pressure decreases to 36 psid.

Which one of the following is the new system flow rate?

A.  506 gpm

B.  576 gpm

C.  675 gpm

D.  745 gpm

ANSWER:  C.

TOPIC:  191002
KNOWLEDGE:  K1.05   [2.6/2.8]
QID:  P2808   (B2806)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe.  When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure:  135 psig
Downstream Pressure: 120 psig

Actual Flow Rate:  100 gpm
Indicated Flow Rate:  100 gpm

Significant erosion of the orifice plate opening has occurred since the last calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 124 psig and 109 psig respectively.

What is the approximate currently indicated flow rate?

A.  44 gpm

B.  67 gpm

C.  100 gpm

D.  120 gpm

ANSWER:  C.

TOPIC:            191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P3207   (B3206)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water 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 <u>no</u> 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

ANSWER:  A.

TOPIC:            191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:              P3306   (B2010)

A cooling water system is operating at steady-state conditions.  A calibrated system flow meter indicates 600 gpm with 50 psid across the flow transmitter venturi.

If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A.  63 psid.

B.  75 psid.

C.  97 psid.

D.  112 psid.

ANSWER:  D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P3706 (B3706)

The following is the current calibration data for an orifice plate that is being used for water flow rate measurement:

Upstream Pressure: 135 psig
Downstream Pressure: 120 psig
Flow Rate: 100 gpm

During a surveillance the following pressures are observed across the orifice plate:

Upstream Pressure: 124 psig
Downstream Pressure: 117 psig

What is the approximate water flow rate through the orifice plate?

A. 47 gpm

B. 57 gpm

C. 68 gpm

D. 78 gpm

ANSWER: C.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P3807   (B3807)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow.  The manometer is currently indicating a water level difference of 16 inches at an air flow rate of 300 ft$^3$/min.

Which one of the following will be the approximate rate of air flow when the manometer indicates a water level difference of 4 inches?

A.  75 ft$^3$/min.

B.  125 ft$^3$/min.

C.  150 ft$^3$/min.

D.  175 ft$^3$/min.

ANSWER:  C.



DIFFERENTIAL PRESSURE MANOMETER
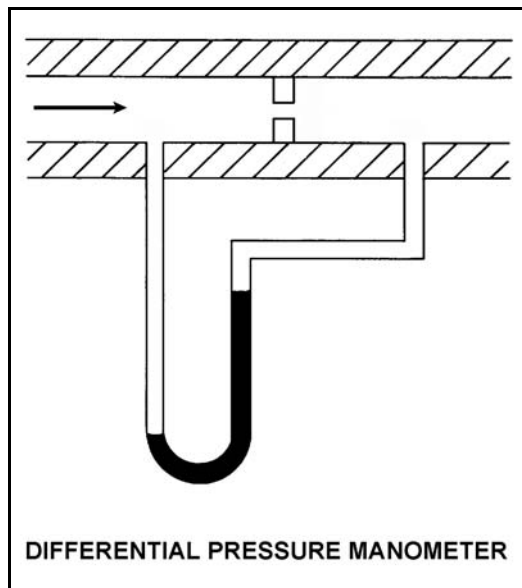
TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:            P4003   (B4005)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe.  When the flow instrument was last calibrated, the following parameters were observed:

| | | | |
|---|---|---|---|
| Upstream Pressure: | 125 psig | Actual Flow Rate: | 100 gpm |
| Downstream Pressure: | 116 psig | Indicated Flow Rate: | 100 gpm |

Since the calibration, debris has collected in the orifice such that the actual flow rate through the orifice has decreased to 80 gpm while the upstream and downstream pressures have changed to 135 psig and 110 psig, respectively.

What is the approximate flow rate that is currently indicated by the flow instrument?

A.  125 gpm

B.  133 gpm

C.  156 gpm

D.  167 gpm

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.05   [2.6/2.8]
QID:             P4604   (B4605)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow.  The manometer is currently indicating a water level difference of 8 inches at an air flow rate of 300 cubic feet per minute ($ft^3$/min).

Which one of the following will be the approximate air flow rate when the manometer indicates a water level difference of 4 inches?

A.  75 $ft^3$/min

B.  150 $ft^3$/min

C.  188 $ft^3$/min

D.  212 $ft^3$/min

ANSWER:  D.



DIFFERENTIAL PRESSURE MANOMETER
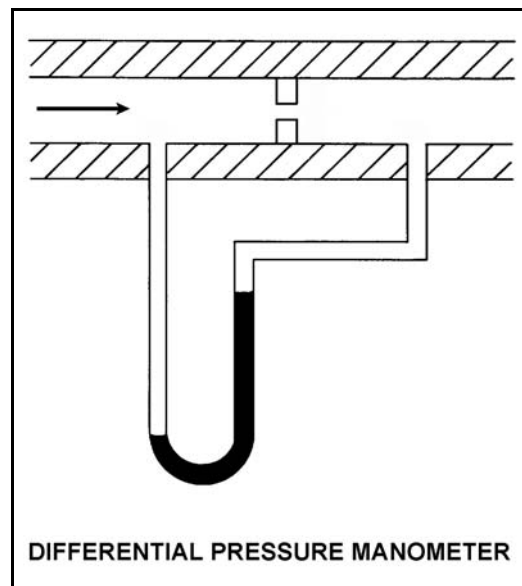
TOPIC:                191002
KNOWLEDGE:    K1.05    [2.6/2.8]
QID:                    P4804   (B4804)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water flow rate indication. Water enters and leaves the venturi at 70°F, 100 psig and 24 ft/sec.  Water velocity at the throat of the venturi is 50 ft/sec.  Assume water is incompressible and the venturi experiences <u>no</u> unrecoverable head loss.

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

A.  98 psig

B.  94 psig

C.  87 psig

D.  74 psig

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P208    (B909)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The associated level instrument was calibrated with the water in the storage tank at 100°F.  If mass in the tank remains constant and the water temperature increases to 120°F, the <u>indicated</u> level will...

A.  increase in direct proportion to the temperature rise.

B.  increase but remain less than actual level.

C.  decrease in direct proportion to the temperature rise.

D.  remain the same although actual level increases.

ANSWER:  D.



TANK OPEN
TO ATMOSPHERE

WATER

D/P
DETECTOR

**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P411

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

With the nuclear power plant at normal operating conditions, a pressurizer level D/P instrument, that had been calibrated while the plant was in a cold condition, would indicate _____ than actual level because of a _____ D/P sensed by the D/P detector at normal operating conditions.

A.  higher; smaller

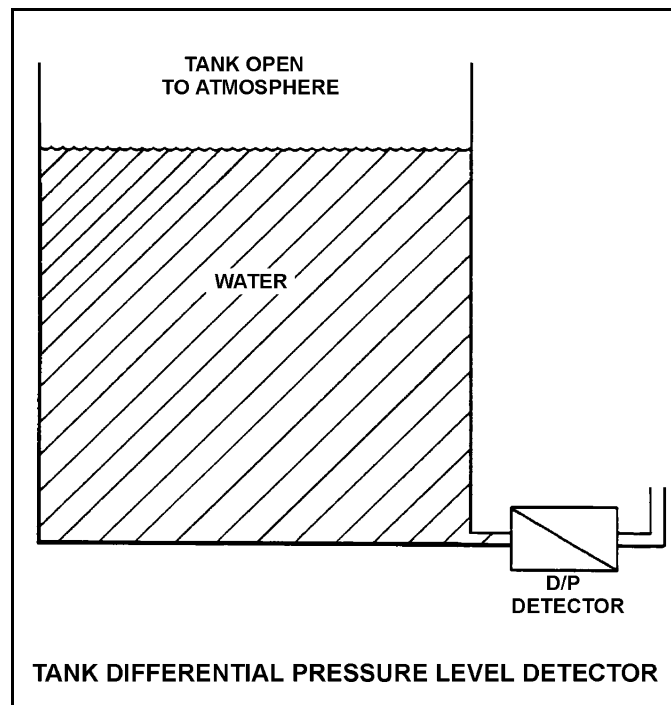B.  higher; larger

C.  lower; smaller

D.  lower; larger

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:             P507

Refer to the drawing of a tank differential pressure level detector that was recently calibrated at a tank water temperature of 80°F (see figure below).

If the mass of the water in the tank remains the same while the tank water temperature is raised from 80°F to 150°F, the <u>indicated</u> level will...

A.  remain equal to actual level.

B.  increase due to the expansion of the water.

C.  remain the same.

D.  decrease due to the expansion of the water.

ANSWER:  C.



TANK OPEN
TO ATMOSPHERE

WATER

D/P
DETECTOR
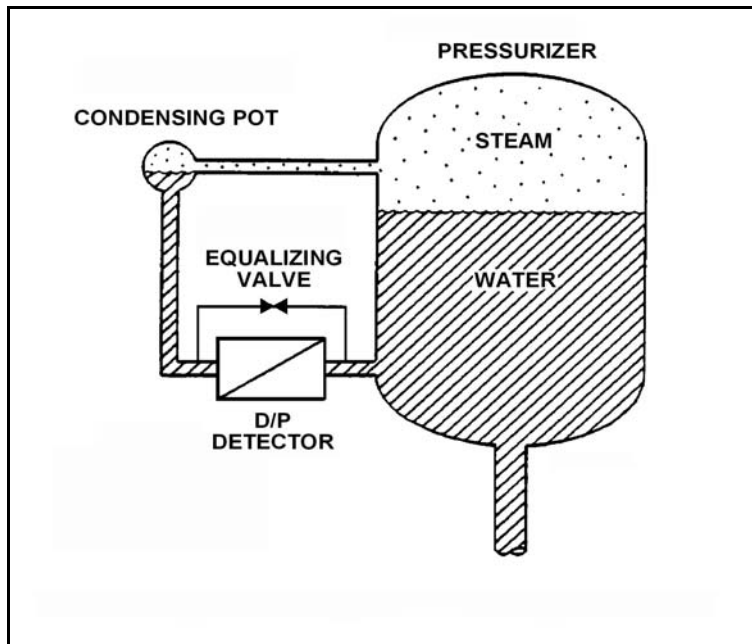
TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR
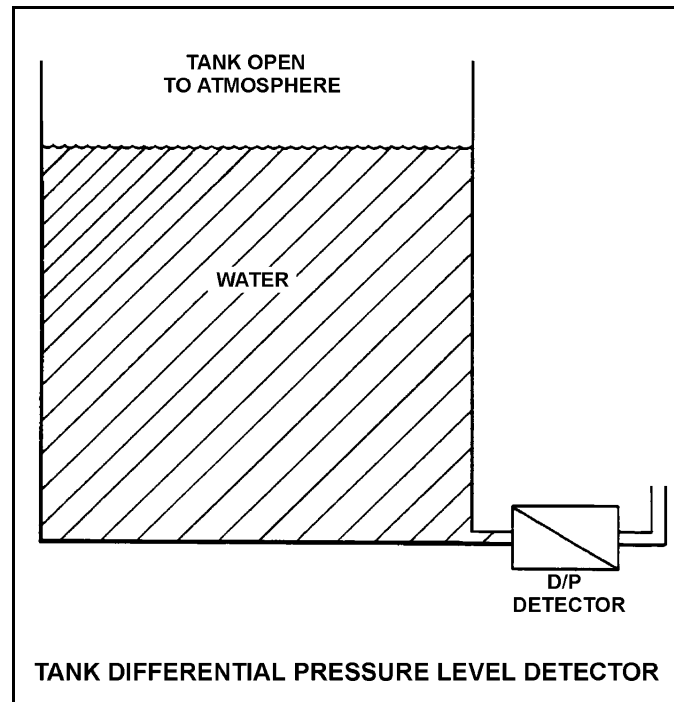
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P608

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

Two D/P level indicators are installed on a large water storage tank.  Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which one will indicate the higher level?

A.  Indicator 1 at all water temperatures

B.  Indicator 2 at all water temperatures

C.  Indicator 1 below 150°F, indicator 2 above 150°F

D.  Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER:  B.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P808    (B809)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The D/P level detector is being used in a level control system that is calibrated to maintain tank level at 80% at the current tank temperature of 100°F.  If tank temperature gradually increases and stabilizes at 150°F, <u>actual</u> tank level will...

A.  remain at 80%.

B.  increase and stabilize above 80%.

C.  oscillate around 80%.

D.  decrease and stabilize below 80%.

ANSWER:  B.

TANK OPEN
TO ATMOSPHERE

WATER

D/P
DETECTOR

**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**

TOPIC:         191002
KNOWLEDGE:   K1.06   [2.5/2.6]
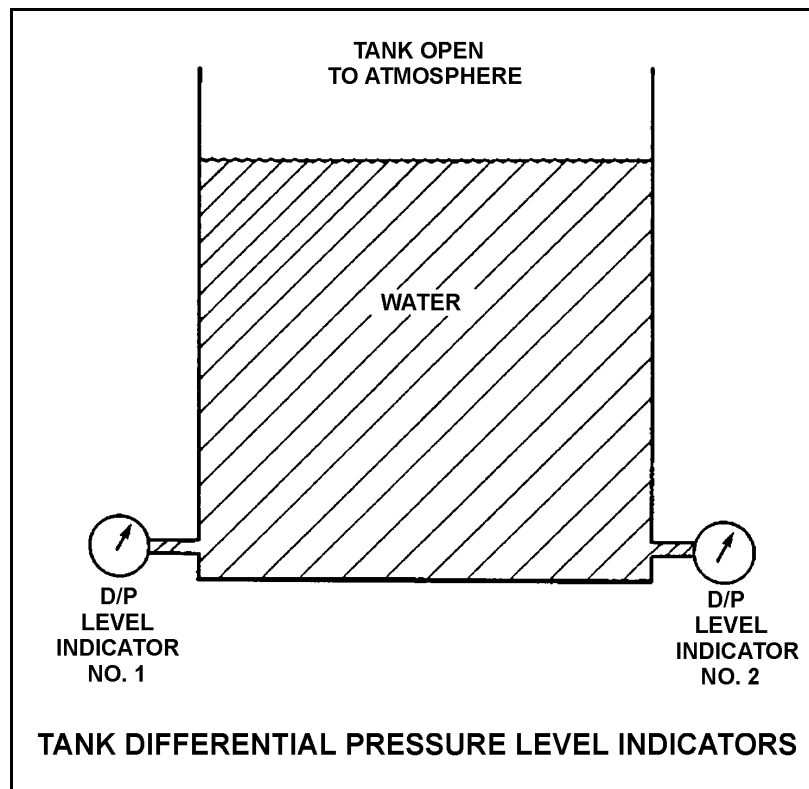QID:            P1107   (B1507)

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

Two D/P level indicators are installed on a large water storage tank.  Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

A.  Indicator 1 at all water temperatures

B.  Indicator 2 at all water temperatures

C.  Indicator 1 below 150°F, indicator 2 above 150°F

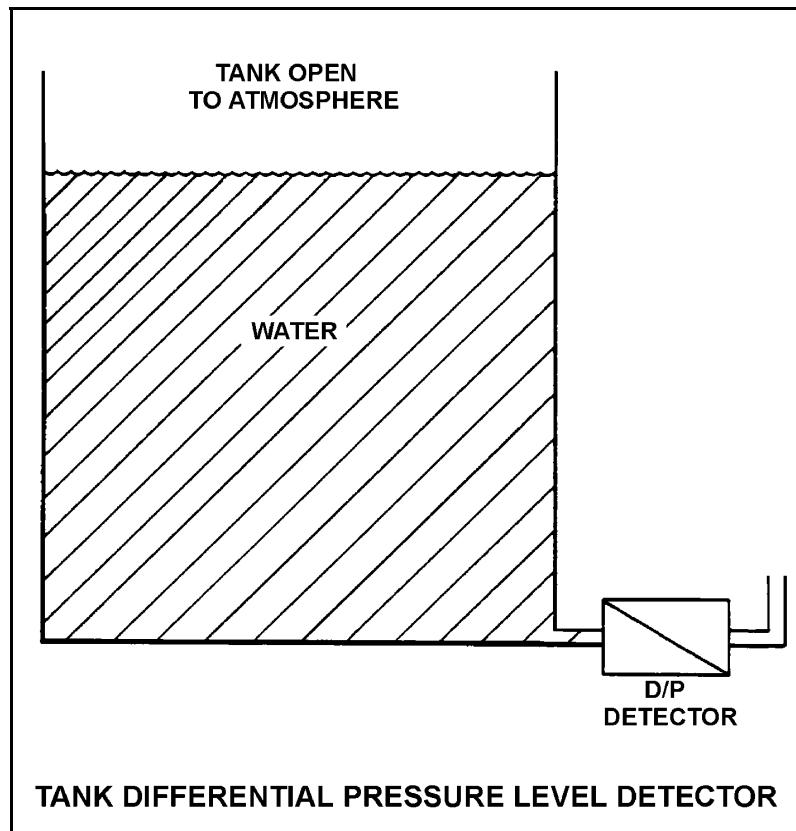D.  Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER:  A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS
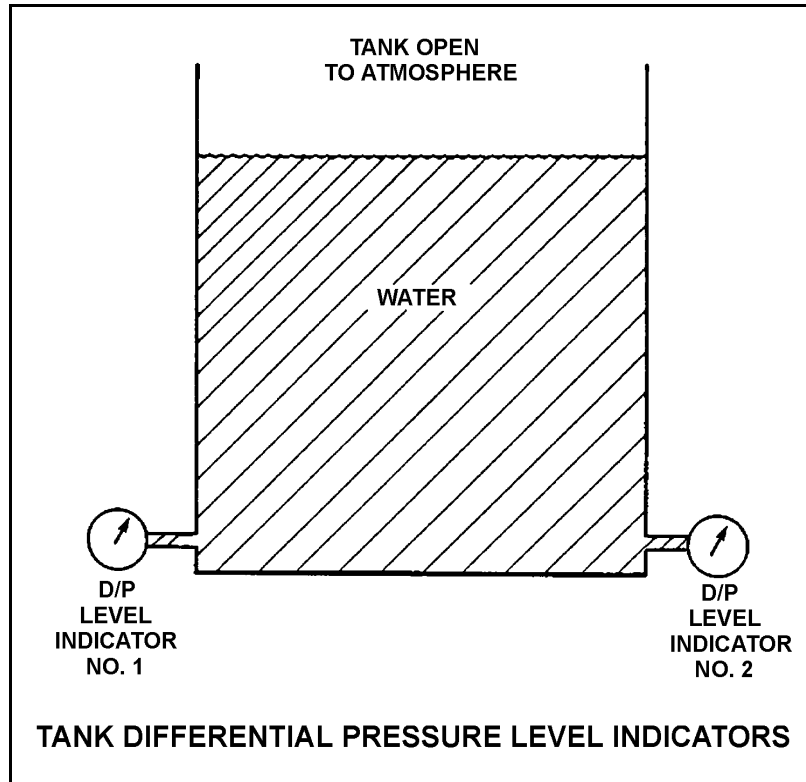
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:             P1706   (B1706)

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

Two D/P level indicators are installed on a large water storage tank.  Indicator No. 1 was calibrated at 200°F water temperature and indicator No. 2 was calibrated at 100°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

A.  Indicator 1 at all water temperatures

B.  Indicator 2 at all water temperatures

C.  Indicator 1 below 150°F, indicator 2 above 150°F

D.  Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER:  B.



TANK OPEN
TO ATMOSPHERE

WATER

D/P
LEVEL
INDICATOR
NO. 1

D/P
LEVEL
INDICATOR
NO. 2

**TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS**
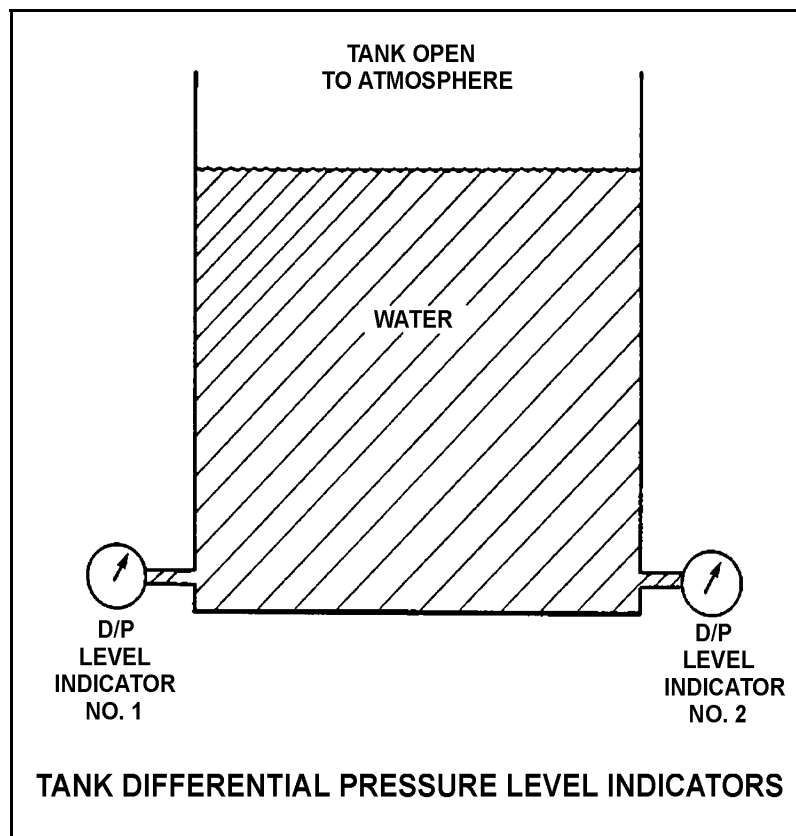
TOPIC:         191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P1907

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 120°F and indicator 2 was calibrated at 180°F.  If tank water temperature is 150°F, then indicator...

A.  1 will read greater than indicator 2 and greater than actual level.

B.  1 will read greater than indicator 2 and less than actual level.

C.  2 will read greater than indicator 1 and greater than actual level.

D.  2 will read greater than indicator 1 and less than actual level.

ANSWER:  C.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS
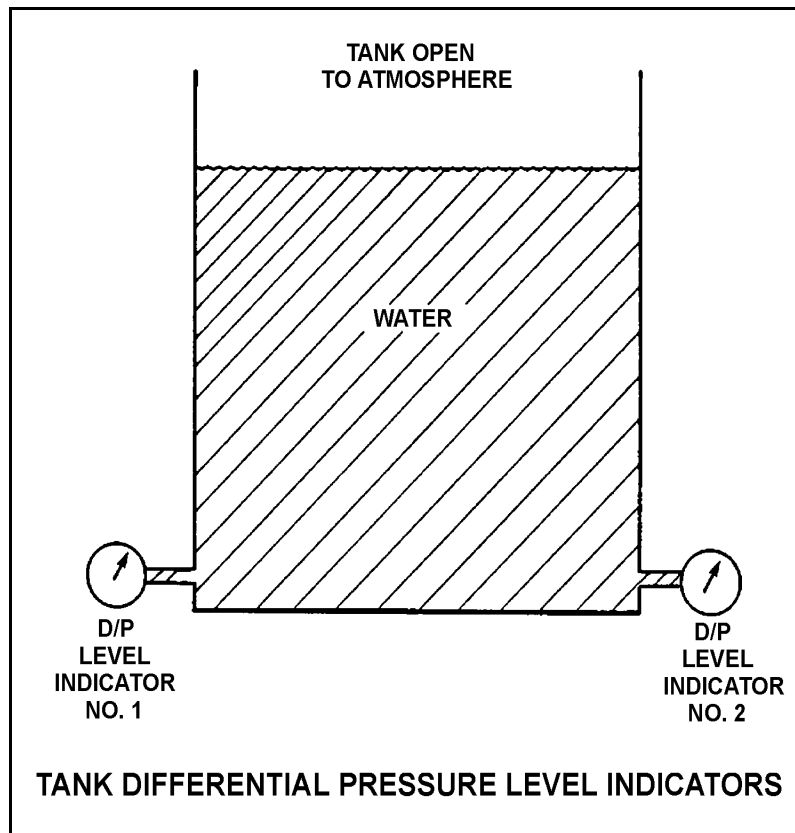
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P2108   (B2408)

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 180°F and indicator 2 was calibrated at 120°F.  If current tank water temperature is 150°F, then indicator...

A.  1 will read greater than indicator 2 and greater than actual water level.

B.  1 will read greater than indicator 2 and less than actual water level.

C.  2 will read greater than indicator 1 and greater than actual water level.

D.  2 will read greater than indicator 1 and less than actual water level.

ANSWER:  A.

TANK OPEN
TO ATMOSPHERE

WATER

D/P
LEVEL
INDICATOR
NO. 1

D/P
LEVEL
INDICATOR
NO. 2

TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS
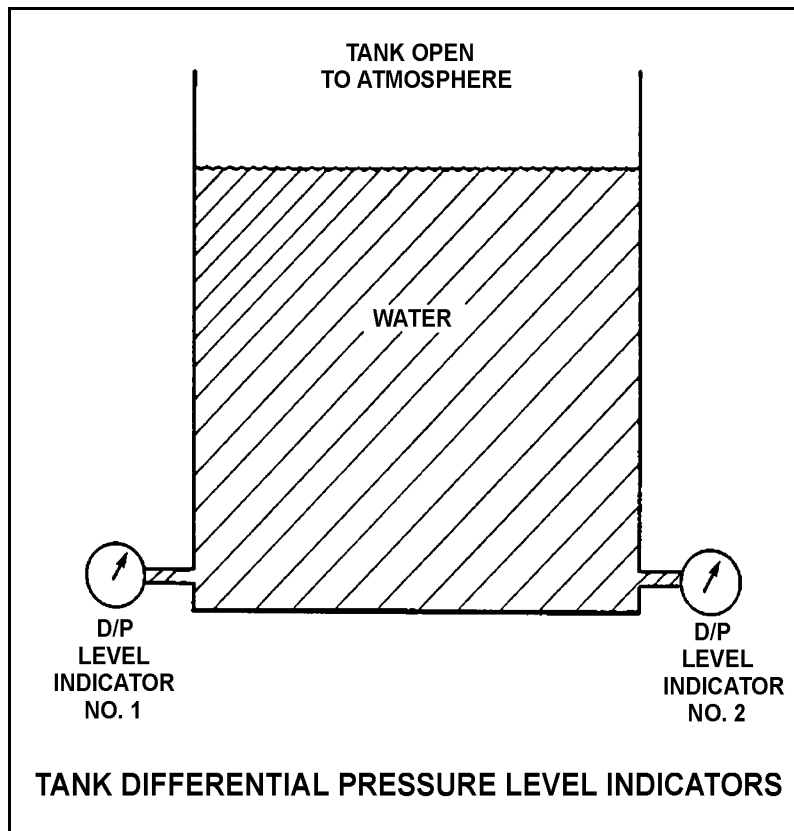
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P2308   (B2308)

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

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

A.  lower; reference leg

B.  lower; steam generator

C.  higher; reference leg

D.  higher; steam generator

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:             P2509

Refer to the drawing of a steam generator (S/G) differential pressure (D/P) level detection system (see figure below) that has been calibrated at the current S/G pressure of 400 psia.

A reactor coolant system heatup has resulted in an increase in S/G pressure from 400 psia to 900 psia over 4 hours.  The ambient air temperature surrounding the S/G has remained constant.

Without density compensation of the level instrumentation, at the end of the heatup S/G level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

A.  higher; steam generator

B.  higher; reference leg

C.  lower; steam generator

D.  lower; reference leg

ANSWER:  C.
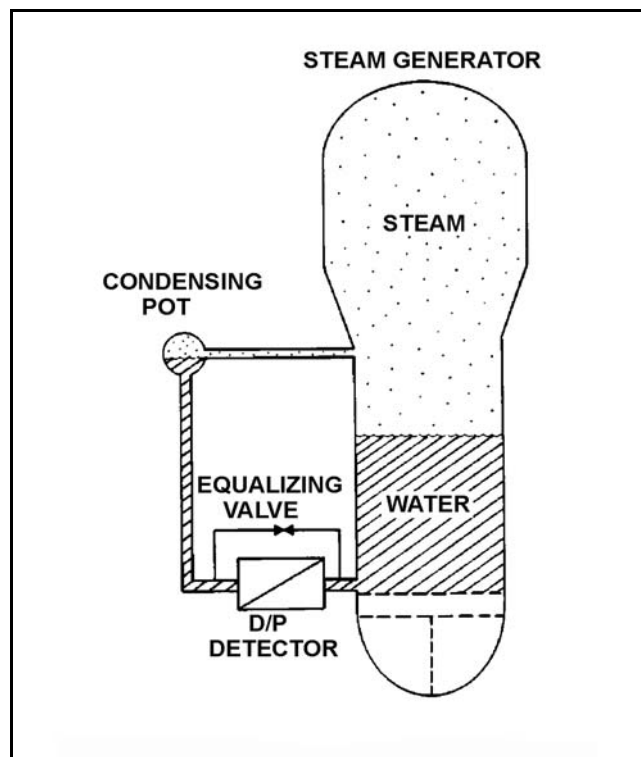
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P3208

A nuclear reactor is currently shut down at 140°F and 150 psig.  Pressurizer level is being monitored using a normal at-power pressurizer level instrument that was calibrated at normal plant operating conditions.

The pressurizer level instrument indicates _____ than actual pressurizer level because, compared to the calibration conditions, there has been a significant change in the density of the fluid in the _____.

A.  lower; reference leg

B.  lower; pressurizer

C.  higher; reference leg

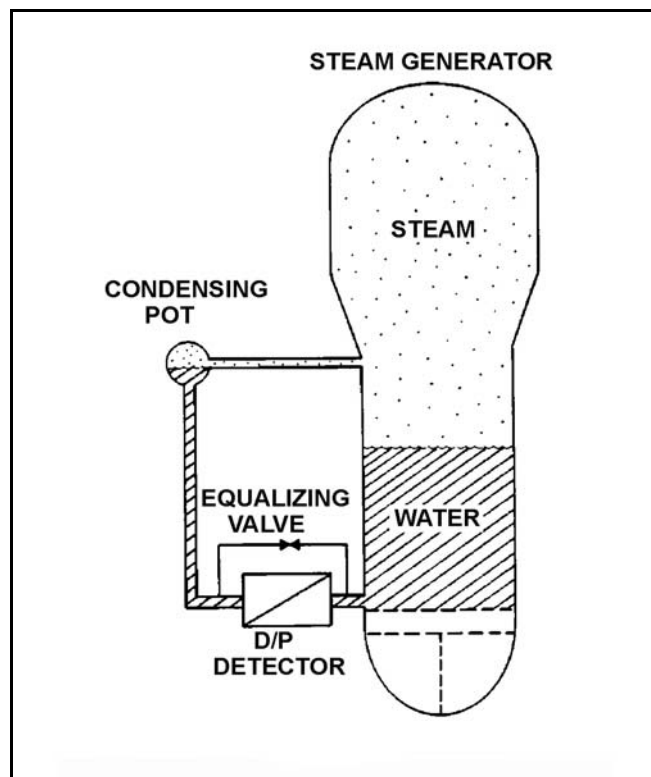D.  higher; pressurizer

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:              P4104

Refer to the drawing of a pressurizer and differential pressure (D/P) level detection system that was recently calibrated at normal operating conditions (see figure below).  Assume that the associated pressurizer level instrument does <u>not</u> use density compensation.

With the nuclear power plant shut down at reduced reactor coolant system temperature and pressure, the pressurizer level instrument will indicate _____ than actual water level because the D/P currently sensed by the D/P detector is_____ than the D/P for the same pressurizer water level at normal operating conditions.

A.  lower; smaller

B.  lower; larger

C.  higher; smaller

D.  higher; larger

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P4204   (B4205)

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.

ANSWER:  C.



TANK OPEN
TO ATMOSPHERE

WATER

D/P
LEVEL
INDICATOR
NO. 1

D/P
LEVEL
INDICATOR
NO. 2

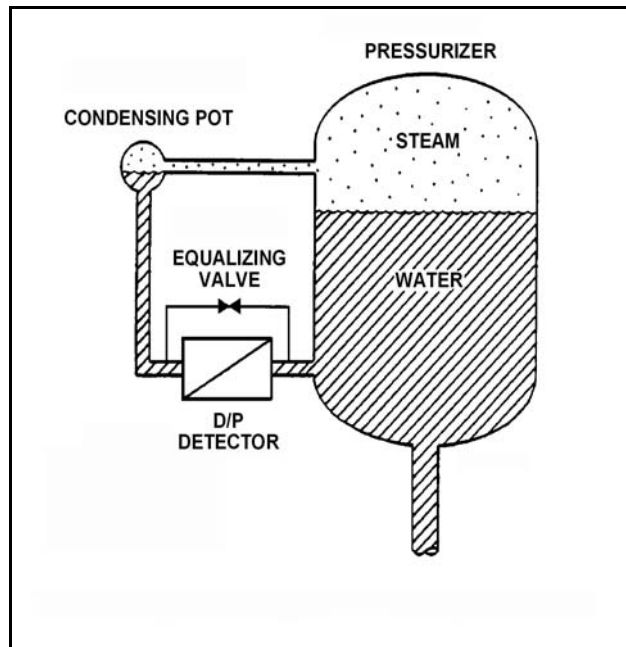**TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS**
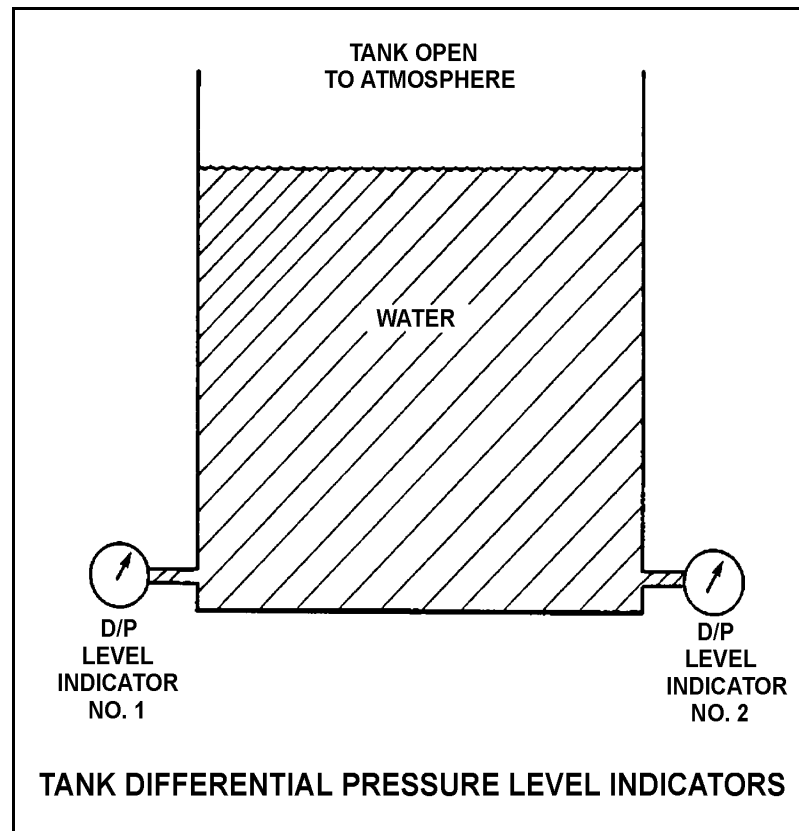
TOPIC:         191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:          P4404

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

The associated pressurizer level instrument was recently calibrated with the nuclear power plant at normal operating conditions.  Assume that the level instrument does not use density compensation.

If the plant is currently shut down at reduced reactor coolant system temperatures and pressure, pressurizer water level will currently indicate _____ than actual water level because, for a given pressurizer water level, the D/P sensed by the D/P detector is currently _____.

A.  higher; smaller

B.  higher; larger

C.  lower; smaller

D.  lower; larger

ANSWER:  A.
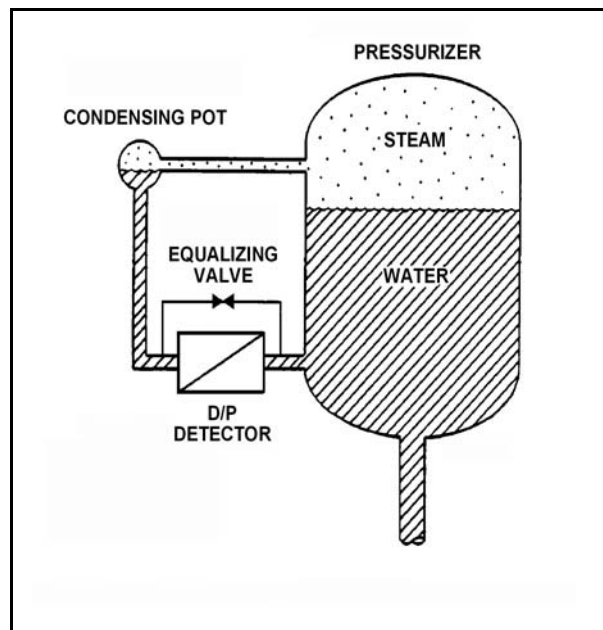
TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:             P4504

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.

 ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:            P5103
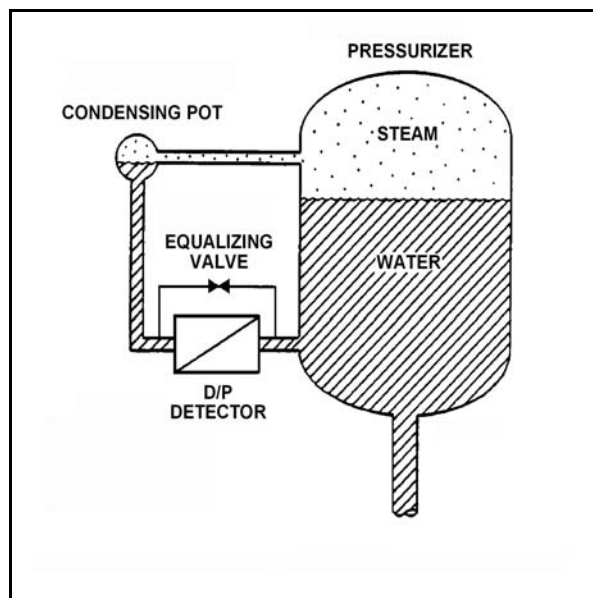
Refer to the drawing of a differential pressure (D/P) level detection system for a pressurizer at normal operating temperature and pressure (see figure below).

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 160°F?

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.

 ANSWER:  D.
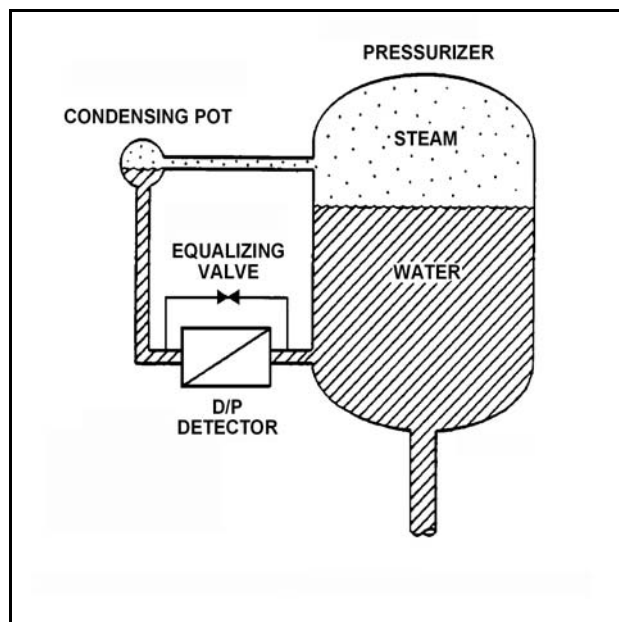
TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:            P410

Refer to the drawing of a tank differential pressure level detector (see figure below).

If the differential pressure detector equalizing valve is opened, level indication will:

A.  decrease and stabilize below actual level.

B.  increase and stabilize above actual level.

C.  oscillate above and below actual level.

D.  remain constant at the current level.

ANSWER:  B.

REFERENCE LEG
FILL CONNECTION                 VENT

EQUALIZING
VALVE

WATER

D/P
DETECTOR

TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR
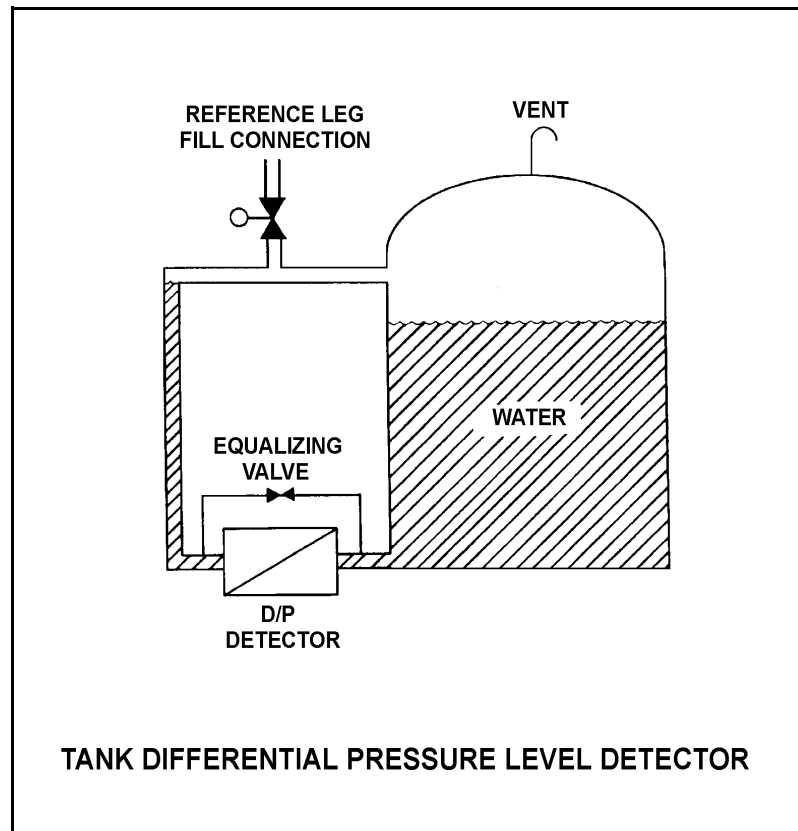
TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:             P708    (B2609)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75% at the current water temperature of 90°F.  If water temperature gradually increases and stabilizes at 120°F, the level control system will cause <u>actual</u> tank level to...

A.  remain at 75%.

B.  increase and stabilize above 75%.

C.  oscillate around 75%.

D.  decrease and stabilize below 75%.

ANSWER:  B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:             P910     (B910)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The D/P sensed by the detector varies in the _____ direction as the temperature of the water in the tank if the _____ of the tank water is constant.  (Assume reference leg and tank water temperatures are initially the same.)

A.  same; level

B.  inverse; level

C.  same; mass

D.  inverse; mass

ANSWER:  A.



**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**

TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:             P1008   (B1909)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75% at the current water temperature of 120°F.  If water temperature gradually decreases and stabilizes at 90°F, <u>actual</u> tank level will...

A.  remain at 75%.

B.  increase and stabilize above 75%.

C.  oscillate around 75%.

D.  decrease and stabilize below 75%.

ANSWER:  D.



**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**

TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:            P1807   (B1211)

A cooling water system is cooling a lube oil heat exchanger.  Cooling water system surge tank level is being measured using a differential pressure level detector that has been calibrated at the current water temperature in the tank.  A leak in the heat exchanger results in lube oil collecting in the surge tank.

Assuming that the temperature of the contents in the surge tank does not change, indicated tank level will be _____ than actual tank level because lube oil is _____ than water.

A.  higher; more dense

B.  higher; less dense

C.  lower; more dense

D.  lower; less dense

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:            P2009

Many steam generator water level instruments are designed with a condensing chamber in the reference leg.  The purpose of the condensing chamber is to...

A.  maintain a constant water level in the reference leg during normal operations.

B.  provide reference leg compensation for the steam generator pressure exerted on the variable leg.

C.  prevent reference leg flashing during a rapid depressurization of the steam generator.

D.  ensure the reference leg temperature remains close to the temperature of the variable leg.

ANSWER:  A.
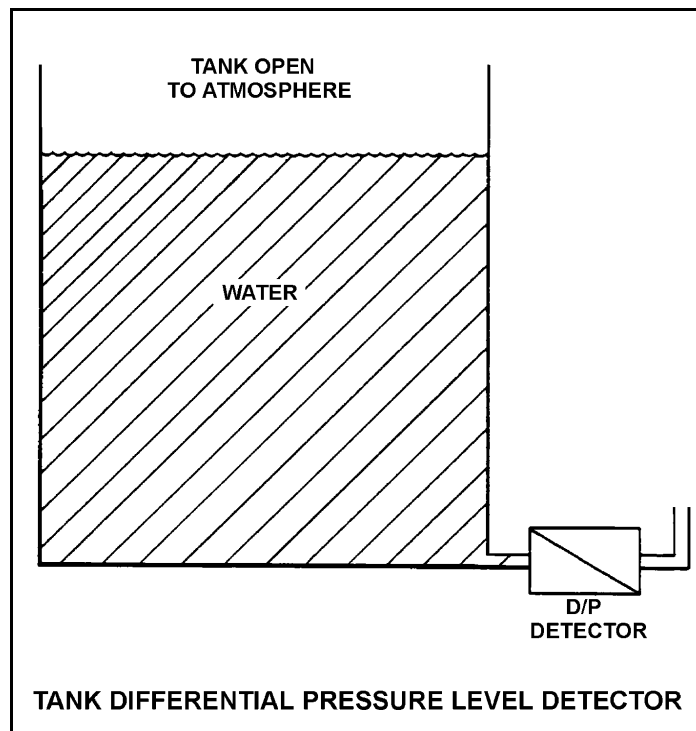
TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:            P3008   (B3010)

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

Assume the initial temperature of the reference leg and the water in the tank is 100°F, and that reference leg temperature does <u>not</u> change.

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

A.  increase; level

B.  decrease; level

C.  increase; mass

D.  decrease; mass

ANSWER:  A.
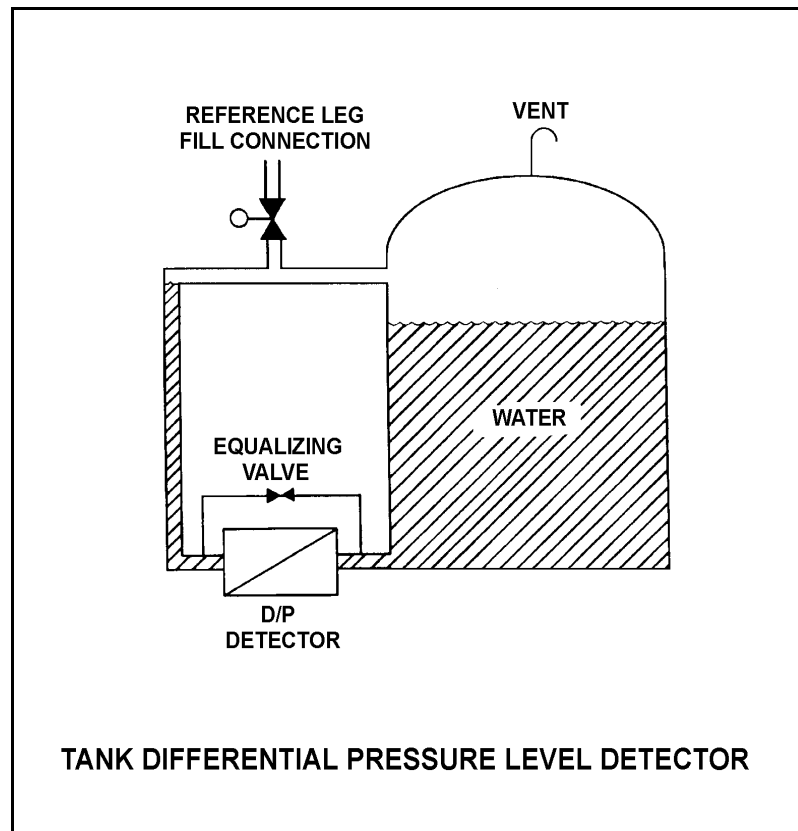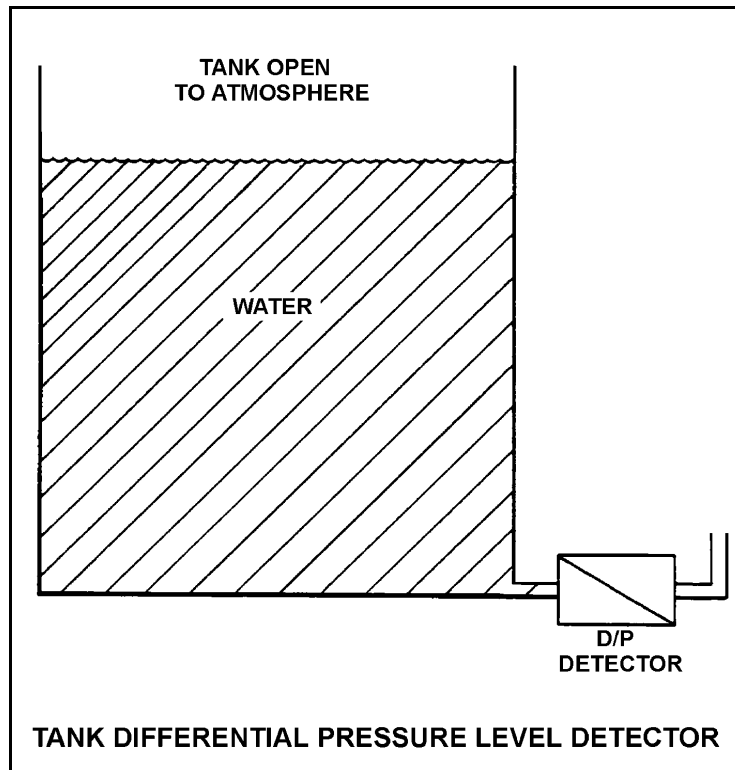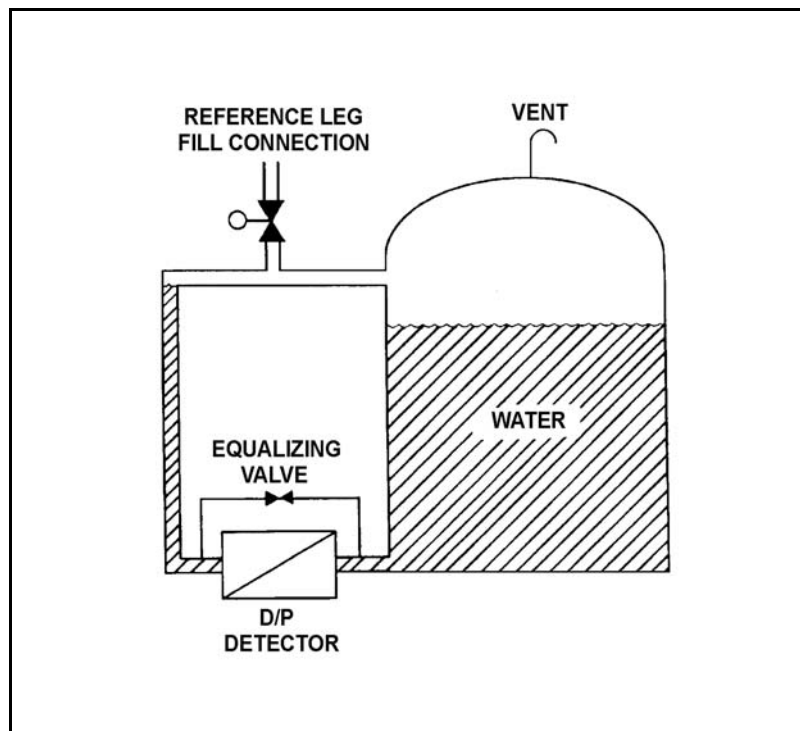
TOPIC:           191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:              P3407   (B3408)

Refer to the drawing of a tank with a differential pressure (D/P) level detector (see figure below). Assume that the initial temperature of the reference leg and the water in the tank are the same, and that reference leg temperature and level do <u>not</u> change.

The level detector is being used in a level control system (not shown) that is calibrated to maintain tank level at 75% at the current tank water temperature (70°F) and pressure (5 psig).

If the tank water temperature remains constant, but the tank pressure is increased by 10 psig, the level control system will cause <u>actual</u> tank level to...

A.  remain at 75%.

B.  increase and stabilize above 75%.

C.  oscillate around 75%.

D.  decrease and stabilize below 75%.

ANSWER:  A.

REFERENCE LEG
FILL CONNECTION

GAS OR VAPOR
PRESSURE

WATER

EQUALIZING
VALVE

D/P
DETECTOR

**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**
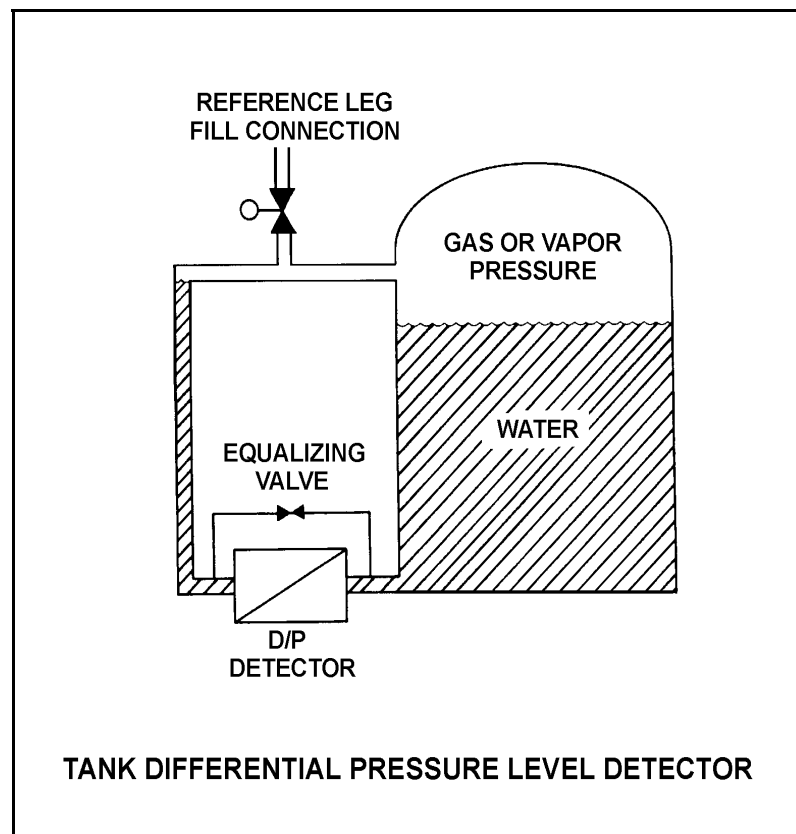
TOPIC:          191002
KNOWLEDGE:  K1.07   [2.5/2.6]
QID:             P5003

The downcomer region of a steam generator contains 40 feet of saturated water at 536°F.  A steam generator water level detector has a pressure tap located at the bottom of the downcomer region.  Approximately how much of the total pressure at the pressure tap is caused by the downcomer water?

A.  0.6 psi

B.  13.0 psi

C.  27.7 psi

D.  156.0 psi

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.07   [2.5/2.6]
QID:            P5204

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

The high pressure side of the detector is connected to the _____; and if the equalizing valve is opened the indicated pressurizer level will be _____ than the actual level.

A.  condensing pot; lower

B.  condensing pot; higher

C.  pressurizer; lower

D.  pressurizer; higher

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:            P11

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

The level instrument has just been calibrated to read actual tank water level.  If the reference leg subsequently experiences high ambient temperature, indicated level will...

A.  equal the actual level.

B.  read less than the actual level.

C.  read greater than the actual level.

D.  drift above and below the actual level.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:              P14      (B510)

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

Indicator 1 was calibrated at 200°F and indicator 2 was calibrated at 100°F.  If tank water temperature is 150°F, then...

A.  indicator 1 will read greater than indicator 2.

B.  indicator 2 will read greater than indicator 1.

C.  indicator 1 and 2 will read the same.

D.  both indicators will be inaccurate, but it is impossible to predict which indicator will read greater.

ANSWER:  A.
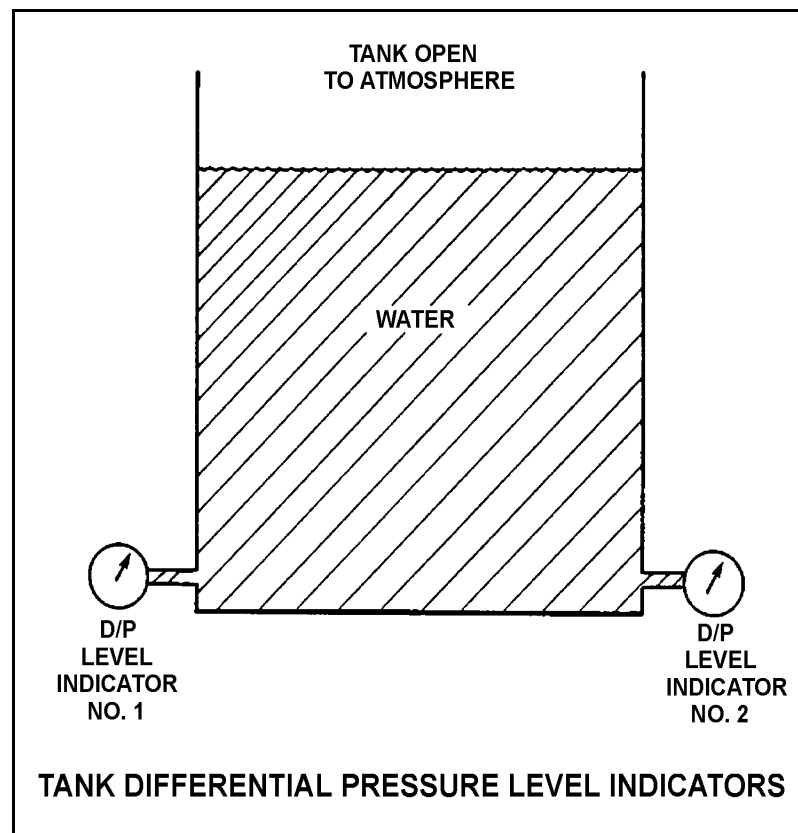
TOPIC:            191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:              P609     (B12)

Refer to the drawing of four tank differential pressure (D/P) level detectors (see figure below).

The tanks are identical with equal water levels and both are pressurized to 20 psig.  All detectors were calibrated at the current water temperature and 70°F external (ambient) temperature.

Which detectors will provide the <u>most</u> <u>accurate</u> level indication following an increase in external (ambient) temperature from 70°F to 100°F?  (Assume tank contents temperatures and external pressure do not change.)

A.  1 and 3

B.  2 and 4

C.  1 and 4

D.  2 and 3

ANSWER:  B.



REFERENCE LEG
FILL CONNECTION

GAS OR VAPOR
PRESSURE

WATER

D/P
DETECTOR
NO. 1

D/P
DETECTOR
NO. 2

REFERENCE LEG
FILL CONNECTION

GAS OR VAPOR
PRESSURE

WATER

D/P
DETECTOR
NO. 3

D/P
DETECTOR
NO. 4

**TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS**
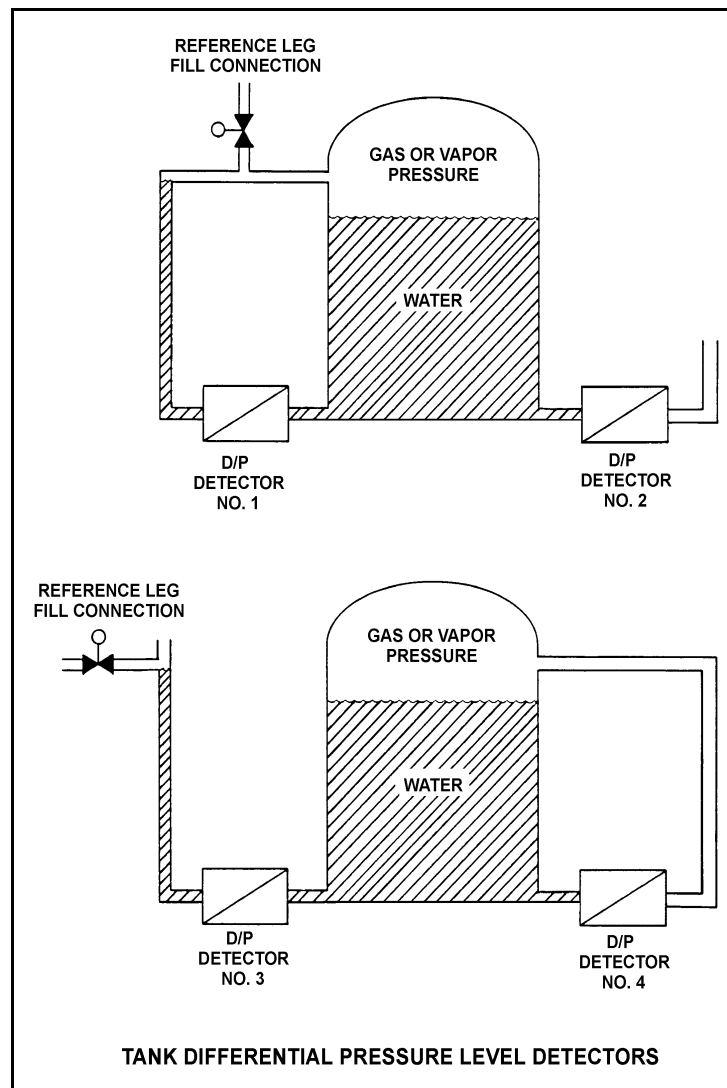
TOPIC:             191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:                P1108   (B1609)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

A calibrated D/P level detector is being used to measure level in a vented tank inside the auxiliary building.  If building pressure increases with no change in temperature, the associated level indication will...

A.  decrease, then increase and stabilize at the actual level.

B.  decrease and stabilize below the actual level.

C.  increase and stabilize above the actual level.

D.  remain at the actual level.

ANSWER:  D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR
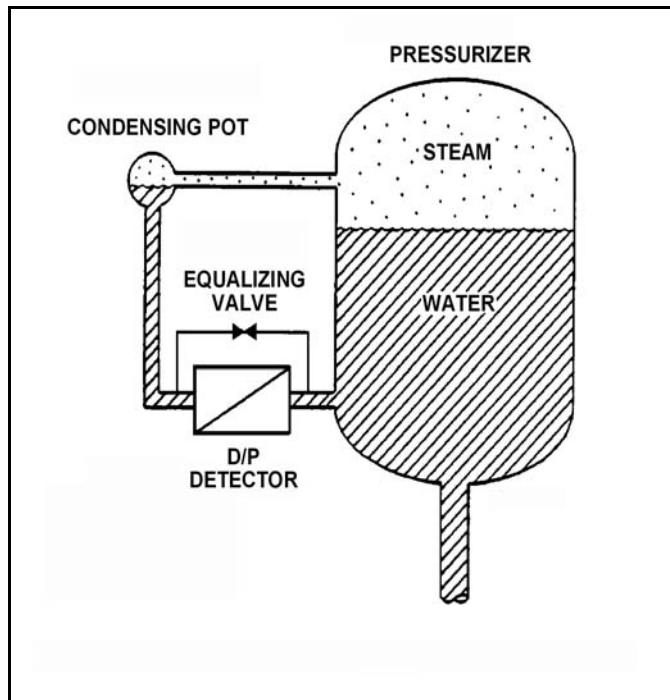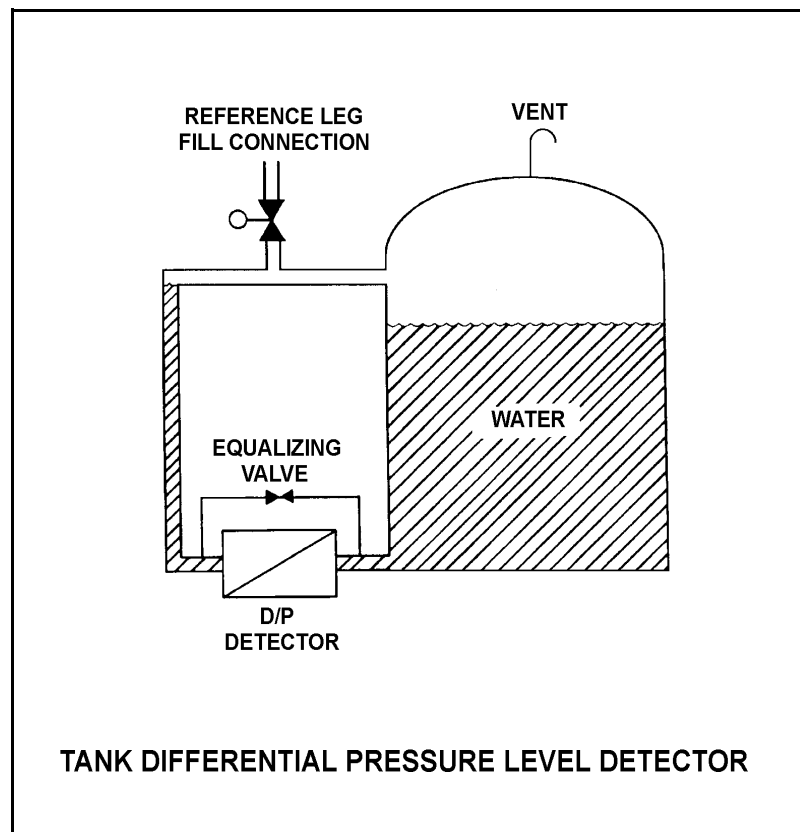
TOPIC:          191002
KNOWLEDGE:  K1.08   [2.8/3.1]
QID:             P1411

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

With the nuclear power plant in cold shutdown conditions, a pressurizer level D/P instrument, which was calibrated while the plant was at normal operating conditions, will indicate _____ than actual level because the D/P sensed by the detector at cold shutdown conditions will be _____ than at normal operating conditions. (Assume actual pressurizer level has not changed.)

A.  lower; larger

B.  lower; smaller

C.  higher; larger

D.  higher; smaller

ANSWER:  D.
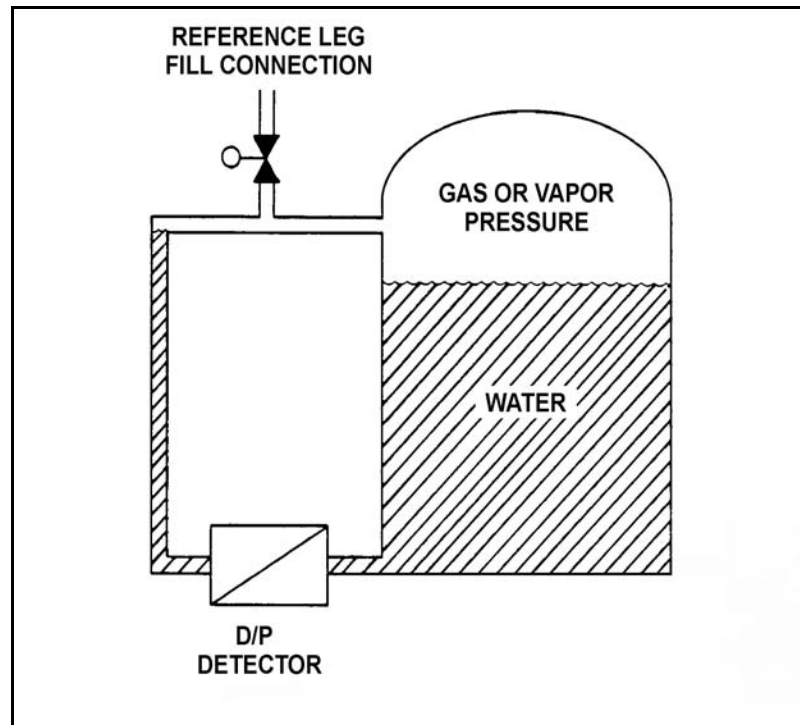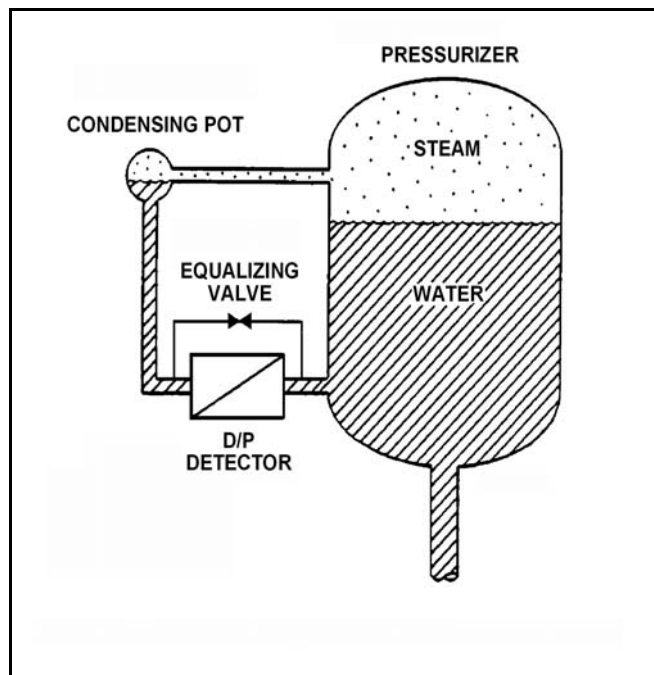
TOPIC:          191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:            P1607   (B1409)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The associated level instrument was calibrated with the water in the tank at 120°F.  If the mass of water in the tank remains constant and the water temperature decreases to 100°F, the indicated level will...

A.  remain the same although actual level increases.

B.  remain the same although actual level decreases.

C.  increase in direct proportion to the temperature decrease.

D.  decrease in direct proportion to the temperature decrease.

ANSWER:  B.

**TANK OPEN
TO ATMOSPHERE**

**WATER**

**D/P
DETECTOR**

**TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR**
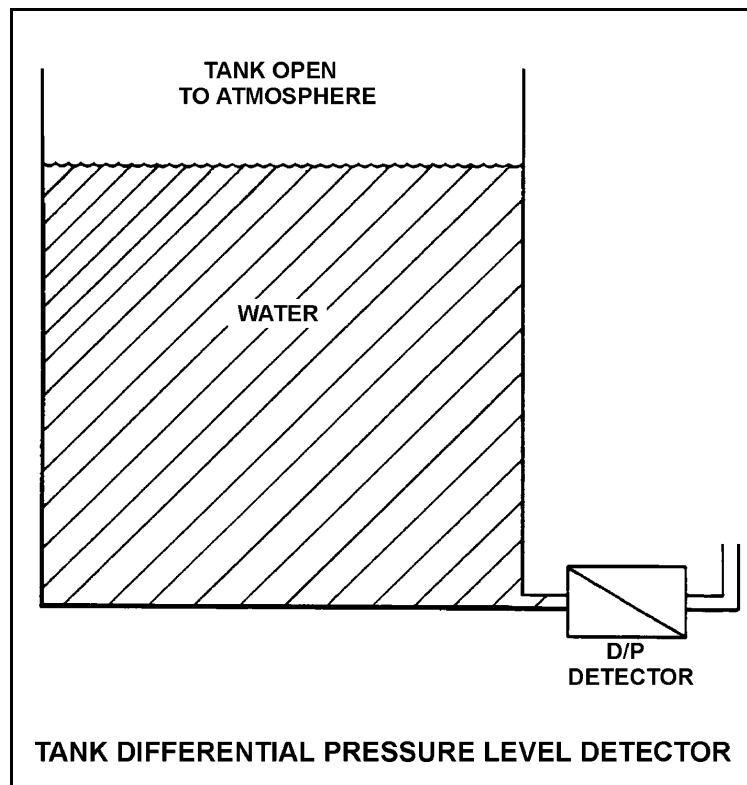
TOPIC:           191002
KNOWLEDGE:   K1.08   [2.8/3.1]
QID:             P2810   (B2808)

Refer to the drawing of a pressurizer level detection system (see figure below).  The differential pressure (D/P) detector was calibrated while the nuclear power plant was at normal operating conditions.

With the plant initially at normal operating conditions, a pressurizer steam space leak occurred. The pressurizer pressure decreased by 300 psia, and the ambient air temperature surrounding the reference leg increased by 80°F, where these parameters stabilized.

If the actual pressurizer water level is 60%, the reduced pressurizer pressure will tend to make the indicated pressurizer level read _____ than actual; and the increased reference leg temperature will tend to make the indicated pressurizer level read _____ than actual.

A.  higher; higher

B.  higher; lower

C.  lower; higher

D.  lower; lower

ANSWER:  A.
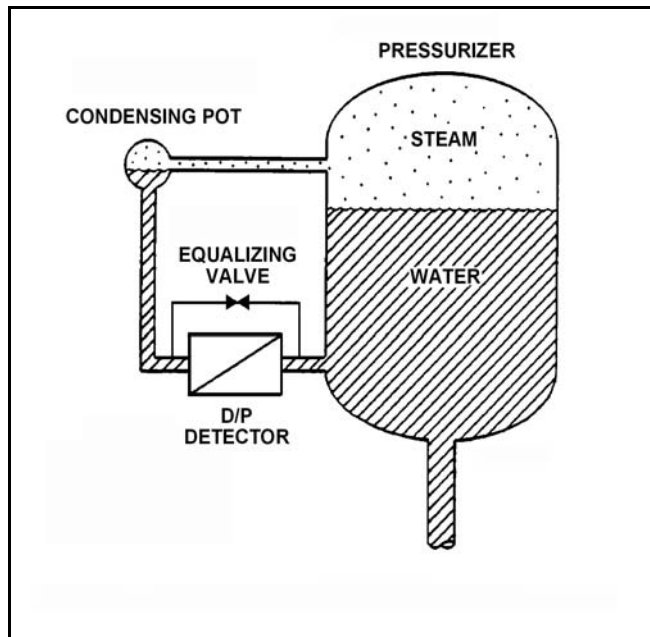
TOPIC:          191002
KNOWLEDGE:  K1.08   [2.8/3.1]
QID:             P4004   (B4006)

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

The level instrument has just been calibrated to indicate actual tank water level.  Assume that tank water temperature and level remain constant.  If the reference leg temperature increases by 20°F, indicated tank water level will...

A.  be unpredictable.

B.  equal the actual level.

C.  read less than the actual level.

D.  read greater than the actual level.

ANSWER:  B.
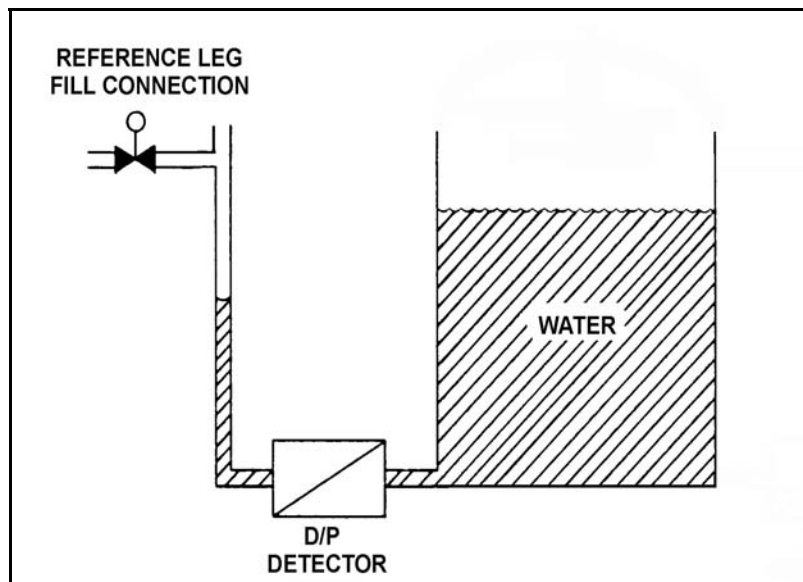
TOPIC:           191002
KNOWLEDGE:   K1.09   [2.9/3.0]
QID:             P12

The level indication for a reference leg differential pressure (D/P) level instrument will fail <u>low</u> as a result of...

A.  a break on the reference leg.

B.  a rupture of the diaphragm in the D/P cell.

C.  the reference leg flashing to steam.

D.  a break on the variable leg.

ANSWER:  D.

TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P209 (B1010)

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

Which one of the following failures will cause the associated steam generator level indicator to indicate the <u>lowest</u> level?

A. The D/P detector diaphragm ruptures.

B. The reference leg ruptures.

C. The variable leg ruptures.

D. The equalizing valve is opened.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P309 (B308)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

Tank water level indication will be <u>lower</u> than actual level when reference leg temperature is _____ than calibration conditions or when there is a break in the _____ leg of the D/P cell.

A. less; reference

B. less; variable

C. greater; reference

D. greater; variable

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC:           191002
KNOWLEDGE:   K1.09   [2.9/3.0]
QID:              P911    (B3508)

Refer to the drawing of a steam generator (S/G) differential pressure level detection system ( see figure below) that was recently calibrated at normal operating conditions.

With the nuclear reactor shut down, S/G pressures were inadvertently decreased from 900 psig to 700 psig in 5 minutes due to operator error.  S/G pressures were stabilized at 700 psig, but during the pressure decrease a small amount of water in the condensing pot flashed to steam.  Assume the reference leg water remains subcooled, except for the small amount of water that flashes to steam in the condensing chamber.

As a result of the small loss of condensing pot water, S/G level will indicate _____ than actual level; and as the condensing pot refills, indicated level will _____.

A.  higher; decrease and stabilize above the actual level

B.  higher; decrease and stabilize below the actual level

C.  lower; increase and stabilize above the actual level

D.  lower; increase and stabilize below the actual level

ANSWER:  A.
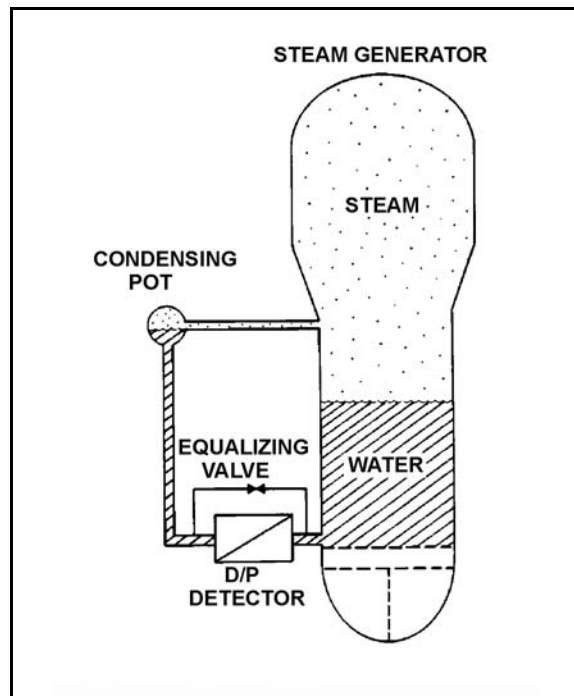
TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2408 (B1212)

Refer to the drawing of a steam generator (S/G) with a differential pressure (D/P) level detection system (see figure below).

Which one of the following events will result in a steam generator level indication that is greater than actual level?

A. The S/G pressure increases by 50 psia.

B. The variable leg breaks and completely drains.

C. A portion of the reference leg water flashes to steam.

D. The temperature surrounding the S/G and reference leg decreases by 30°F.

ANSWER: C.
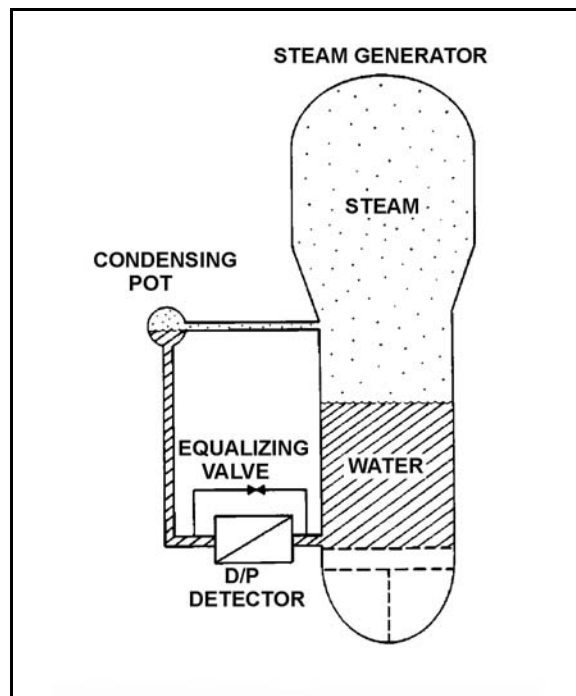
TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2609

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

The S/G is at normal operating temperature and pressure with accurate level indication. Which one of the following events will result in a S/G level indication that is greater than actual level?

A. The external pressure surrounding the D/P detector increases by 2 psi.

B. S/G pressure increases by 50 psi with no change in actual water level.

C. Actual S/G level increases by 6 inches.

D. The temperature of the reference leg increases by 20°F.

ANSWER: D.
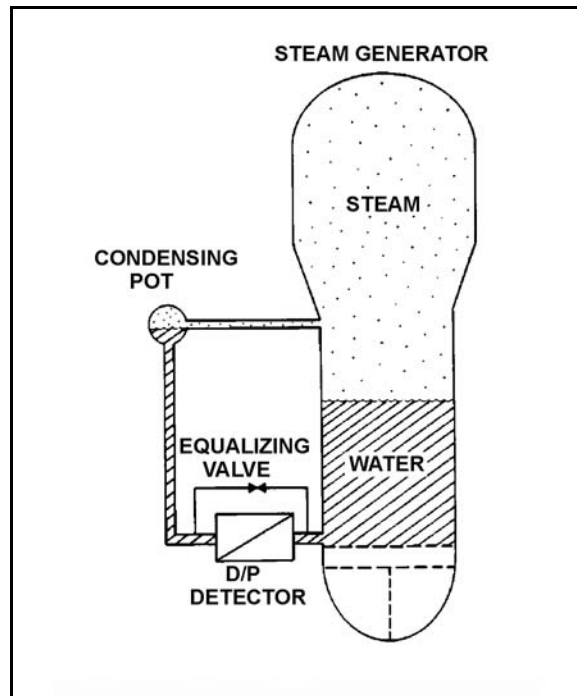
TOPIC:          191002
KNOWLEDGE:  K1.09  [2.9/3.0]
QID:            P2708

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

The S/G is supplying steam at normal operating temperature and pressure and the level instrumentation has just been calibrated.  Which one of the following events will result in a S/G level indication that is less than actual level?

A.  S/G pressure increases by 50 psi.

B.  Actual S/G water level decreases by 6 inches.

C.  The external pressure surrounding the D/P detector decreases by 2 psi.

D.  The temperature surrounding the reference leg increases by 20°F.

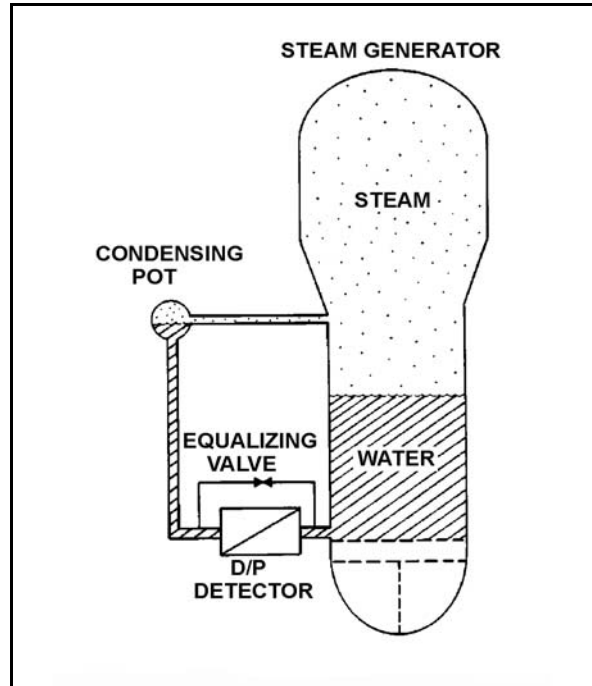ANSWER:  A.
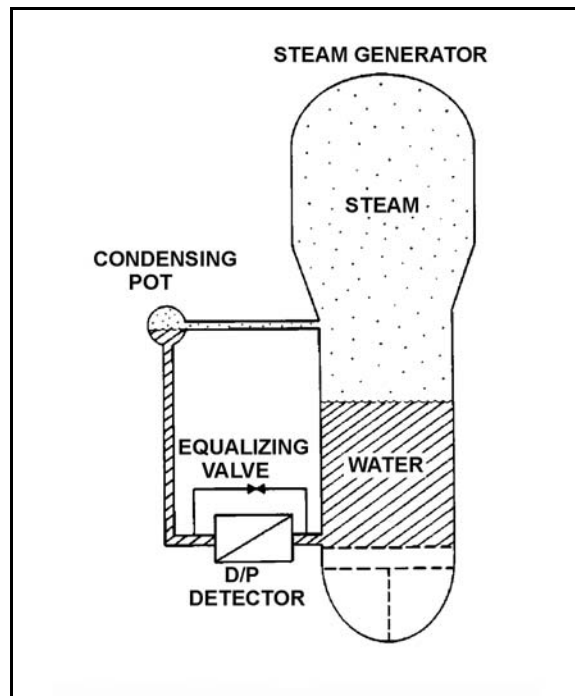
TOPIC:          191002
KNOWLEDGE:   K1.09   [2.9/3.0]
QID:            P2907   (B1410)

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

The S/G is at normal operating temperature and pressure with accurate level indication.  Which one of the following events will result in a S/G level indication that is lower than actual level?

A.  Actual S/G level decreases by 6 inches.

B.  The temperature surrounding the reference leg decreases by 20°F.

C.  The external pressure surrounding the D/P detector decreases by 2 psi.

D.  S/G pressure decreases by 50 psi with no change in actual water level.

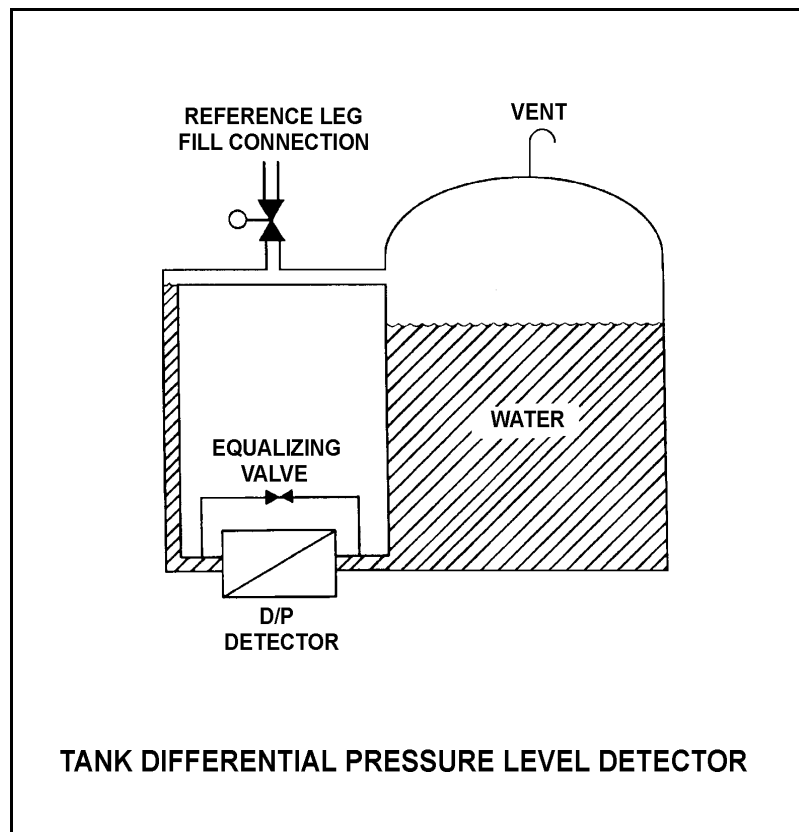ANSWER:  B.
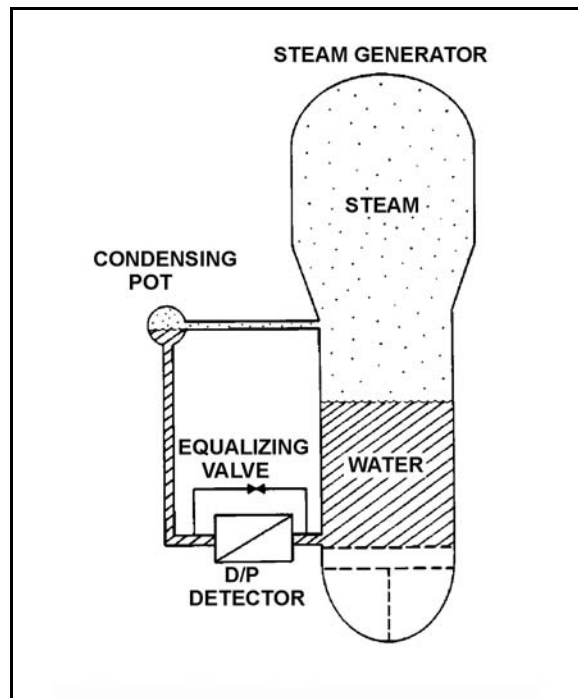
TOPIC:           191002
KNOWLEDGE:   K1.09   [2.9/3.0]
QID:             P3808

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

A nuclear reactor is shutdown with the reactor coolant system being maintained at 100 psia.  The level detector has just been calibrated.  Suddenly a rupture in the condensing pot of the level detector results in a rapid drop of the condensing pot pressure to atmospheric pressure.

Given the following current conditions:

- The condensing pot is at atmospheric pressure.
- Pressurizer pressure is 98 psia and slowly decreasing.
- Bulk reference leg temperature is 120°F.
- Actual pressurizer level has not changed significantly.

Which one of the following describes the current pressurizer level indication from the detector?

A.  Offscale low because the bulk of the water in the reference leg has flashed to steam.

B.  Offscale high because the bulk of the water in the reference leg has flashed to steam.

C.  Offscale low because the static pressure on the reference leg is much less than the static pressure in the pressurizer.

D.  Offscale high because the static pressure on the reference leg is much less than the static pressure in the pressurizer.

ANSWER:  D.
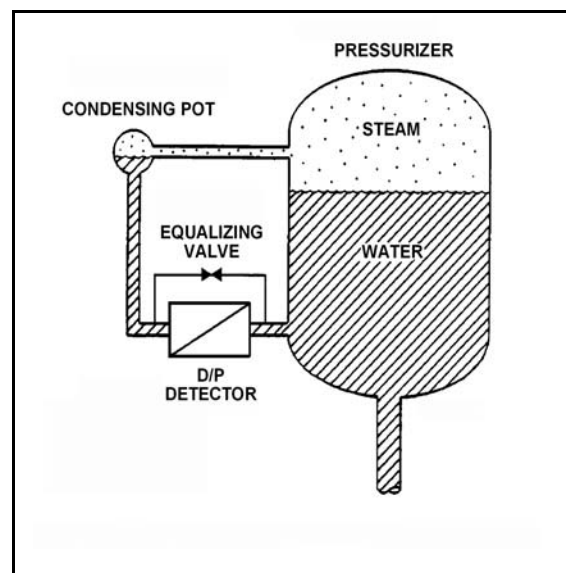
TOPIC:          191002
KNOWLEDGE:   K1.10   [2.3/2.5]
QID:             P310

Semiconductor strain gages are often used in transmitters for...

A.  reactor coolant pressure instruments.

B.  reactor coolant temperature instruments.

C.  control rod position instruments.

D.  steam generator level instruments.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.10   [2.3/2.5]
QID:             P413    (B410)

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

A.  increase; outer

B.  increase; inner

C.  decrease; outer

D.  decrease; inner

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.10   [2.3/2.5]
QID:            P810

In a diaphragm type pressure detector, pressure is measured using the _____ of the diaphragm.

A.  rotational movement

B.  axial deflection

C.  change in circumference

D.  change in diameter

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.10   [2.3/2.5]
QID:            P1508   (B1011)

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

A.  coil due to an increased pressure-induced force on the outside of the tube.

B.  straighten due to an increased pressure-induced force on the outside of the tube.

C.  coil due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

D.  straighten due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.10   [2.3/2.5]
QID:            P2109   (B2109)

A centrifugal pump is taking suction from the bottom of a vented cylindrical storage tank that contains 100,000 gallons of water at 60°F.  A pressure gauge at the inlet to the pump indicates 40 psig.  Over the next several days storage tank temperature increases to 90°F with <u>no</u> change in tank water level and <u>no</u> change in head loss in the pump suction line.

Which one of the following is the current pressure at the inlet to the pump?

A.  39.8 psig

B.  37.4 psig

C.  34.6 psig

D.  31.2 psig

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.11   [2.7/3.0]
QID:            P210    (B210)

A simple bellows pressure detector is connected to a cooling water system.  The detector is located in the reactor containment and has its low pressure side vented to the containment atmosphere.  Current system pressure indication is 100 psig.

If a main steam line break raises containment pressure by 40 psig, the system pressure indication will:  (Disregard any temperature effect on the pressure detector.)

A.  increase by 40 psig.

B.  increase by the square <u>root</u> of 40 psig.

C.  decrease by 40 psig.

D.  decrease by the square <u>root</u> of 40 psig.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.11   [2.7/3.0]
QID:            P509    (B1310)

A cooling water system bourdon tube pressure detector is located inside a sealed building and system pressure currently indicates 50 psig.  A building ambient temperature increase of 100°F will cause a _____ change in indicated system pressure, and a building pressure increase of 20 psig will cause a _____ change in indicated system pressure.

A.  significant; significant

B.  negligible; significant

C.  significant; negligible

D.  negligible; negligible

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.11   [2.7/3.0]
QID:            P611

A bellows pressure transmitter with its low-pressure side vented to containment atmosphere is being used to measure reactor coolant system (RCS) pressure.  A decrease in the associated pressure indication could be caused by either a containment pressure _____ or a RCS pressure _____.

A.  decrease; decrease

B.  increase; increase

C.  decrease; increase

D.  increase; decrease

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.11   [2.7/3.0]
QID:            P710    (B711)

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

A.  increase by 20 psi.

B.  decrease by 20 psi.

C.  increase by the square root of 20 psi.

D.  decrease by the square root of 20 psi.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.11   [2.7/3.0]
QID:            P3509  (B2912)

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

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

A.  increase to 120 psig.

B.  increase by a small, but indeterminate amount.

C.  decrease by a small, but indeterminate amount.

D.  decrease to 80 psig.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:             P211    (B212)

A bourdon-tube pressure detector was indicating 50% of scale when it was suddenly exposed to a high-pressure transient that caused permanent strain to the bourdon tube.  The detector remained intact and actual pressure was restored to its original value.

During the pressure transient, the affected pressure indication initially went off-scale high.  After the original pressure was restored, the indication was...

A.  unpredictable.

B.  less than 50% of scale.

C.  50% of scale.

D.  greater than 50% of scale.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:            P510    (B1610)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use.  If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

A.  Increase, because the spring will expand more.

B.  Decrease, because the spring will expand more.

C.  Increase, because the spring will compress more.

D.  Decrease, because the spring will compress more.

ANSWER:  C.



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR
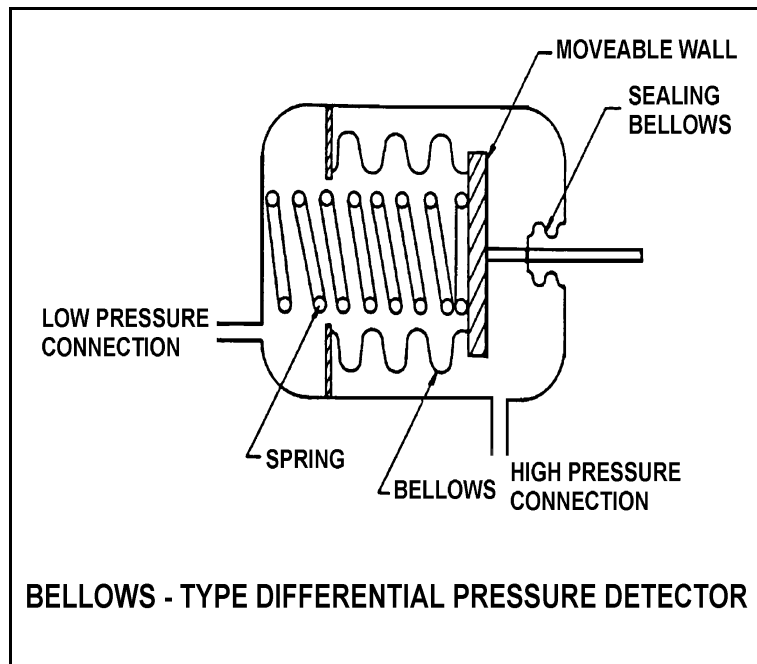
TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:          P511

If a bourdon tube pressure detector is over-ranged sufficiently to permanently distort the bourdon tube, subsequent pressure measurement will be inaccurate because the _____ of the detector tube will be inaccurate.

A.  distance moved by the tip

B.  change in the length

C.  expansion of the cross-sectional area

D.  change in the volume

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:          P1011   (B2910)

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.  0 psia.

B.  15 psia.

C.  60 psia.

D.  90 psia.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:            P2211   (B1908)

Refer to the drawing of a bellows-type pressure detector (see figure below).

A bellows-type pressure detector with its low-pressure side vented to containment atmosphere is being used to measure pressurizer pressure.  A decrease in the associated pressure indication will be caused by either a containment pressure _____ or a _____.

A.  increase; ruptured bellows

B.  increase; broken spring

C.  decrease; ruptured bellows

D.  decrease; broken spring

ANSWER:  A.



BELLOWS - TYPE PRESSURE DETECTOR
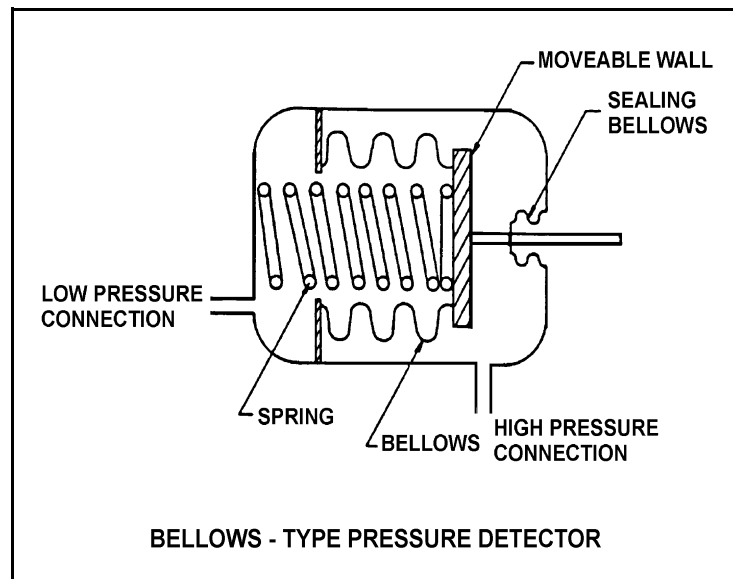
TOPIC:          191002
KNOWLEDGE:   K1.12   [2.8/2.9]
QID:             P2610   (B610)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use.  If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

A.  Decrease, because the high pressure will compress the spring more

B.  Increase, because the high pressure will compress the spring more

C.  Decrease, because the spring will expand more

D.  Increase, because the spring will expand more

ANSWER:  B.
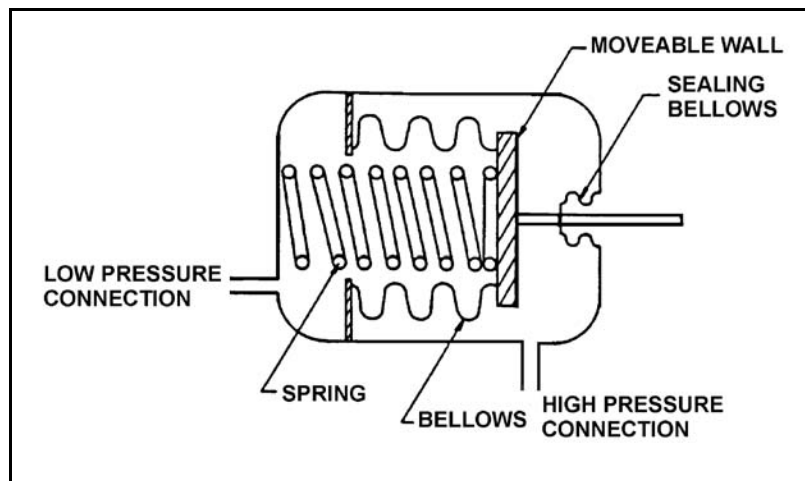
TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P13

A resistance temperature detector operates on the principle that the change in electrical resistance of...

A.  two dissimilar metals is directly proportional to the  temperature change measured at their junction.

B.  two dissimilar metals is inversely proportional to the temperature change measured at their junction.

C.  a metal is directly proportional to its change in temperature.

D.  a metal is inversely proportional to its change in temperature.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P212

A resistance temperature detector operates on the principle that the change in metal resistance is _____ proportional to the change in _____.

A.  inversely; metal temperature

B.  inversely; metal temperature squared

C.  directly; metal temperature

D.  directly; metal temperature squared

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P311

When comparing a thermocouple to a resistance temperature detector, the thermocouple...

A.  measures temperature less accurately.

B.  requires an external power supply to produce an electrical output.

C.  is unable to withstand high temperatures.

D.  responds much slower to a temperature change.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P812

If the reference junction temperature of a thermocouple remains constant, the output voltage of the thermocouple is _____ proportional to the _____.

A.  directly; measuring junction temperature

B.  directly; square root of the measuring junction temperature

C.  inversely; measuring junction temperature

D.  inversely; square root of the measuring junction temperature

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:            P1209   (B1314)

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

Thermocouple temperature indication is currently 350°F.  A small steam leak occurs that raises reference (cold) junction temperature by 20°F.  Assume measuring junction temperature remains constant.  Without temperature compensation for the reference junction, the new temperature indication will be...

A.  310°F.

B.  330°F.

C.  370°F.

D.  390°F.

ANSWER:  B.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:            P1311

A thermocouple operates on the principle that a measurable voltage will be produced when two...

A.  similar metals form two junctions at the same temperature.

B.  similar metals form two junctions at different temperatures.

C.  dissimilar metals form two junctions at the same temperature.

D.  dissimilar metals form two junctions at different temperatures.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:            P1412   (B2911)

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

Thermocouple temperature indication is currently 390°F.  A small steam leak occurs that raises reference (cold) junction temperature by 20°F.  Assume measuring junction temperature remains constant.  Without temperature compensation for the reference junction, the new temperature indication will be...

A.  370°F.

B.  390°F.

C.  400°F.

D.  410°F.

ANSWER:  A.



MEASURING [HOT]
JUNCTION

REFERENCE [COLD]
JUNCTION

POTENTIOMETER
(TEMPERATURE INDICATION)

VOLTAGE

**SIMPLE THERMOCOUPLE CIRCUIT**

TOPIC:           191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P1510   (B309)

In contrast to a thermocouple, a resistance temperature detector...

A.  is used in high temperature applications.

B.  does <u>not</u> require an external power supply for temperature indication.

C.  uses a single type of metal or alloy in the sensing element.

D.  is commonly placed in direct contact with the monitored substance.

ANSWER:  C.

TOPIC:            191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:              P1710   (B1710)

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

Thermocouple temperature indication is currently 150°F.  A small steam leak occurs that raises both the measuring (hot) junction and reference (cold) junction temperatures by 20°F.  Without temperature compensation for the reference junction, the new temperature indication will be...

A.  130°F.

B.  150°F.

C.  170°F.

D.  190°F.

ANSWER:  B.

MEASURING [HOT]
JUNCTION

VOLTAGE

REFERENCE [COLD]
JUNCTION

POTENTIOMETER
(TEMPERATURE INDICATION)

**SIMPLE THERMOCOUPLE CIRCUIT**

TOPIC:            191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:              P2212   (B1510)

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

Circuit temperature indication is currently 350°F.  The reference (cold) junction temperature decreases by 10°F.  Assume the measuring junction temperature remains constant.  Without temperature compensation for the reference junction, the new temperature indication will be...

A.  340°F.

B.  350°F.

C.  360°F.

D.  370°F.

ANSWER:  C.

MEASURING [HOT]
JUNCTION

VOLTAGE

REFERENCE [COLD]
JUNCTION

POTENTIOMETER
(TEMPERATURE INDICATION)

**SIMPLE THERMOCOUPLE CIRCUIT**

TOPIC:              191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:                  P2409   (B2412)

What is the purpose of the reference junction panel that is provided with many thermocouple circuits?

A.  Ensures that thermocouple output is amplified sufficiently for use by temperature indication devices.

B.  Ensures that temperature changes away from the thermocouple measuring junction do <u>not</u> affect thermocouple temperature indication.

C.  Ensures that electrical noise in the thermocouple extension wires does <u>not</u> affect thermocouple temperature indication.

D.  Ensures that different lengths of thermocouple extension wires do <u>not</u> affect thermocouple temperature indication.

ANSWER:  B.

TOPIC:              191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:                  P2711   (B2712)

<u>Unlike</u> a resistance temperature detector, a typical thermocouple...

A.  uses a single type of metal in the sensing element

B.  requires a temperature-controlled reference junction.

C.  can provide temperature input to a valve controller in a cooling water system.

D.  requires an external power supply to provide indication of temperature.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:             P3011   (B3013)

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

Thermocouple temperature indication is 410°F with the reference (cold) junction at 125°F.  An ambient temperature decrease lowers reference junction temperature to 110°F.  Assume the measuring junction temperature remains constant.  Without temperature compensation for the reference junction, the new thermocouple temperature indication will be...

A.  380°F.

B.  395°F.

C.  410°F.

D.  425°F.

ANSWER:  D.
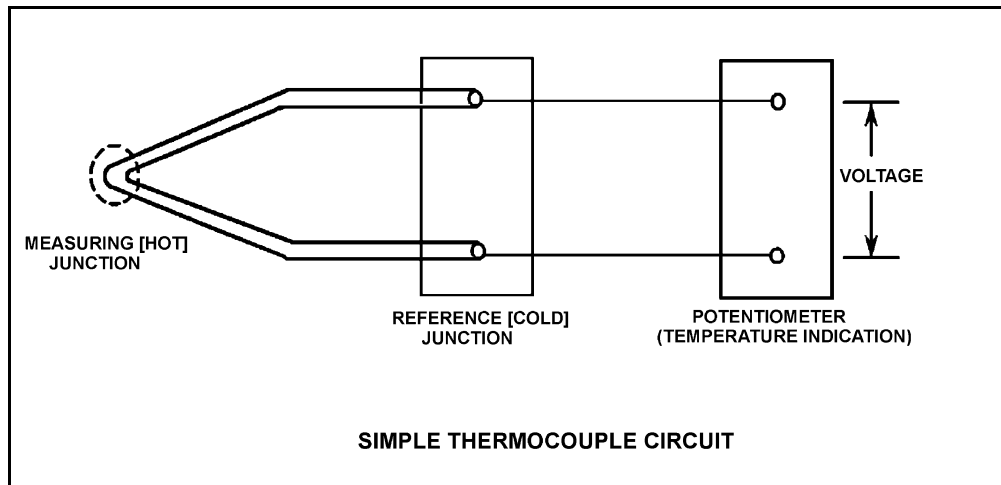


**SIMPLE THERMOCOUPLE CIRCUIT**
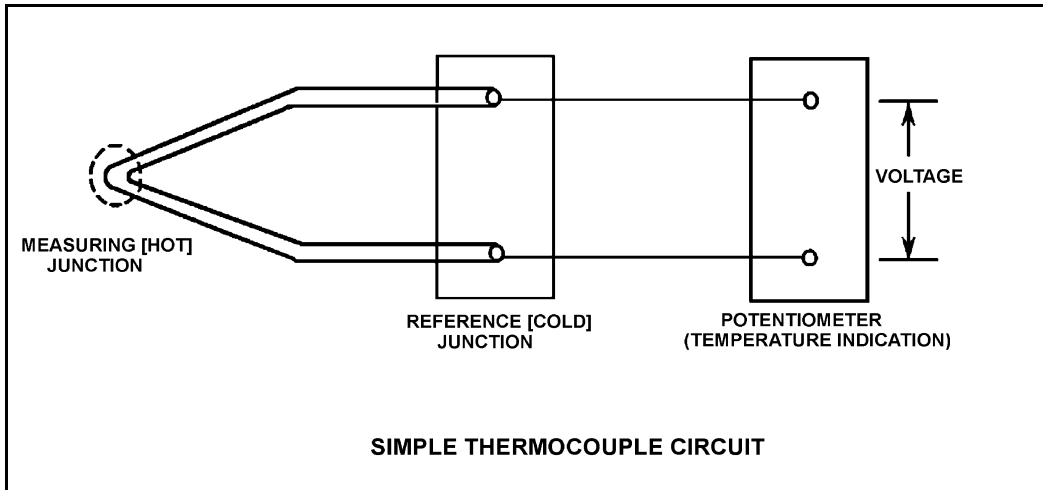
TOPIC:            191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:              P4206   (B4206)

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°F, indicated temperature will...

A.  not be affected.

B.  increase by 10°F.

C.  decrease by 10°F.

D.  change in an unpredictable manner.

ANSWER:  A.



MEASURING [HOT]
JUNCTION

VOLTAGE

REFERENCE [COLD]
JUNCTION

POTENTIOMETER
(TEMPERATURE INDICATION)
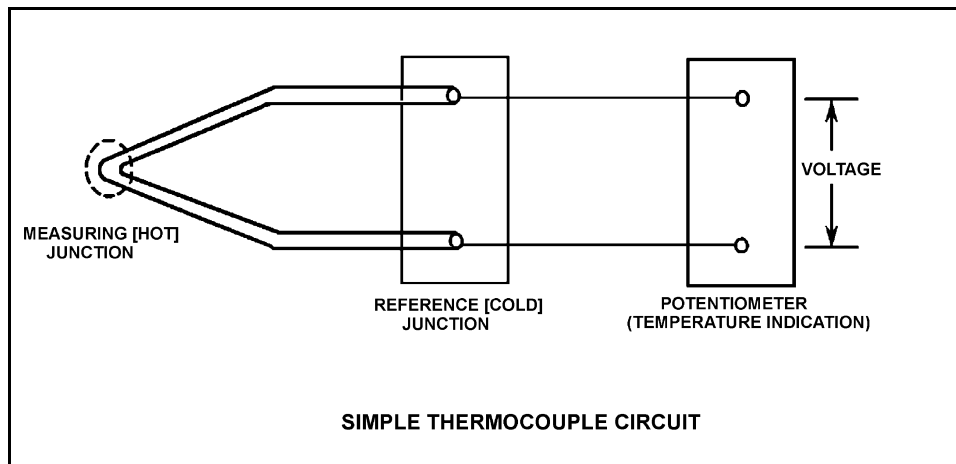
**SIMPLE THERMOCOUPLE CIRCUIT**
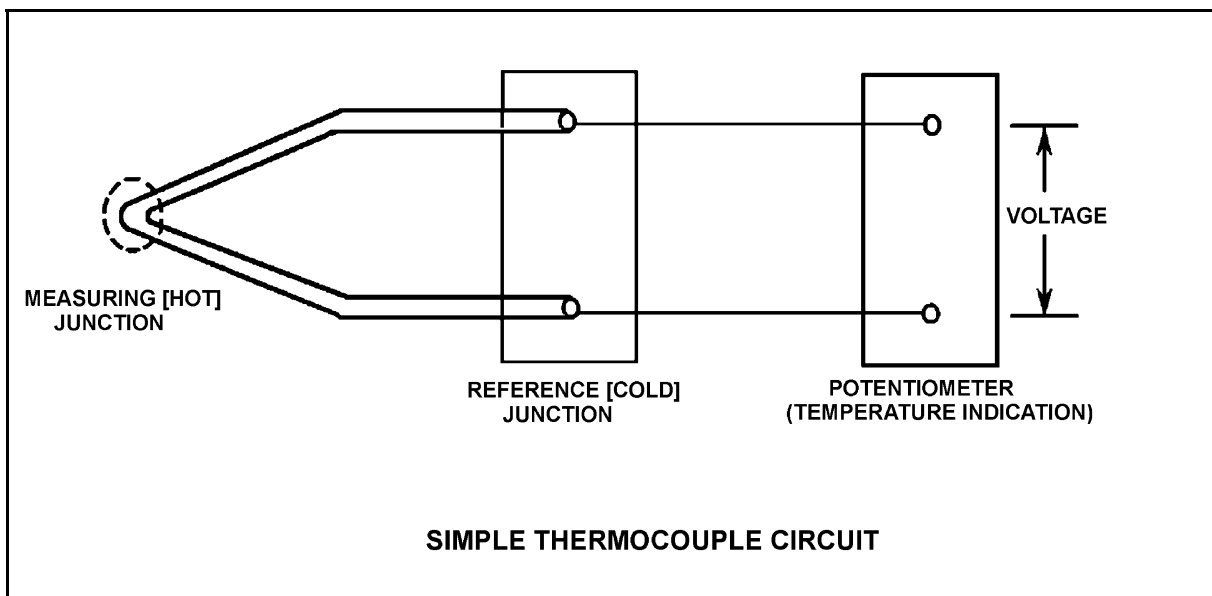
TOPIC:            191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:                 P5305   (B5305)

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

The measuring and reference junctions are located inside the reactor containment building while the potentiometer is located in a remote location outside the containment building.  Thermocouple temperature indication is initially 500°F.

An ambient temperature decrease outside the containment building lowers the temperature of the potentiometer by 10°F while the measuring and reference junction temperatures remain constant. Thermocouple temperature indication at the lower ambient temperature will be...

A.  490°F.

B.  500°F.

C.  510°F.

D.  unpredictable.

ANSWER:  B.



MEASURING [HOT]
JUNCTION

REFERENCE [COLD]
JUNCTION

POTENTIOMETER
(TEMPERATURE INDICATION)
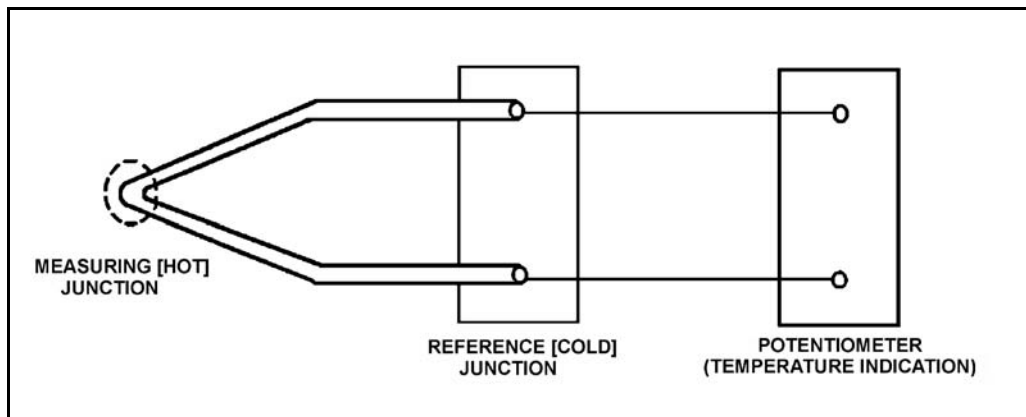
TOPIC:          191002
KNOWLEDGE:   K1.13   [2.6/2.8]
QID:            P5505   (B5507)

Refer to the drawing of a Chromel-Alumel thermocouple circuit (see figure below).

What is the effect on the thermocouple reference junctions if the chromel and alumel extension wires from the thermocouple connection head to the reference junction panel are replaced with copper wires?

A.  The reference junctions will be located in the thermocouple connection head.

B.  The reference junctions will still be located in the reference junction panel.

C.  The reference junctions will be located in the temperature instrument.

D.  There will no longer be any reference junctions.

ANSWER:  A.
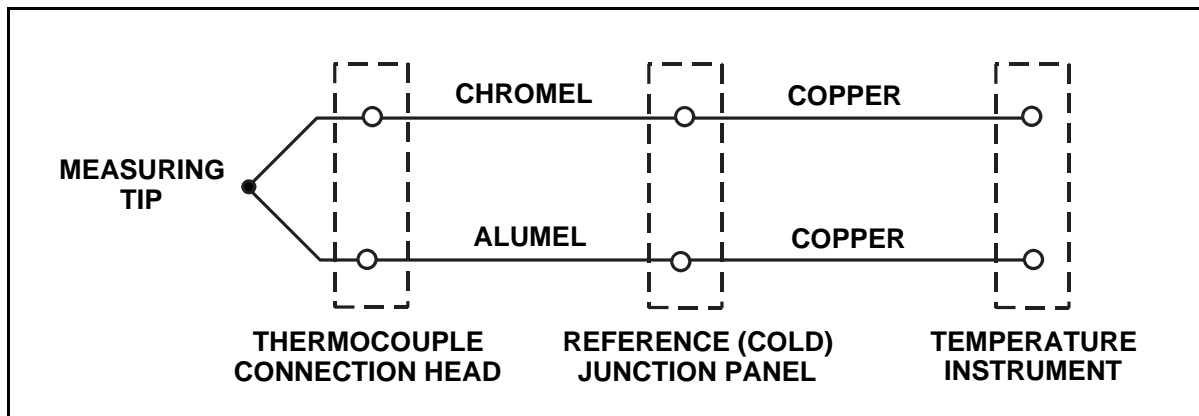
TOPIC:            191002
KNOWLEDGE:   K1.14   [2.8/2.9]
QID:              P213

An open circuit in a thermocouple detector causes the affected temperature indication to fail...

A.  high.

B.  low.

C.  to reference junction temperature.

D.  as is.

ANSWER:  B.

TOPIC:            191002
KNOWLEDGE:   K1.14   [2.8/2.9]
QID:              P312    (B310)

If shorting occurs within a resistance temperature detector, the associated indication will fail...

A.  low.

B.  high.

C.  as is.

D.  to midscale.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.14   [2.8/2.9]
QID:             P414     (B208)

If a resistance temperature detector develops an <u>open</u> circuit (bridge circuit remains intact), indication will fail...

A.  high.

B.  low.

C.  as is.

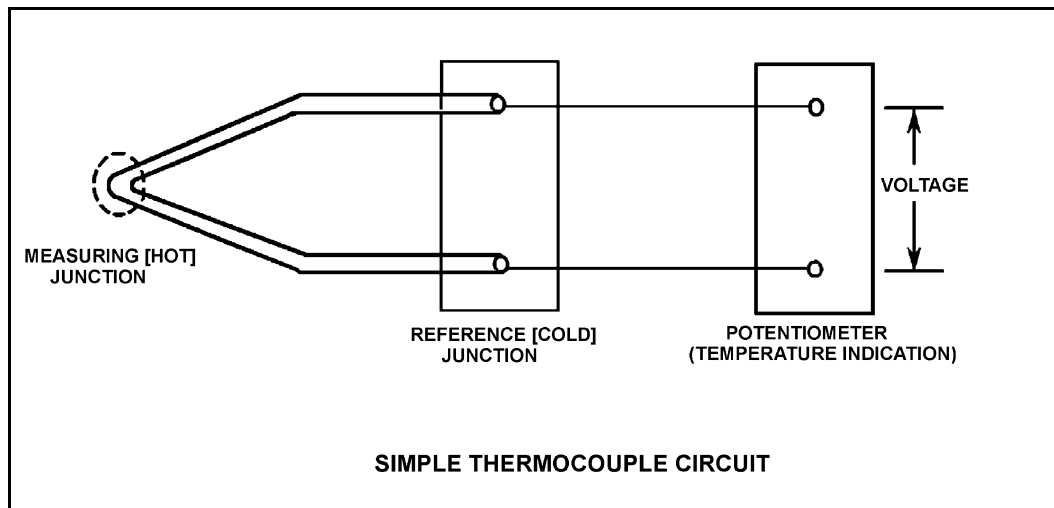D.  to midscale.

ANSWER:  A.
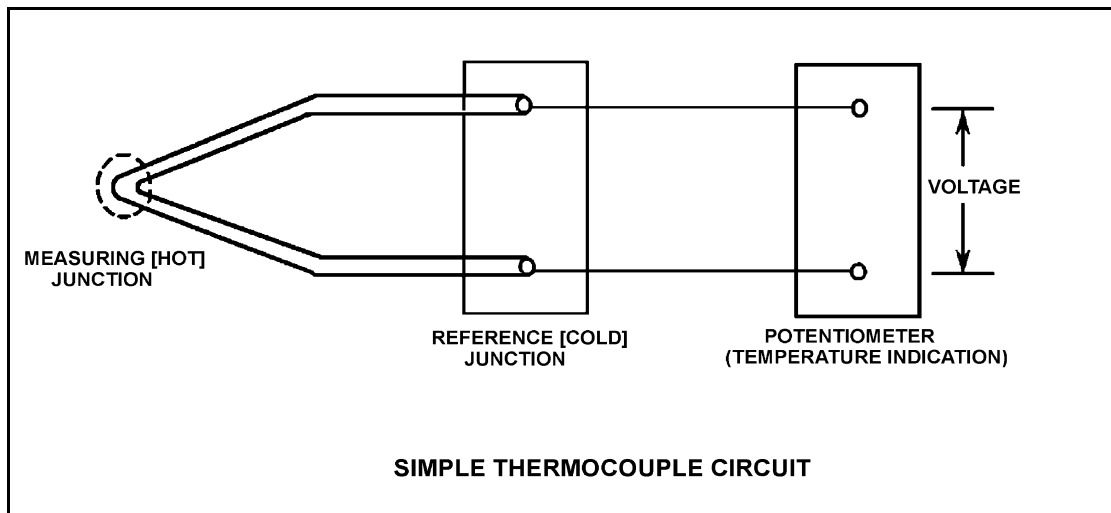
TOPIC:          191002
KNOWLEDGE:   K1.14   [2.8/2.9]
QID:            P2011   (B2009)

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

Thermocouple temperature indication is currently 150°F.  Reference junction temperature is currently 90°F.  Indicator range is from 0°F to 2000°F.

If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

A.  Minimum instrument reading (0°F)

B.  60°F

C.  90°F

D.  Maximum instrument reading (2000°F)

ANSWER:  A.



SIMPLE THERMOCOUPLE CIRCUIT
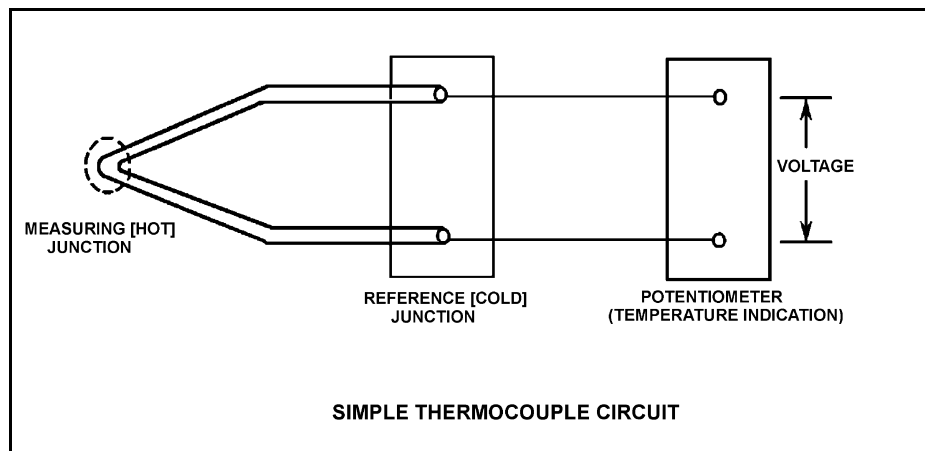
TOPIC:          191002
KNOWLEDGE:   K1.16   [2.3/2.7]
QID:            P813    (B812)

What is the most common type of sensor used to provide remote position indication of a valve that is normally either fully open or fully closed?

A.  Limit switch

B.  Reed switch

C.  Servo transmitter

D.  Linear variable differential transformer

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.16   [2.3/2.7]
QID:            P1313   (B1712)

Which one of the following devices is capable of providing remote indication of valve position on an analog meter in units of "percent of full open"?

A.  Reed switch

B.  Limit switch

C.  Resistance temperature detector

D.  Linear variable differential transformer

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.16   [2.3/2.7]
QID:             P2611

Refer to the simplified drawing of a control rod position detector (see figure below).

Coils of wire connected to an ac power supply are being used to monitor the position of a control rod in a nuclear reactor.  The coils are mounted in a column outside the reactor vessel head such that the steel control rod drive shaft passes upward through the coils as the control rod is withdrawn.  Currently, the top of a control rod drive shaft is located between coils A and B as shown.  The control rod is to be withdrawn until the top of the control rod drive shaft is located just below coil C.

Compared to the initial coil output currents, after the control rod is withdrawn the output current of coil A will be _____; and the output current of coil B will be _____.

A.  higher; higher

B.  higher; lower

C.  the same; higher

D.  the same; lower

ANSWER:  D.



**CONTROL ROD POSITION DETECTOR**
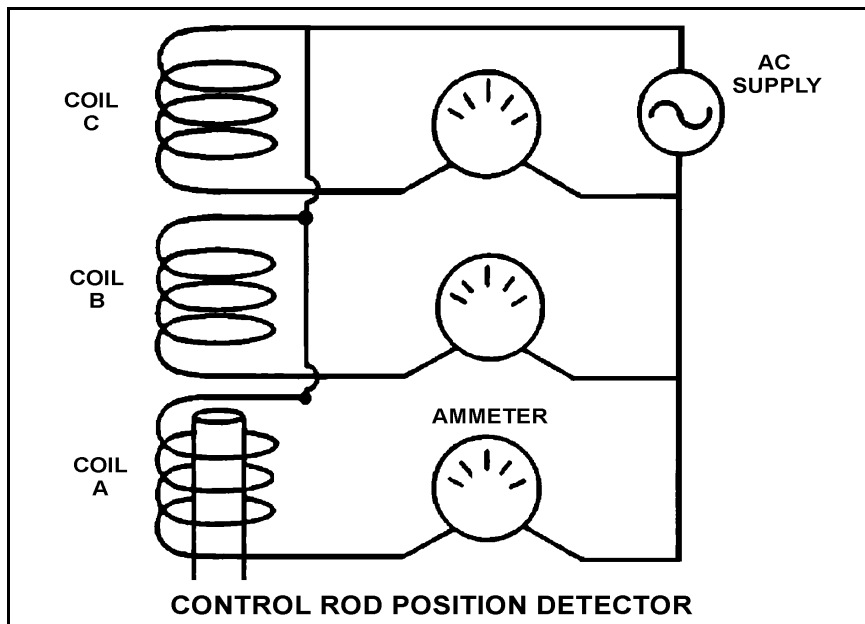
TOPIC:          191002
KNOWLEDGE:   K1.16   [2.3/2.7]
QID:             P2813   (B2811)

Refer to the simplified drawing of a control rod position detector circuit (see figure below).

A magnet on the control rod extension (or drive) shaft sequentially closes individual reed switches mounted vertically adjacent to the control rod drive housing.  A constant +5 dc volts is supplied to the input of the resistor network at resistor $R_1$.

A control rod is initially fully inserted such that all reed switch contacts are open; then the rod is withdrawn until reed switch contact $S_1$ is closed.  Compared to the initial circuit currents,  the current through resistor $R_5$ after the rod withdrawal will be _____, and the output current of the resistor network to the amplifier will be _____.

A.  lower, higher

B.  lower, lower

C.  higher, higher

D.  higher, lower

ANSWER:  A.



CONTROL ROD POSITION DETECTOR
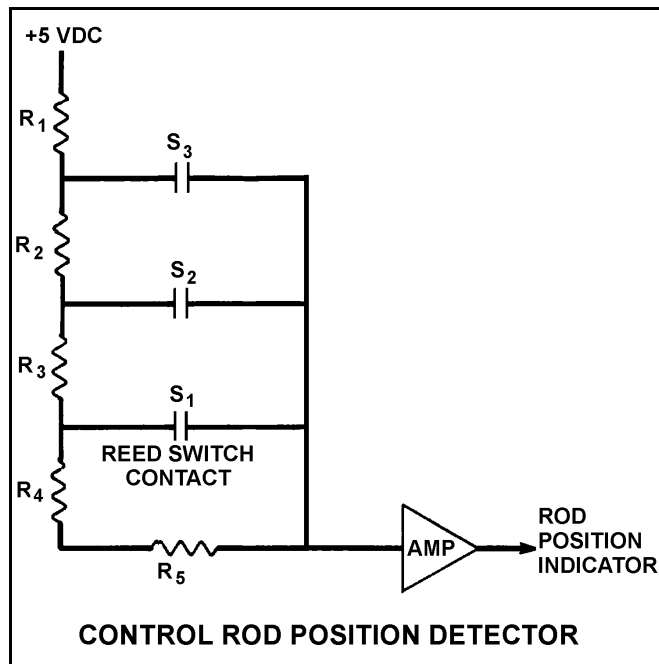
TOPIC:          191002
KNOWLEDGE:   K1.16   [2.3/2.7]
QID:            P2911

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

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

A.  An ac coil on the control rod drive shaft induces a voltage into each reed switch as the drive shaft passes by.

B.  A metal tab on the control rod drive shaft mechanically closes each reed switch as the drive shaft passes by.

C.  The primary and secondary coils of each reed switch attain maximum magnetic coupling as the drive shaft passes by.

D.  A permanent magnet on the control rod drive shaft attracts the movable contact arm of each reed switch as the drive shaft passes by.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:            P415

A nuclear power plant has experienced a loss of coolant accident with degraded emergency core cooling flow.  Core voiding is homogeneous and the core void fraction is currently 20%.

Which one of the following describes excore source/startup range neutron level indication as homogeneous core voiding increases from 20% to 100% of the core?  (Assume the neutron detectors are located adjacent to the bottom portion of the core.)

A.  Decreases continuously.

B.  Decreases, then increases.

C.  Increases continuously.

D.  Increases, then decreases.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:            P1312

A nuclear reactor is shut down at 100 cps in the source/startup range when a loss of coolant accident occurs.  How will excore source/startup range neutron level indication change as homogeneous core voiding increases from 20% to 100% in a shutdown reactor?

A.  Increases because more neutron leakage occurs and then continues to increase because more neutrons are available for subcritical multiplication.

B.  Increases because more neutron leakage occurs and then decreases because fewer neutrons are available for subcritical multiplication.

C.  Decreases because less neutron leakage occurs and then increases because more neutrons are available for subcritical multiplication.

D.  Decreases because fewer neutrons are available for subcritical multiplication and then increases because more neutron leakage occurs.

ANSWER:  B.

TOPIC:              191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:                 P1612

A nuclear reactor is shut down at 100 cps in the source/startup range when a loss of coolant accident occurs. Which one of the following describes excore source/startup range neutron level indication as homogeneous core voiding increases from 20% to 40%?

A.  Increases because more neutron leakage is occurring

B.  Decreases because less neutron leakage is occurring

C.  Increases because $K_{eff}$ is increasing

D.  Decreases because $K_{eff}$ is decreasing

ANSWER:  A.

TOPIC:              191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:                 P1811

A nuclear reactor is shut down at 100 counts per second in the source range when a loss of coolant accident occurs. How will excore source range neutron level indication change as homogeneous core voiding increases from 80% to 100%?

A.  Decreases because $K_{eff}$ is decreasing.

B.  Increases because $K_{eff}$ is increasing.

C.  Decreases because a smaller fraction of the core neutron population is leaking out of the core.

D.  Increases because a larger fraction of the core neutron population is leaking out of the core.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:            P1910

During a nuclear reactor refueling, the fuel assemblies were reconfigured to reduce the power being produced at the center of the core while maintaining the same rated thermal power.  No maintenance or adjustments have been performed on the power range detectors.

How will reactor power level indication compare to actual reactor power when power is stabilized at 50% power?

A.  Indication will be higher than actual power due to increased neutron leakage.

B.  Indication will be higher than actual power due to decreased neutron leakage.

C.  Indication will be lower than actual power due to decreased neutron leakage.

D.  Indication will be lower than actual power due to increased neutron leakage.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:              P2513

A nuclear power plant startup is in progress immediately following a reactor refueling outage.  The external nuclear instrumentation (NI) was calibrated at 90% power just prior to the refueling outage and has <u>not</u> been readjusted.

If actual reactor power level is increased to 90% and stabilized, NI power level will be _____ than actual reactor power level because, when compared to pre-outage 90% power level operation, _____.

A   higher; the total core fission rate has increased

B.  lower; the total core fission rate has decreased

C.  higher; the fission rate in the outer portion of the core has increased

D.  lower; the fission rate in the outer portion of the core has decreased

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:            P2713

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

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

A.  Actual reactor power will be higher than indicated reactor power due to increased core neutron leakage.

B.  Actual reactor power will be higher than indicated reactor  power due to decreased core neutron leakage.

C.  Actual reactor power will be lower than indicated reactor power due to decreased core neutron leakage.

D.  Actual reactor power will be lower than indicated reactor power due to increased core neutron leakage.

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:    K1.17   [3.3/3.5]
QID:              P2812

A nuclear power plant has experienced a loss of coolant accident combined with a loss of emergency coolant injection flow.  Homogeneous core voiding has occurred, with the void fraction currently nearing 100%.  Now, emergency coolant injection flow is restored, which causes a steady reduction in the core void fraction as the core is refilled.

Which one of the following describes the expected trend in excore source/startup range neutron level indication as the homogeneous core void fraction decreases from 100% to 20% in the core and downcomer?  (Assume the source/startup range neutron detectors are located adjacent to the bottom one-third of the core.)

A.  Increases, then decreases

B.  Increases continuously

C.  Decreases, then increases

D.  Decreases continuously

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.17   [3.3/3.5]
QID:            P3112

Given:

- The nuclear reactor is shut down.
- The reactor coolant system is at normal operating pressure and temperature.
- The $BF_3$ source/startup range detectors are properly positioned outside the reactor vessel and adjacent to the lower portion of the core.
- All $BF_3$ source/startup range detectors are indicating approximately 100 cps.
- A sudden loss of coolant pressure accident occurs that causes bulk boiling and homogeneous core voiding in the reactor vessel.

How and why will source/startup range detector outputs change as homogeneous core voiding increases from 0% to 50%?

A.  Increase, because the detectors will experience a higher rate of neutron interactions due to the axial power distribution shifting toward the lower portion of the core.

B.  Increase, because the detectors will experience a higher rate of neutron interactions due to increasing neutron leakage from the core.

C.  Decrease, because the detectors will experience a lower rate of neutron interactions due to a decreasing subcritical multiplication neutron level.

D.  Decrease, because the detectors will experience a lower rate of gamma interactions due to decreasing reactor coolant attenuation.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P15      (B314)

Scintillation detectors convert radiation energy into light by a process known as...

A.  gas amplification.

B.  space charge effect.

C.  luminescence.

D.  photoionization.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P16

A $BF_3$ proportional counter is being used to measure neutron level during a reactor startup.  Which of the following describes the method used to ensure that neutron indication is not being affected by gamma reactions in the detector?

A.  Two counters are used, one sensitive to neutron and gamma and the other sensitive to gamma only.  The outputs are  electrically opposed to cancel the gamma-induced currents.

B.  The BF3 proportional counter measures neutron flux of  sufficient intensity that the gamma signal is insignificant compared to the neutron signal.

C.  In a proportional counter gamma-induced pulses are of insufficient duration to generate a significant log-level amplifier output.  Only neutron pulses have sufficient duration to be counted by the detector instrumentation.

D.  In a proportional counter neutron-induced pulses are significantly larger than gamma pulses.  The detector instrumentation filters out the smaller gamma pulses.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:  K1.18  [2.6/2.8]
QID:            P214    (B213)

Most of the electrons collected in a fission chamber are released as a result of ionizations caused <u>directly</u> by...

A.  fission betas.

B.  fission gammas.

C.  fission neutrons.

D.  fission fragments.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:  K1.18  [2.6/2.8]
QID:            P215

Which one of the following describes the reason for the high sensitivity of a Geiger-Mueller tube radiation detector?

A.  Changes in applied detector voltage have little effect on detector output.

B.  Geiger-Mueller tubes are thinner than other radiation detector types.

C.  Any incident radiation event causing primary ionization results in ionization of the entire detector gas volume.

D.  Geiger-Mueller tubes are operated at relatively low detector voltages, allowing detection of low energy radiation.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P314

A gas-filled radiation detector that is operating in the ionization region is exposed to a gamma radiation field.  If the gamma radiation field is constant and the applied voltage is increased but maintained within the ionization region, the detector output will:

A.  increase, because of an increase in secondary ionizations.

B   remain the same, because detector output is not affected by a change in voltage in this region.

C   increase, because of a decrease in recombination of primary ions.

D   remain the same, because the detector is already producing its maximum output.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P316

Which one of the following materials is installed inside an ion chamber that is typically used for thermal neutron detection and reactor power indication?

A.  Polyethylene

B.  Boron-10

C.  Uranium-238

D.  Rhodium-103

ANSWER:  B.

TOPIC:         191002
KNOWLEDGE:  K1.18  [2.6/2.8]
QID:           P614

Refer to the drawing of a gas-filled detector characteristic curve (see figure below).

In a gas-filled radiation detector, operating in the "proportional" region, essentially _____ of the ions caused by incident radiation are collected and the number of ions collected from secondary ionizations is _____ applied voltage.

A.  all; independent of

B.  none; related to

C.  all; related to

D.  none; independent of

ANSWER:  C.



GAS-FILLED DETECTOR CURVE
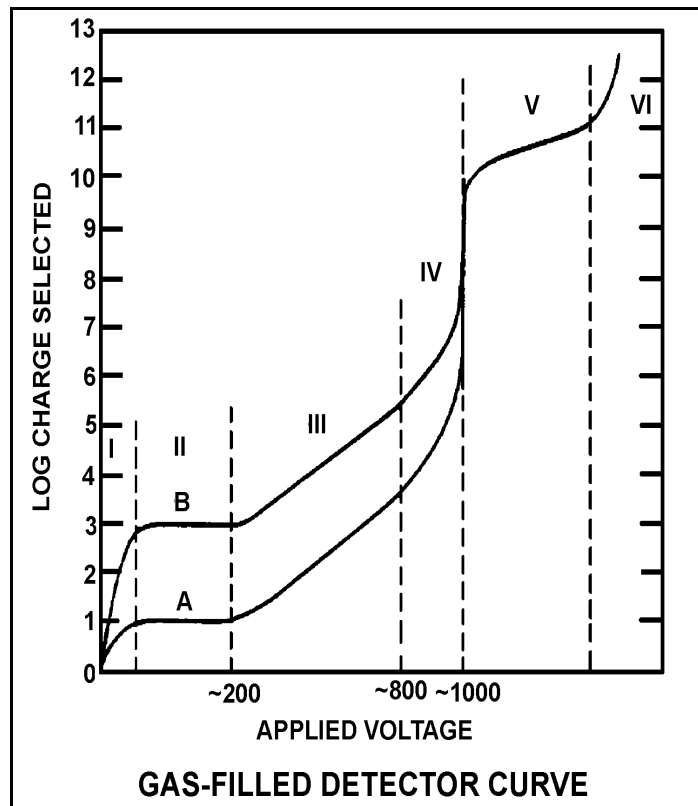
TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P1013

A gas-filled radiation detector that is used to measure thermal neutron flux requires a special feature because thermal neutrons are not directly ionizing particles.  Which one of the following will allow thermal neutron detection in a gas-filled detector?

A.  Encapsulate the detector with polyethylene

B.  Encapsulate the detector with boron-10

C.  Line the inside of the detector with polyethylene

D.  Line the inside of the detector with boron-10

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P1112

Which one of the following is a characteristic of Geiger-Mueller tube radiation detectors?

A.  They can discriminate between neutron and gamma radiation.

B.  They can discriminate between gammas of differing energies in the MeV range.

C.  They provide an output that is inversely proportional to the applied voltage within the Geiger-Mueller region.

D.  They undergo maximum gas amplification whenever an ion is formed in the tube.

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:              P1213

Which one of the following describes why a $BF_3$ proportional counter can be used in the source range to measure neutron radiation in a radiation field that also contains gamma radiation?

A.  Neutrons directly ionize the $BF_3$ gas, producing larger pulses than gammas.

B.  Neutrons interacting with the $BF_3$ gas result in the release of alpha particles which produce larger pulses than gammas.

C.  Neutrons are captured by boron-10 and produce additional neutrons that completely ionize the fill gas in the detector.

D.  The gamma radiation field is insignificant when compared to the neutron field.

ANSWER:  B.

TOPIC:            191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:              P1314

Which one of the following types of radiation will produce the greatest number of ions while passing through 1 centimeter of air?  (Assume the same kinetic energy for each.)

A.  Alpha

B.  Beta

C.  Gamma

D.  Neutron

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:             P1513   (B1514)

Which one of the following lists the two types of gas-filled radiation detectors whose outputs will be least affected by a small variation ($\pm$ 10 volts) in the voltage applied to the detectors?  (Assume voltage remains within normal range.)

A.  Geiger Mueller and ion chamber

B.  Proportional and limited proportional

C.  Ion chamber and proportional

D.  Limited proportional and Geiger Mueller

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:             P1613   (B913)

Which one of the following describes a characteristic of a gas-filled radiation detector operating in the Geiger-Mueller region?

A.  Radiation types can be identified by pulse height.

B.  Specific radionuclides can be identified by energy level.

C.  Small variations in applied voltage will result in large changes in detector output.

D.  Any type of radiation that ionizes the detector gas will produce the same magnitude detector output pulse.

ANSWER:  D.

TOPIC:              191002
KNOWLEDGE:    K1.18   [2.6/2.8]
QID:                 P1713   (B1714)

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

A.  Beta radiation will produce a larger pulse size than either gamma or fast neutron radiation.

B.  Gamma radiation will produce a larger pulse size than either beta or fast neutron radiation.

C.  Fast neutron radiation will produce a larger pulse size than either beta or gamma radiation.

D.  Beta, gamma, and fast neutron radiation will produce pulse sizes that are equal in magnitude.

ANSWER:  D.

TOPIC:              191002
KNOWLEDGE:    K1.18   [2.6/2.8]
QID:                 P1812   (B814)

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

A.  stay approximately the same because all of the primary ions were already being collected at the lower voltage.

B.  stay approximately the same because the ion chamber is operating at saturated conditions.

C.  increase because fewer primary ions are recombining in the detector prior to reaching the electrodes.

D.  increase because more secondary ionizations are occurring in the detector.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P1909   (B1113)

Which one of the following is the function of the positive electrode in an ion chamber?

A.  Produces ions when exposed to a radiation field

B.  Releases electrons to combine with positive ions

C.  Performs gas quenching to maximize detector sensitivity

D.  Collects electrons released during gas ionization

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P2013   (B313)

An ion chamber radiation detector is exposed to a constant gamma radiation field.  If the applied voltage is increased but maintained within the ion chamber region, the rate of ion collection will...

A.  increase with voltage because more secondary ionizations are occurring in the detector.

B.  increase with voltage because less primary ions are recombining in the detector prior to reaching the electrodes.

C.  stay approximately the same because all of the primary ions  were already being collected at the lower voltage.

D.  stay approximately the same because the ion chamber is operating at saturated conditions.

ANSWER:  C.

TOPIC:           191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:              P2014   (B2413)

What is the effect on a proportional neutron detector if the detector operating voltage is increased such that the detector operates near the high end of the true proportional region on the gas-filled detector characteristic curve?

A.  Neutron-induced pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.

B.  The positive space charge effect will increase and prevent collection of both gamma- and neutron-induced pulses, yielding a less accurate neutron count rate.

C.  A high rate of incident gamma radiation will result in the combination of multiple small gamma-induced pulses into larger pulses.  The larger combined pulses will be counted as neutron-induced pulses, yielding a less accurate neutron count rate.

D.  Detection of any single ionizing event will result in ionizing nearly the entire detector gas volume.  The resulting large pulses will prevent the detector from differentiating between radiation types, yielding a less accurate neutron count rate.

ANSWER:  C.

TOPIC:        191002
KNOWLEDGE:  K1.18  [2.6/2.8]
QID:         P2313  (B2613)

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

A.  stay approximately the same because all of the primary ions were already being collected at the higher voltage.

B.  stay approximately the same because the ion chamber is still operating at saturated conditions.

C.  decrease because more primary ions are recombining in the detector prior to reaching the electrodes.

D.  decrease because fewer secondary ionizations are occurring in the detector.

ANSWER:  D.

TOPIC:        191002
KNOWLEDGE:  K1.18  [2.6/2.8]
QID:         P2413  (B2414)

A gas-filled radiation detector operating in the ionization chamber (IC) region is being exposed to a constant gamma radiation field.  If the applied voltage is decreased but maintained within the IC region, the rate of ion collection will...

A.  stay approximately the same because all of the primary ions continue to be collected and essentially no secondary ionizations are occurring.

B.  stay approximately the same because detector operation in the ionization chamber region is characterized by complete ionization of the detector gas.

C.  decrease because fewer primary ionizations are occurring in the detector as detector voltage decreases.

D.  decrease because fewer secondary ionizations are occurring in the detector as detector voltage decreases.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P2613   (B1114)

Which one of the following describes the reason for the high sensitivity of a gas-filled ion chamber operating in the Geiger-Mueller region?

A.  Any radiation-induced ionization results in a large detector output pulse.

B.  Geiger-Mueller detectors are longer than other types of radiation detectors, resulting in greater detector surface area.

C.  The detector output is directly proportional to the applied voltage within the Geiger-Mueller region.

D.  The high detector voltage allows differentiation between the various radiation types.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:             P2913   (B414)

Refer to the drawing of a gas-filled radiation detector characteristic curve (see figure below).

Which one of the following statements describes how a gas-filled radiation detector, operating in the "proportional" region, functions?

A.  Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations are independent of the applied voltage on a logarithmic scale.

B.  The number of ions collected from both primary and secondary ionizations vary directly with the applied voltage on a logarithmic scale.

C.  Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations vary directly with the applied voltage on a logarithmic scale.

D.  The number of ions collected from both primary and secondary ionizations are independent of the applied voltage on a logarithmic scale.

ANSWER:  C.
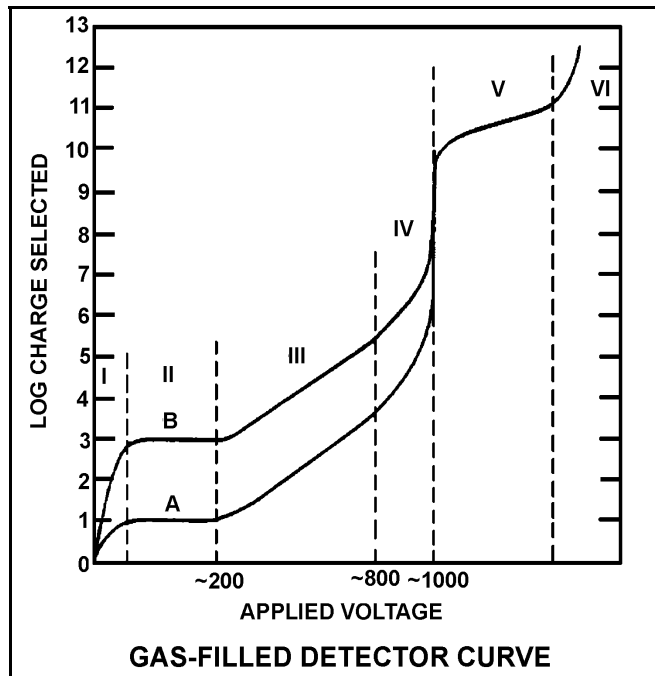
TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P3413

A boron trifluoride ($BF_3$) detector (proportional counter) is normally used to monitor only source range core neutron level.  How will the detector and source range count rate indication be affected if normal detector high voltage is inadvertently applied during nuclear reactor operation in the power range?

A.  The $BF_3$ gas will become completely ionized and source range indication will stabilize at a constant low value.

B.  The $BF_3$ gas will become completely ionized and source range indication will stabilize at a constant high value.

C.  The detector electrodes will become exposed to an extremely high neutron flux and cause a false high reading on the source range indication.

D.  The detector electrodes will become exposed to an extremely high gamma flux and cause a false high reading on the source range indication.

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P3906  (B3907)

A beta particle and an alpha particle enter and cause ionization in a gas-filled radiation detector operating in the Geiger-Mueller region.  Which one of the following accurately compares the amplitude of the detector pulses caused by each type of radiation?

A.  The beta particle pulse will be larger in amplitude.

B.  The alpha particle pulse will be larger in amplitude.

C.  The pulses will be identical for both types of radiation.

D.  Cannot be determined without particle kinetic energy information.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P4506   (B4507)

A nuclear power plant has been shutdown for one month.  A portable gas-filled radiation detector is needed to monitor shutdown reactor core neutron level from a location outside the reactor vessel.  The detector must be able to distinguish between ionizations caused by gamma and neutron radiation.

Which region(s) of the gas-filled detector characteristic curve is/are acceptable for operation of the detector?

A.  Geiger-Mueller, Ionization, and Proportional regions are all acceptable.

B.  Proportional region is acceptable, and Ionization region also may be usable.

C.  Ionization region is acceptable, and Geiger-Mueller region also may be usable.

D.  Geiger-Mueller region is acceptable, and Proportional region also may be usable.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P4806   (B4807)

Select the option that correctly fills in the blanks.

Quench gases are added to gas-filled radiation detectors that operate in the _____ region; the quench gases prevent a single ionization event from causing _____ in the detector gas volume.

A.  ion chamber; multiple discharges

B.  ion chamber; secondary ionizations

C.  Geiger-Mueller; multiple discharges

D.  Geiger-Mueller; secondary ionizations

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:             P4906   (B4907)

Which one of the following contains the pair of radiation detector types that are the most sensitive to low-energy beta and/or gamma radiation?

A.  Geiger-Mueller and scintillation

B.  Geiger-Mueller and ion chamber

C.  Ion chamber and scintillation

D.  Ion chamber and proportional

ANSWER:  A.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:             P5206   (B5207)

A beta particle and an alpha particle with equal kinetic energies cause ionization in a gas-filled radiation detector.  The detector is operating in the ion chamber region of the gas ionization curve.  Which one of the following describes the amplitudes of the detector pulses caused by each type of radiation?

A.  The beta particle pulse will be larger in amplitude.

B.  The alpha particle pulse will be larger in amplitude.

C.  The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region.

D.  The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region, as well as all detector voltages outside the ion chamber region.

ANSWER:  B.

TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P5306   (B5307)

Which one of the following types of radiation detectors is generally <u>not</u> used for measuring a high-intensity beta and gamma radiation field because of a relatively long detector recovery time, or dead time, following each ionization event.

A.  Geiger-Mueller

B.  Ion chamber

C.  Proportional

D.  Scintillation

ANSWER: A.


TOPIC:          191002
KNOWLEDGE:   K1.18   [2.6/2.8]
QID:            P5606   (B5607)

A proportional detector with pulse height discrimination circuitry is being used in a constant field of neutron and gamma radiation to provide source range neutron count rate indication.  Assume that the pulse height discrimination setpoint does <u>not</u> change.

If the detector's operating voltage is increased but maintained within the true proportional operating region, count rate indication will increase because...

A.  a single neutron- or gamma- induced ionizing event will result in multiple pulses inside the detector.

B.  the ratio of the number of neutron-induced pulses to gamma-induced pulses inside the detector will increase.

C.  the positive space charge effect will increase and promote the collection of both gamma- and neutron-induced pulses.

D.  all detector pulses will increase in amplitude and previously uncounted gamma pulses will be added to the total count rate.

ANSWER:  D.

TOPIC:          191002
KNOWLEDGE:   K1.19   [3.1/3.3]
QID:            P216    (B214)

Which one of the following describes a characteristic of a self-reading pocket dosimeter (SRPD)?

A.  The output of an SRPD is a dose rate in mR/hr.

B.  SRPDs are primarily sensitive to beta radiation.

C.  SRPD readings must be considered inaccurate when they are dropped.

D.  SRPDs hold their charge indefinitely when removed from a radiation field.

ANSWER:  C.

TOPIC:          191002
KNOWLEDGE:   K1.19   [3.1/3.3]
QID:            P714    (B714)

Which one of the following types of radiation is the major contributor to the dose indication on a self-reading pocket dosimeter (SRPD)? (also called SRD, PIC, and direct reading dosimeter)

A.  Alpha

B.  Beta

C.  Gamma

D.  Neutron

ANSWER:  C.

TOPIC:            191002
KNOWLEDGE:   K1.20   [2.5/2.7]
QID:              P1114

Which one of the following describes the ion collection that occurs in a proportional counter, such as a BF$_3$ detector?

A.  A fraction of the ions created by primary ionizations are collected.  No secondary ionizations take place.

B.  Virtually all of the ions created by primary ionizations are collected.  No secondary ionizations take place.

C.  Virtually all of the ions created by primary ionizations along with a fraction of the ions created by secondary ionizations are collected.

D.  Virtually all of the ions created by primary and secondary ionizations are collected.

ANSWER:  D.

TOPIC:            191002
KNOWLEDGE:   K1.20   [2.5/2.7]
QID:              P1514   (B511)

A BF$_3$ gas-filled detector, operating in the proportional region, is being used to monitor reactor power while shut down.  If a complete loss of detector gas pressure occurs, the instrument indication will fail...

A.  upscale.

B.  downscale.

C.  as is.

D.  to midscale.

ANSWER:  B.

NRC Generic Fundamentals Examination Question Bank--PWR
August 2008

TOPIC:          191002
KNOWLEDGE:   K1.20   [2.5/2.7]]
QID:            P3714   (B3714)

During reactor power operation, a reactor coolant sample is taken and analyzed.  Which one of the following lists three radionuclides that are all indicative of a fuel cladding failure if detected in elevated concentrations in the reactor coolant sample?

A.  Lithium-6, cobalt-60, and argon-41

B.  Iodine-131, cesium-138, and strontium-89

C.  Nitrogen-16, xenon-135, and manganese-56

D.  Hydrogen-2 (deuterium), hydrogen-3 (tritium), and oxygen-18

ANSWER:  B.

TOPIC: 191003
KNOWLEDGE: K1.01 [3.1/3.2]
QID: P17 (B15/B1414)

The difference between the setpoint in an automatic controller and the steady-state value of the controlled parameter is called...

A. offset.

B. gain.

C. deadband.

D. feedback.

ANSWER: A.

TOPIC: 191003
KNOWLEDGE: K1.01 [3.1/3.2]
QID: P217 (B215)

In an automatic flow controller, the range of values around the set point of a measured variable where no action occurs is called...

A. bias.

B. error.

C. deadband.

D. deviation.

ANSWER: C.

TOPIC:              191003
KNOWLEDGE:   K1.01   [3.1/3.2]
QID:                P715    (B1817)

An automatic flow controller is being used to position a valve in a cooling water system.  The controller develops a flow error signal and then increases the magnitude of the signal to drive the valve operator.

The factor by which the magnitude of the flow error signal is increased is referred to as...

A.  bias.

B.  gain.

C.  feedback.

D.  offset.

ANSWER:  B.

TOPIC:              191003
KNOWLEDGE:   K1.01
QID:                P1115

A typical flow controller uses the _____ method of control.

A.  open-loop

B.  on-off

C.  closed-loop

D.  external regulating

ANSWER:  C.

TOPIC:          191003
KNOWLEDGE:  K1.01   [3.1/3.2]
QID:             P1518   (B1616)

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

A.  Offset

B.  Gain

C.  Dead time

D.  Feedback

ANSWER:  C.

TOPIC:          191003
KNOWLEDGE:  K1.01   [3.1/3.2]
QID:             P1615   (B715)

An automatic flow controller is being used to position a valve in a cooling water system.  A signal from the valve, which is proportional to valve position, is returned to the controller.  This signal is referred to as...

A.  gain.

B.  bias.

C.  feedback.

D.  error.

ANSWER:  C.

TOPIC:           191003
KNOWLEDGE:   K1.01   [3.1/3.2]
QID:             P3715   (B3715)

A flow controller has proportional, integral, and derivative control features. Which one of the following lists the effect on the control features when the controller is switched from the automatic mode to the manual mode?

A.  Only the derivative feature will be lost.

B.  Only the integral and derivative features will be lost.

C.  All proportional, integral, and derivative features will be lost.

D.  All control features will continue to influence the controller output.

ANSWER:  C.

TOPIC:           191003
KNOWLEDGE:   K1.01   [3.1/3.2]
QID:             P5607   (B5608)

Consider a direct-acting proportional flow controller that is maintaining flow rate at a value that is offset from the controller setpoint.  If the controller's gain is increased, the controller's offset will _____ and the controller's proportional band will _____.

A.  decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:  K1.02   [2.6/2.7]
QID:            P218    (B3115)

An emergency diesel generator (D/G) is operating as the only power source connected to an emergency bus.  The governor of the D/G is <u>directly</u> sensing D/G _____ and will <u>directly</u> adjust D/G _____ flow to maintain a relatively constant D/G frequency.

A.  speed; fuel

B.  speed; air

C.  load; fuel

D.  load; air

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:  K1.02   [2.6/2.7]
QID:            P417    (B417)

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

A.  decrease to a minimum speed setpoint.

B.  increase, until the mismatch with demanded turbine speed is nulled.

C.  decrease, until the mismatch with demanded turbine speed is nulled.

D.  increase, until an upper limit is reached or the turbine trips on overspeed.

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.02   [2.6/2.7]
QID:             P1316

An emergency diesel generator (D/G) is the only power source connected to an emergency bus.  The governor of the D/G directly senses D/G _____ and adjusts D/G fuel flow to maintain a relatively constant D/G _____.

A.  voltage; voltage

B.  voltage; frequency

C.  speed; voltage

D.  speed; frequency

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.02   [2.6/2.7]
QID:             P1815   (B1016)

If the turbine shaft speed signal received by a typical turbine governor control system fails <u>high</u> 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.

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.03   [3.1/3.1]
QID:            P616

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

An increasing steam generator (S/G) level will decrease the S/G level control signal and reduce the control air pressure applied to the feed control valve which reduces feedwater flow to the S/G.

If the level control signal is manually increased, how will the pneumatic control system affect steam generator level?

A.  Level will increase because the valve positioner will close more.

B.  Level will decrease because the valve positioner will close more.

C.  Level will increase because the valve positioner will open more.

D.  Level will decrease because the valve positioner will open more.

ANSWER:  C.



**PNEUMATIC CONTROL SYSTEM - PWR**
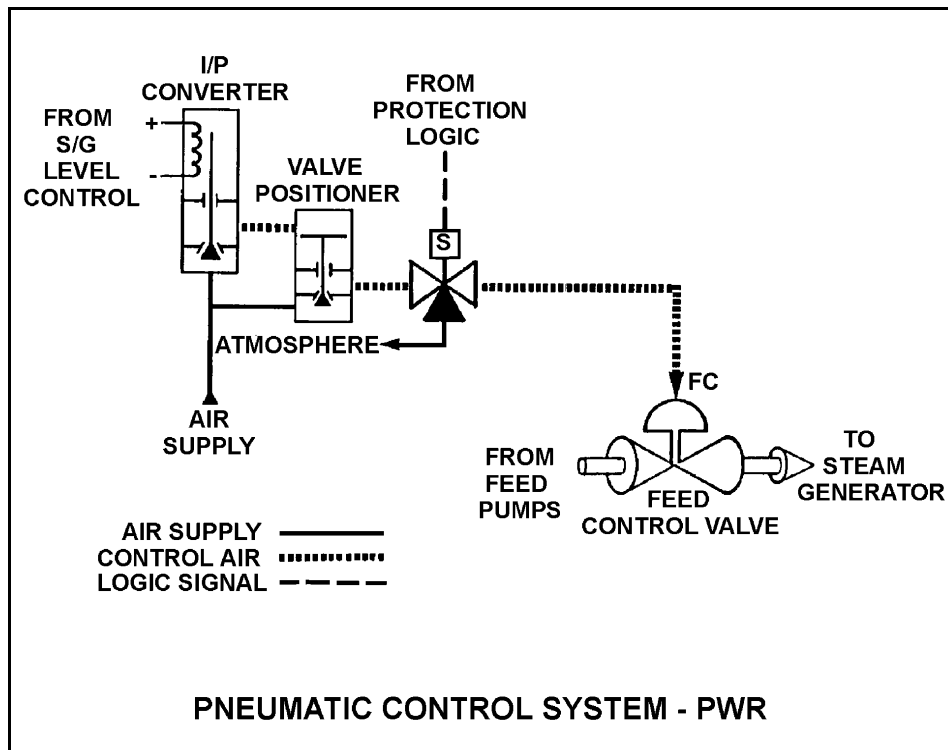
TOPIC:         191003
KNOWLEDGE:   K1.03   [3.1/3.1]
QID:           P2117

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

An increasing steam generator (S/G) water level will decrease the S/G level control signal and reduce the control air pressure applied to the actuator of the feed control valve.

If the level control signal fails high, S/G water level will _____ because the control air pressure to the valve positioner will _____.

A.  decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  D.
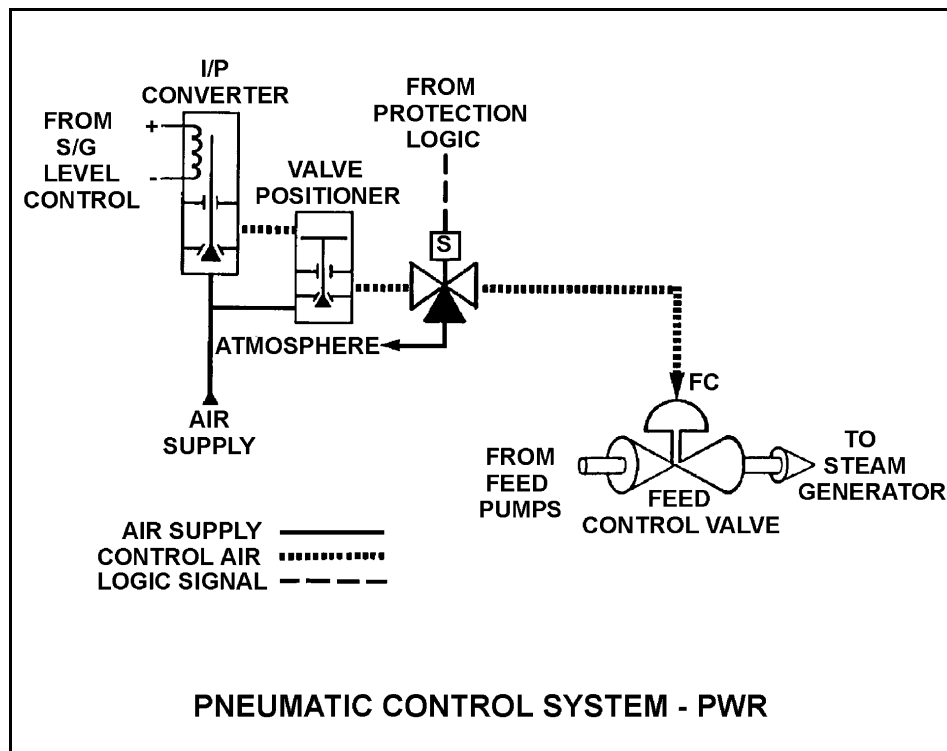
TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P617    (B516)

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

If the temperature transmitter fails <u>high</u> (high temperature output signal), the temperature controller will _____ the temperature control valve, causing the actual heat exchanger lube oil outlet temperature to _____.

A.  open; decrease

B.  open; increase

C.  close; decrease

D.  close; increase

ANSWER:  A.



LUBE OIL TEMPERATURE CONTROL SYSTEM
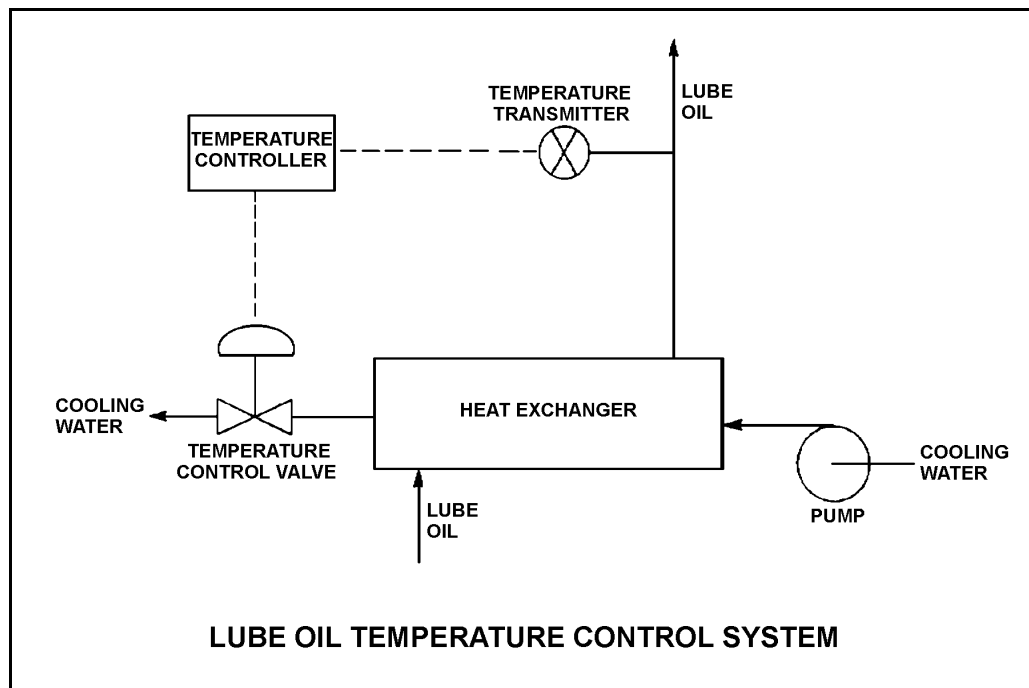
TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P1216

If a typical flow controller is in manual control, the output of the flow controller is determined by the...

A.  operator.

B.  system feedback.

C.  plant computer.

D.  flow error signal.

ANSWER:  A.

TOPIC:         191003
KNOWLEDGE:  K1.04   [2.8/3.0]
QID:            P1315   (B917)

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

If the temperature transmitter fails <u>low</u> (low temperature output signal), the temperature controller will throttle the temperature control valve _____, causing the actual heat exchanger lube oil outlet temperature to _____.

A.  closed; decrease

B.  closed; increase

C.  open; decrease

D.  open; increase

ANSWER:  B.



**LUBE OIL TEMPERATURE CONTROL SYSTEM**
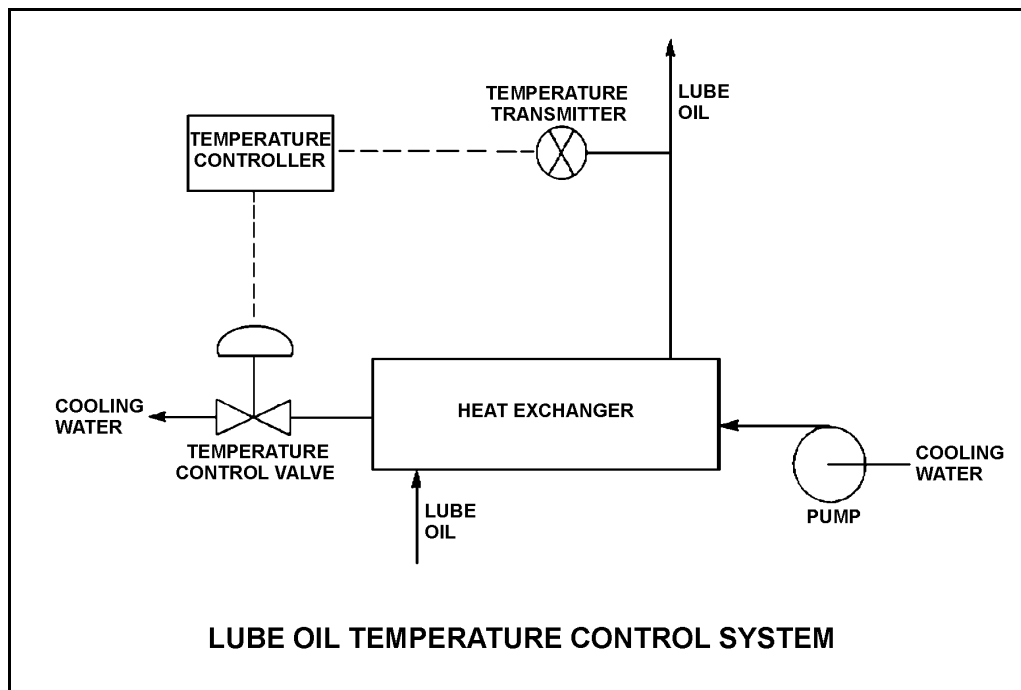
TOPIC:        191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:          P1715   (B1914)

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

Which one of the following describes the type of control used in the lube oil temperature control system?

A.  Open loop, because lube oil temperature feedback is being provided to the controller from the lube oil temperature transmitter

B.  Open loop, because lube oil temperature is being controlled by positioning a flow control valve in a separate system

C.  Closed loop, because lube oil temperature feedback is being provided to the controller from the lube oil temperature transmitter

D.  Closed loop, because lube oil temperature is being controlled by positioning a flow control valve in a separate system

ANSWER:  C.



**LUBE OIL TEMPERATURE CONTROL SYSTEM**

TOPIC:      191003
KNOWLEDGE:  K1.04  [2.8/3.0]
QID:          P2016  (B2016)

Refer to the drawing of a lube oil temperature control system (see figure below). The temperature control valve is currently 50% open.

If the cooling water inlet temperature decreases, the temperature controller will position the temperature control valve more _____, causing cooling water differential temperature through the heat exchanger to _____.

A.  closed; increase

B.  closed; decrease

C.  open; increase

D.  open; decrease

ANSWER:  A.



LUBE OIL TEMPERATURE CONTROL SYSTEM

TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:              P3015   (B3016)

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram.  The bistable turns on to actuate an alarm at a system pressure of 100 psig.  The bistable has a 5 psig dead band, or neutral zone.

If current system pressure is 90 psig, which one of the following describes the alarm response as system pressure is slowly increased to 110 psig?

A.  The alarm is currently actuated and will turn off at 95 psig.

B.  The alarm will actuate at 100 psig and will <u>not</u> turn off.

C.  The alarm is currently actuated and will turn off at 105 psig.

D.  The alarm will actuate at 100 psig and will turn off at 105 psig.

ANSWER:  C.

TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:              P3215   (B3216)

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram.  The bistable turns on to actuate an alarm at a system pressure of 100 psig.  The bistable has a 5 psig dead band, or neutral zone.

If current system pressure is 90 psig, which one of the following describes the alarm response as system pressure is slowly increased to 110 psig?

A.  The alarm is currently actuated and will turn off at 95 psig.

B.  The alarm will actuate at 100 psig and will <u>not</u> turn off.

C.  The alarm is currently actuated and will turn off at 105 psig.

D.  The alarm will actuate at 100 psig and will turn off at 105 psig.

ANSWER:  B.

TOPIC:        191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:          P3516

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram.  The bistable turns on to actuate an alarm at a system pressure of 100 psig.  The bistable has a 5 psig dead band, or neutral zone.

If system pressure is currently 110 psig, which one of the following describes the alarm circuit response as system pressure slowly decreases to 90 psig?

A.  The alarm will actuate at 100 psig and will <u>not</u> turn off.

B.  The alarm will actuate at 100 psig and will turn off at 95 psig.

C.  The alarm is currently actuated and will <u>not</u> turn off.

D.  The alarm is currently actuated and will turn off at 95 psig.

ANSWER:  A.

PRESSURE SIGNAL

BISTABLE

A
ALARM
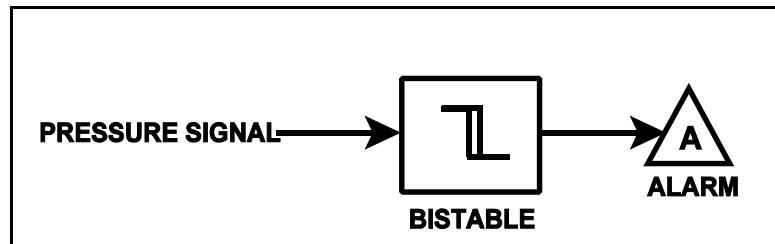
TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P3816   (B3817)

Refer to the drawing of four bistable symbols (see figure below).

A temperature controller uses a bistable that turns on to actuate a warning light when the controlled temperature reaches a low setpoint.  The warning light extinguishes immediately after the temperature increases above the low setpoint.

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

A.  1.

B.  2.

C.  3.

D  4.

ANSWER:  A.
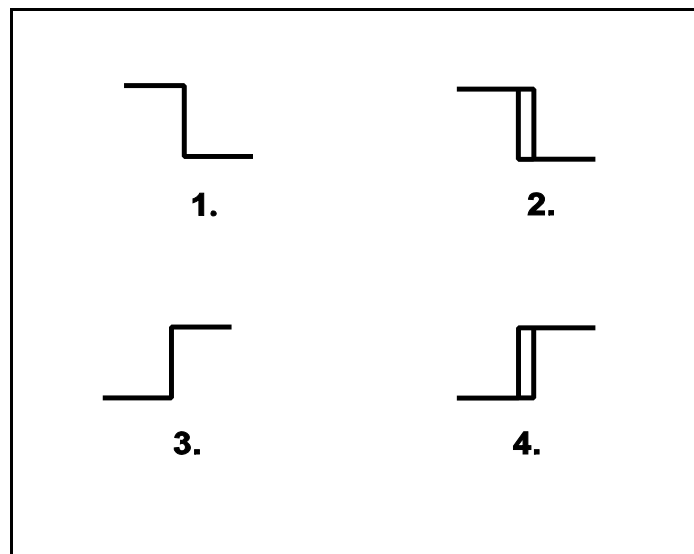
TOPIC:           191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:              P4508   (B4509)

Refer to the drawing of four bistable symbols (see figure below).

A temperature controller uses a bistable that turns on to actuate a warning light when the controlled temperature reaches a high setpoint.  The bistable turns off to extinguish the warning light when the temperature decreases to 5°F below the high setpoint.

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

A.  1.

B.  2.

C.  3.

D   4.

ANSWER:  D.
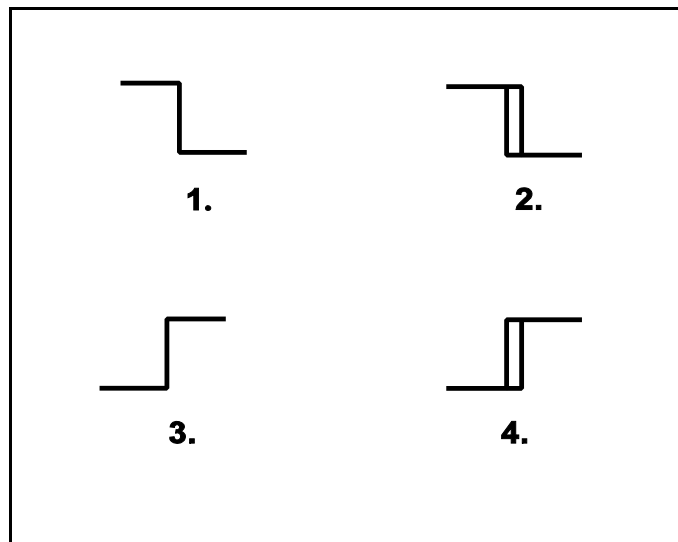
TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:              P4607  (B4609)

Refer to the drawing of a temperature bistable in a bistable alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram.  The bistable turns on to actuate an alarm at a temperature of 130°F.  The bistable has a 5°F dead band, or neutral zone.

If the current temperature is 150°F, which one of the following describes the alarm response as temperature slowly decreases to 110°F?

A.  The alarm is currently actuated and will <u>not</u> turn off.

B.  The alarm will actuate at 130°F and will <u>not</u> turn off.

C.  The alarm is currently actuated and will turn off at 125°F.

D.  The alarm will actuate at 130°F and will turn off at 125°F.

ANSWER:  B.
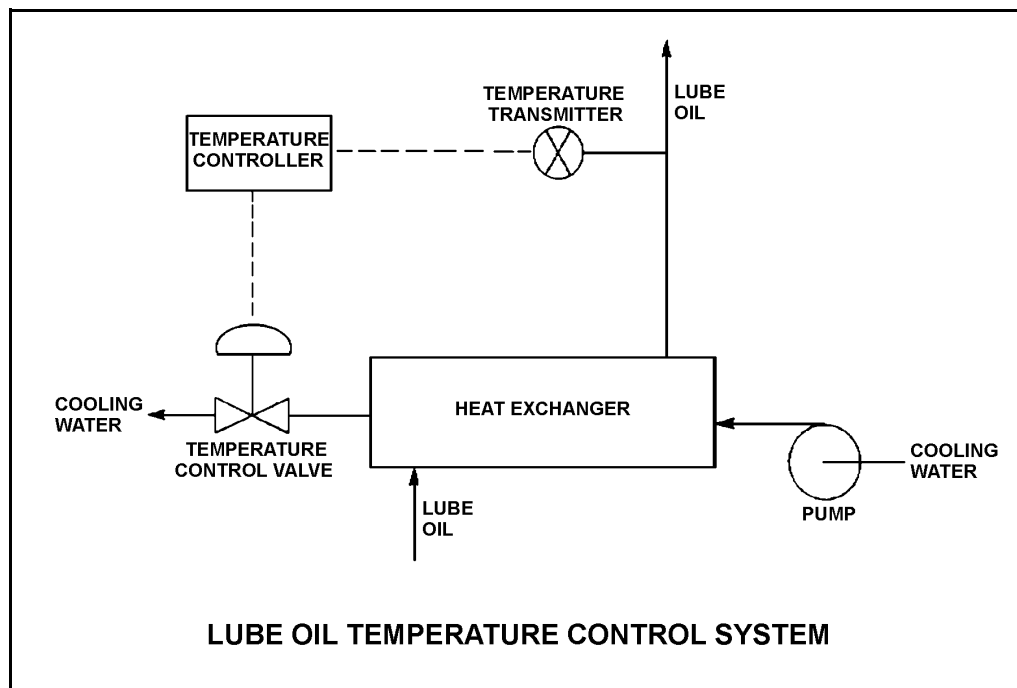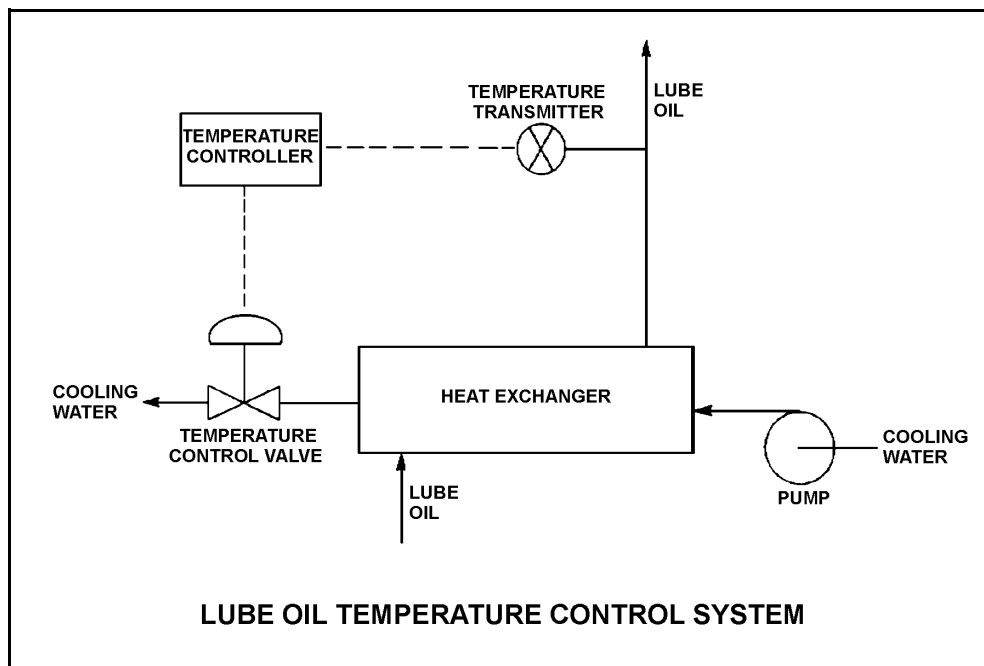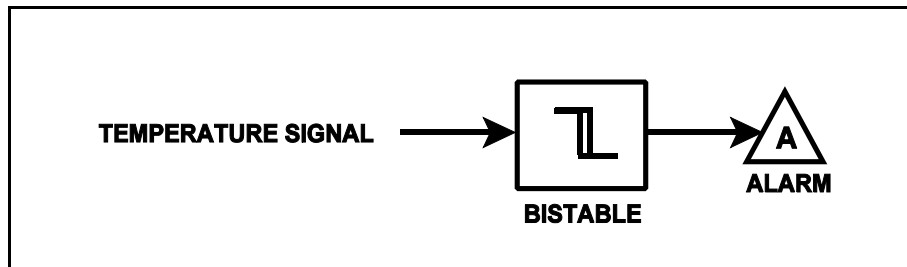
TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P5107   (B5109)

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

The temperature controller is a direct-acting proportional controller with a gain of 1.0.  Which one of the following describes the effect of changing the gain to 2.0?

A.  Half the temperature deviation from setpoint will produce a given controller output.

B.  Twice the temperature deviation from setpoint will produce a given controller output.

C.  The temperature control valve will move half as far for a given change in controller output.

D.  The temperature control valve will move twice as far for a given change in controller output.

ANSWER:  A.



LUBE OIL TEMPERATURE CONTROL SYSTEM
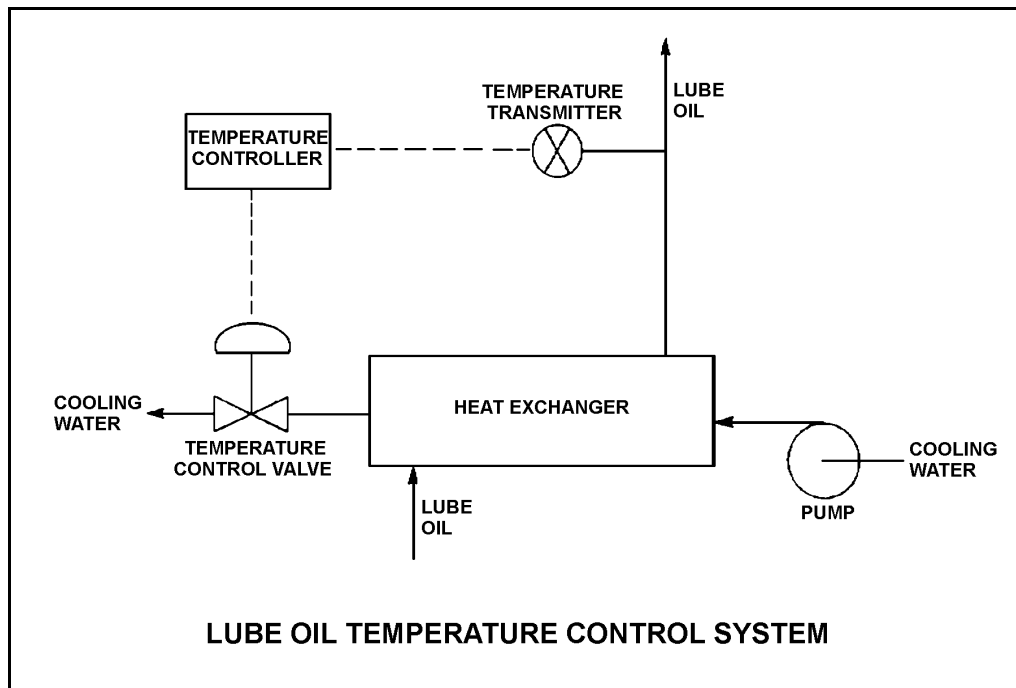
TOPIC:            191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:               P5308   (B5309)

A direct-acting proportional controller is being used to control the temperature of lube oil exiting a heat exchanger.  The controller's proportional band is 70°F to 120°F.

Which one of the following will be the controller output percentage when the measured lube oil temperature is 83°F?

A.  13%

B.  26%

C.  37%

D.  74%

ANSWER: B.

TOPIC:            191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:               P5508   (B5509)

A reverse-acting proportional controller is being used to control the temperature of lube oil exiting a heat exchanger.  The controller's proportional band is 70°F to 120°F.

Which one of the following will be the controller output when the measured lube oil temperature is 83°F?

A.  13%

B.  26%

C.  74%

D.  87%

ANSWER: C.

TOPIC:          191003
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P5608   (B5609)

The temperature of the water in a storage tank is monitored by a bistable alarm circuit.  If water temperature decreases to 50°F a bistable turns on to actuate an alarm indicator.  As soon as the water temperature exceeds 50°F the bistable turns off to clear the alarm.

Which one of the following bistable symbols indicates the characteristics of the bistable used in the alarm circuit?

A.  1.

B.  2.

C.  3.

D   4.

ANSWER:  A.
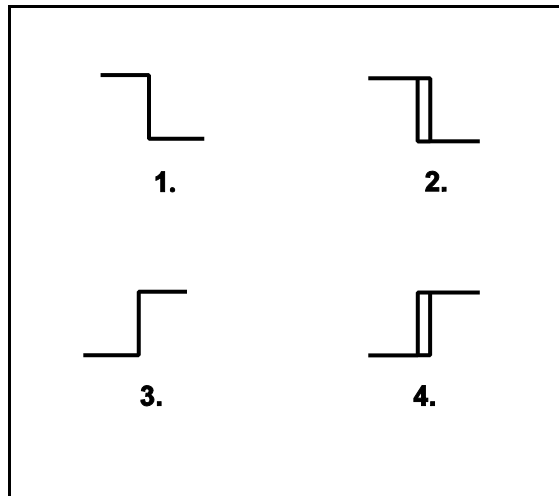
TOPIC:            191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:              P18     (B816/B217)

The output pressure of a pneumatic controller is typically insufficient to drive a valve actuator accurately.  To overcome this problem, a valve operating control loop would <u>normally</u> employ a...

A.  valve actuating lead/lag unit.

B.  pressure regulator.

C.  valve positioner.

D.  pressure modulator.

ANSWER:  C.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:              P318     (B317)

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.

ANSWER:  A.



PNEUMATIC CONTROL SYSTEM - PWR
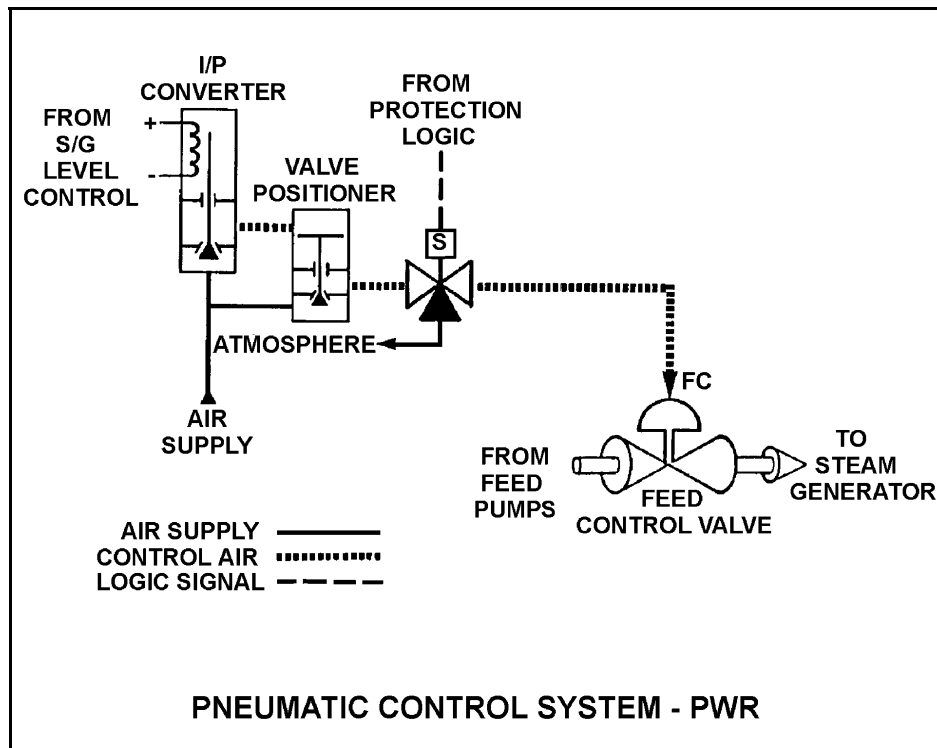
TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:             P1116   (B2816)

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

A.  They provide auto and manual demand signals to valve controllers and valve actuators.

B.  They supply air pressure to valve actuators in response to a control signal to regulate valve position.

C.  They can either receive or supply air to/from valve controllers, depending on the direction of valve travel.

D.  They act independently of the valve controller, in order to prevent pressure transients on the actuator diaphragm.

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:             P1117   (B1116)

An air-operated isolation valve requires 4,800 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation.  The air supply system can provide a nominal 80 psig of air pressure to the actuator.

What is the minimum surface area of the actuator diaphragm required for proper valve operation?

A.   15 square inches

B.   60 square inches

C.  120 square inches

D.  240 square inches

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:            P1217   (B1416)

The purpose of a typical valve positioner in a pneumatic control system is to...

A.  provide actual valve position feedback to the valve controller.

B.  position the solenoid valve that supplies air to the valve actuator.

C.  compare valve controller output signal to setpoint error and adjust valve actuator air supply pressure to position the valve.

D.  compare valve controller output signal to valve position, and adjust valve actuator air supply pressure to position the valve.

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:            P1516   (B1517)

An air-operated isolation valve requires 3,200 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation.  The area of the actuator diaphragm is 80 square inches.

What is the minimum air pressure (rounded to the nearest psig) required for proper valve operation?

A.  10 psig

B.  25 psig

C.  40 psig

D.  55 psig

ANSWER:  C.

TOPIC:         191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:            P1618   (B1617)

An air-operated isolation valve requires 3,600 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation.  The valve positioner can supply a nominal 120 psig of air pressure to the actuator.

What is the minimum surface area of the actuator diaphragm required for proper valve operation?

A.  30 square inches

B.  60 square inches

C.  90 square inches

D.  120 square inches

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:          P1716

Refer to the drawing of an air-operated isolation valve (see figure below).

The valve requires 2,400 lbf applied to the top of the actuator diaphragm to open.  The actuator diaphragm has a surface area of 60 square inches and the valve stem travels 2 inches from fully open to fully closed.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the minimum air pressure required to open the valve?

A.  10 psig

B.  20 psig

C.  30 psig

D.  40 psig

ANSWER:  D.



**PNEUMATIC CONTROL SYSTEM - PWR**
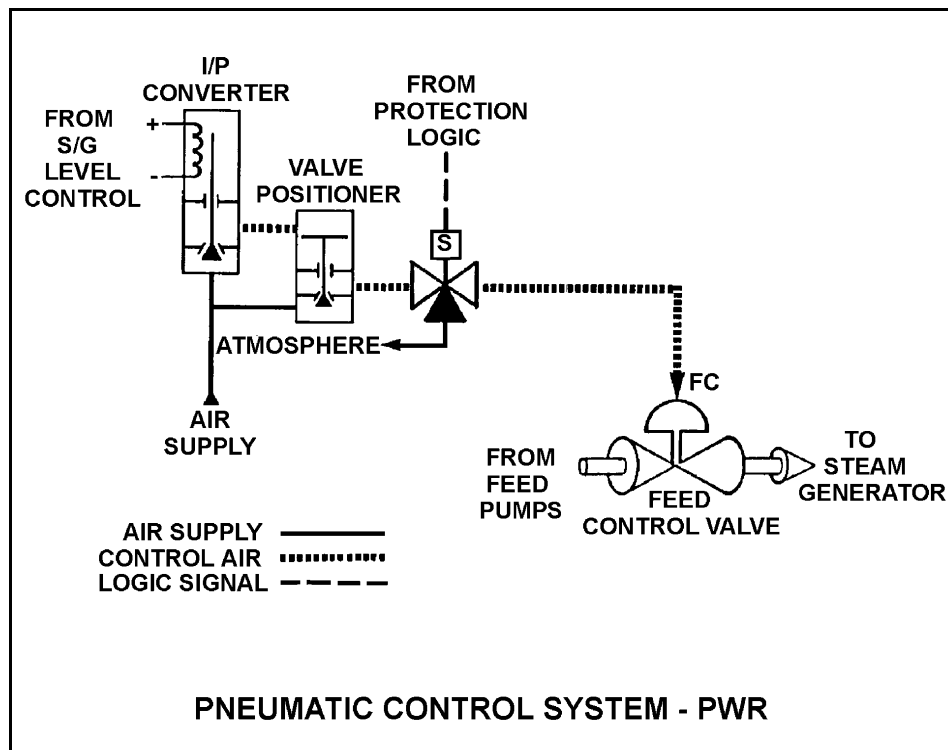
TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:              P2116   (B2117)

An air-operated isolation valve requires 3,200 pounds-force from its pneumatic actuator and 4 inches of stem travel for proper operation.  The area of the actuator diaphragm is 160 square inches.

What is the minimum air pressure (rounded to the nearest psig) required for proper valve operation?

A.  20 psig

B.  40 psig

C.  60 psig

D.  80 psig

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:              P2216   (B3317)

An air-operated isolation valve requires 2,800 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation.  The valve positioner can supply a nominal 117 psig of air pressure to the actuator.

What is the minimum surface area of the actuator diaphragm required for proper valve operation? (Answer options are rounded to the nearest square inch.)

A.  24 square inches

B.  48 square inches

C.  94 square inches

D.  138 square inches

ANSWER:  A.

TOPIC:            191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:              P2416   (B2917)

Which one of the following describes the operation of a typical pneumatic valve positioner?

A.  Compares the valve controller demand signal with actual valve position and sends an error signal to the valve controller for adjustment of the demand signal.

B.  Compares the valve controller automatic and manual setpoints and sends an error signal to the valve controller to ensure the manual demand signal is tracking the automatic demand signal.

C.  Receives a valve position error signal from the valve controller and positions the valve as necessary to null the valve position error signal.

D.  Receives a demand signal from the valve controller and supplies the appropriate air pressure to the valve actuator to move the valve to the demanded position.

ANSWER:  D.

TOPIC:            191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:              P2417   (B2416)

An air-operated isolation valve requires 3,600 lbf applied to the top of the actuator diaphragm to open.  The actuator diaphragm has a diameter of 9 inches.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the approximate air pressure at which the valve will begin to open?

A.  14 psig

B.  57 psig

C.  81 psig

D.  127 psig

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:              P2517   (2516)

An air-operated isolation valve requires 2,400 lbf applied to the top of the actuator diaphragm to open.  The actuator diaphragm has a diameter of 12 inches.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the approximate air pressure at which the valve will begin to open?

A.  21 psig

B.  34 psig

C.  43 psig

D.  64 psig

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:  K1.05   [2.5/2.8]
QID:              P2617   (B2216)

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

A.  They can provide automatic and manual demand signals to pneumatic controllers and valve actuators.

B.  They can increase or decrease air pressure to valve actuators to obtain the proper valve response.

C.  They can either supply or receive air to/from pneumatic controllers, depending on the direction of valve travel.

D.  They can increase air pressure to valve actuators above existing main air header pressure.

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:            P2716   (B2716)

An air-operated isolation valve requires 3,600 lbf applied to the top of the actuator diaphragm to open.  The actuator diaphragm has a diameter of 8 inches.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the approximate air pressure at which the valve will begin to open?

A.  32 psig

B.  45 psig

C.  56 psig

D.  72 psig

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.05   [2.5/2.8]
QID:            P2917   (B2915)

An air-operated isolation valve requires 2,400 lbf applied to the top of the actuator diaphragm to open against spring pressure.  The actuator diaphragm has a diameter of 12 inches.

If control air pressure to the valve actuator begins to decrease from 100 psig, which one of the following is the approximate air pressure at which the valve will begin to close?

A.  5.3 psig

B.  16.7 psig

C.  21.2 psig

D.  66.7 psig

ANSWER:  C.

TOPIC:         191003
KNOWLEDGE:  K1.06   [2.3/2.6]
QID:            P419    (B1316)

Refer to the drawing of a flyball-weight mechanical speed governor (see figure below).

In a flyball-weight mechanical speed governor, the purpose of the spring on the flyball mechanism is to _____ centrifugal force by driving the flyballs _____.

A.  counteract; apart

B.  aid; together

C.  counteract; together

D.  aid; apart

ANSWER:  C.



**FLYBALL-WEIGHT MECHANICAL SPEED GOVERNOR**
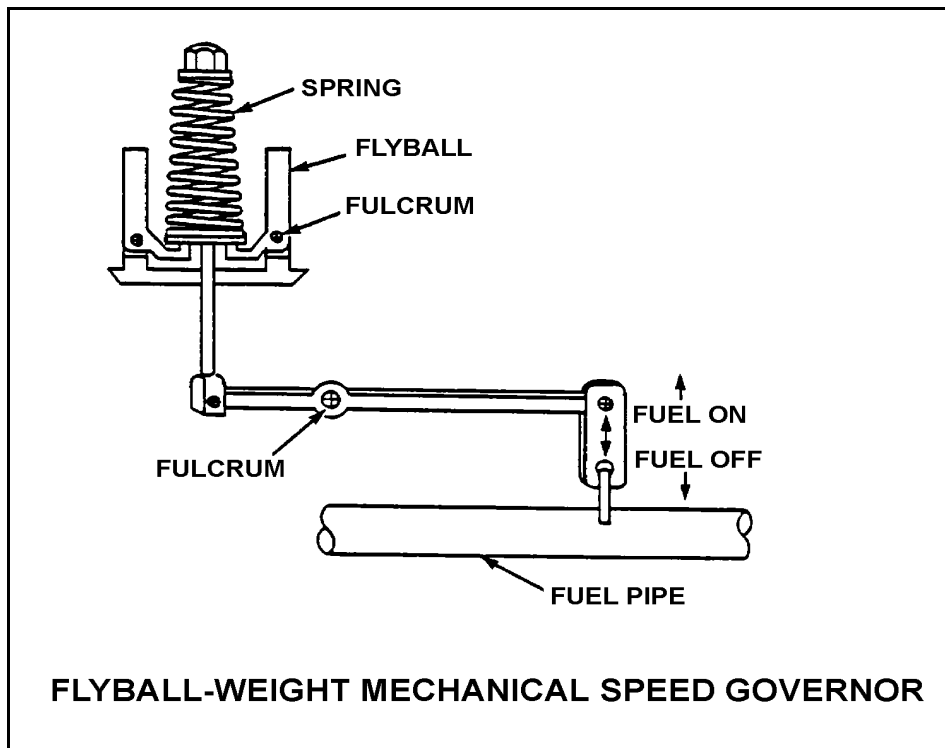
TOPIC:          191003
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:           P1818   (B1815)

A diesel generator is supplying an isolated electrical bus with the governor operating in the isochronous mode.  If a large electrical load is started on the bus, generator frequency will...

A.  initially decrease, then increase and stabilize below the initial value.

B.  initially decrease, then increase and stabilize at the initial value.

C.  initially decrease, then increase and stabilize above the initial value.

D.  remain constant during and after the load start.

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:           P2018   (B2015)

A diesel generator is supplying an isolated electrical bus with the governor operating in the isochronous mode.  If a large electrical bus load trips, generator frequency will...

A.  initially increase, then decrease and stabilize below the initial value.

B.  initially increase, then decrease and stabilize at the initial value.

C.  initially increase, then decrease and stabilize above the initial value.

D.  remain constant during and after the load trip.

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:             P2818   (B2817)

A diesel generator (DG) is supplying an isolated electrical bus with the DG governor operating in the speed droop mode.  Assuming the DG does <u>not</u> trip, if a large electrical bus load trips, bus frequency will initially...

A.  increase, then decrease and stabilize below the initial value.

B.  increase, then decrease and stabilize above the initial value.

C.  decrease, then increase and stabilize below the initial value.

D.  decrease, then increase and stabilize above the initial value.

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.07   [2.3/2.6]
QID:             P1019

Which one of the following refers to the transfer of controller modes from automatic-to-manual or manual-to-automatic without causing a system perturbation?

A.  A direct transfer

B.  A deadband transfer

C.  An analog-to-digital transfer

D.  A bumpless transfer

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:            P3617   (B3616)

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

Given:

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

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

A.  direct-acting; open

B.  direct-acting; closed

C.  reverse-acting; open

D.  reverse-acting; closed

ANSWER:  D.
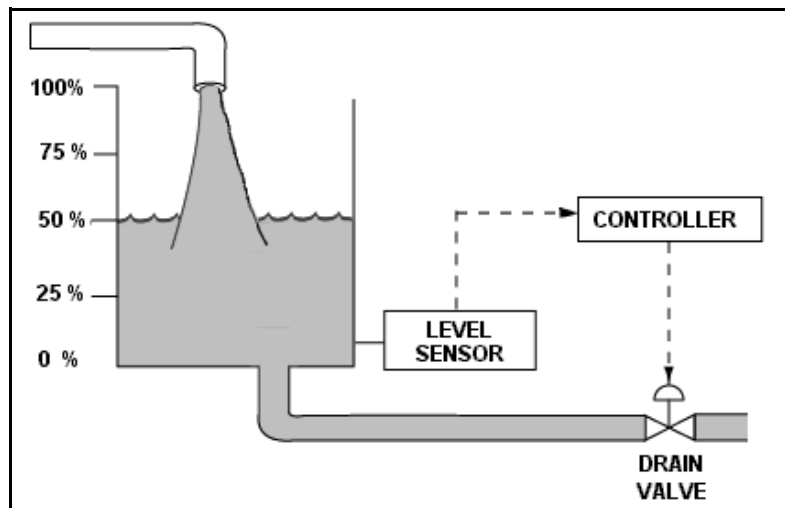
TOPIC:          191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:            P4109   (B4108)

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

Given:

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

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

A.  direct-acting; open

B.  direct-acting; closed

C.  reverse-acting; open

D.  reverse-acting; closed

ANSWER:  B.
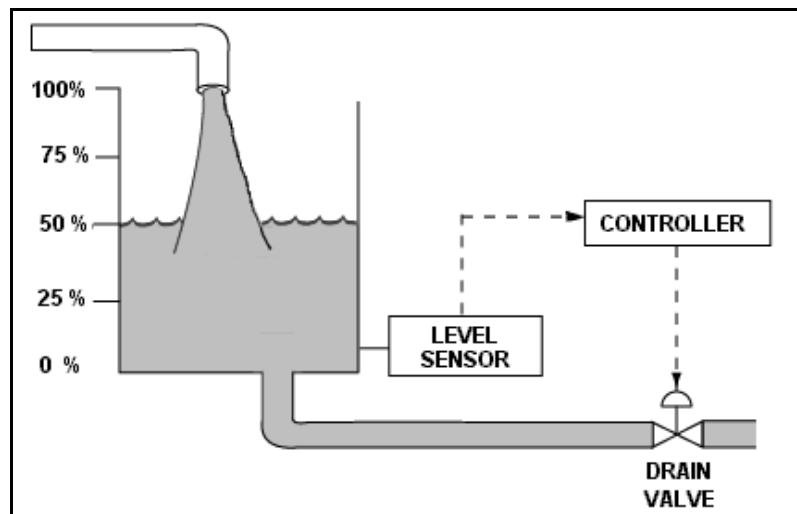
TOPIC:           191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:             P4408   (B4408)

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

ANSWER:  D.
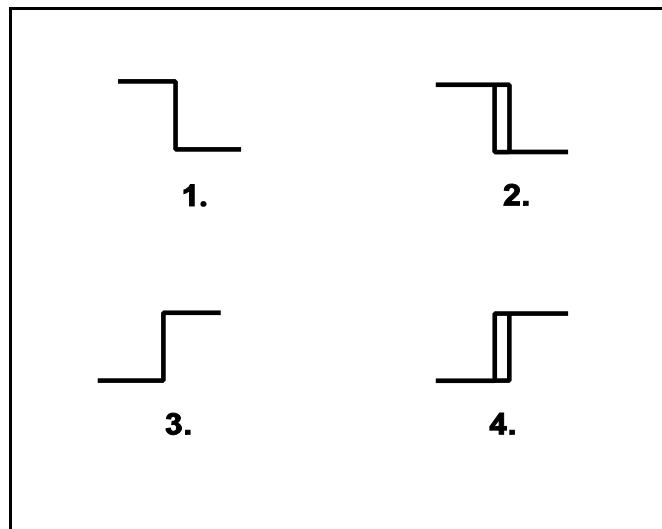
TOPIC:          191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:             P4707   (B4708)

Refer to the valve controller logic diagram (see figure below).

Which one of the following combinations of inputs will result in the valve receiving an open signal?

INPUTS

|    | 1. | 2. | 3. | 4. |
|----|----|----|----|----|
| A. | On  | Off | Off | On  |
| B. | Off | On  | On  | Off |
| C. | On  | Off | On  | Off |
| D. | Off | On  | Off | On  |

ANSWER:  B.
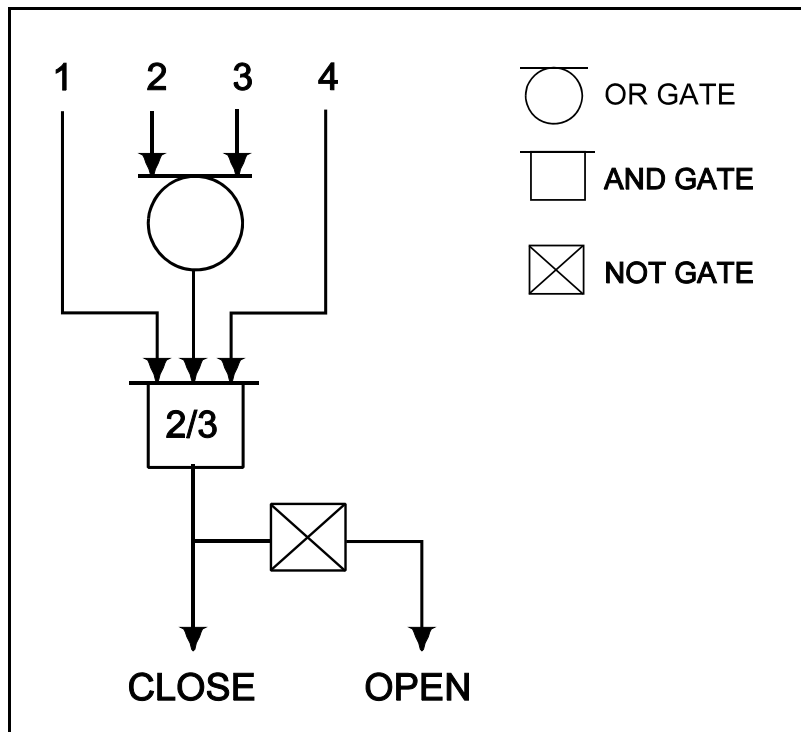
TOPIC:          191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:             P4909   (B4908)

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

ANSWER:  B.
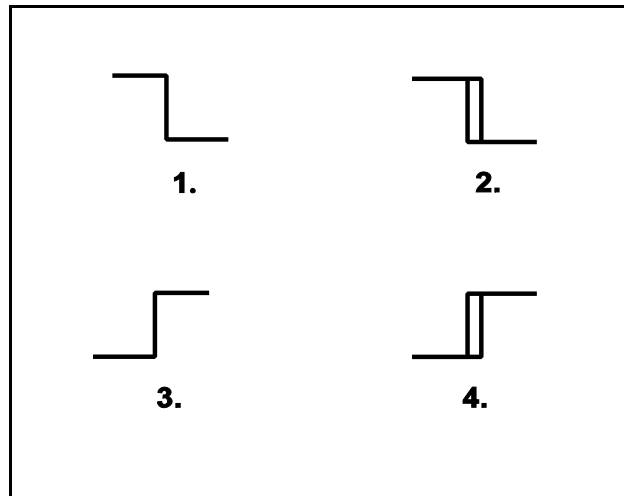
TOPIC:          191003
KNOWLEDGE:   K1.08   [2.1/2.6]
QID:             P5009   (B5009)

Refer to the valve controller logic diagram (see figure below).

Which one of the following combinations of inputs will result in the valve receiving a close signal?

INPUTS

|    | 1. | 2. | 3. | 4. |
|----|----|----|----|----|
| A. | On | On | Off | Off |
| B. | Off | Off | On | Off |
| C. | On | Off | Off | On |
| D. | On | On | On | Off |

ANSWER:  B.
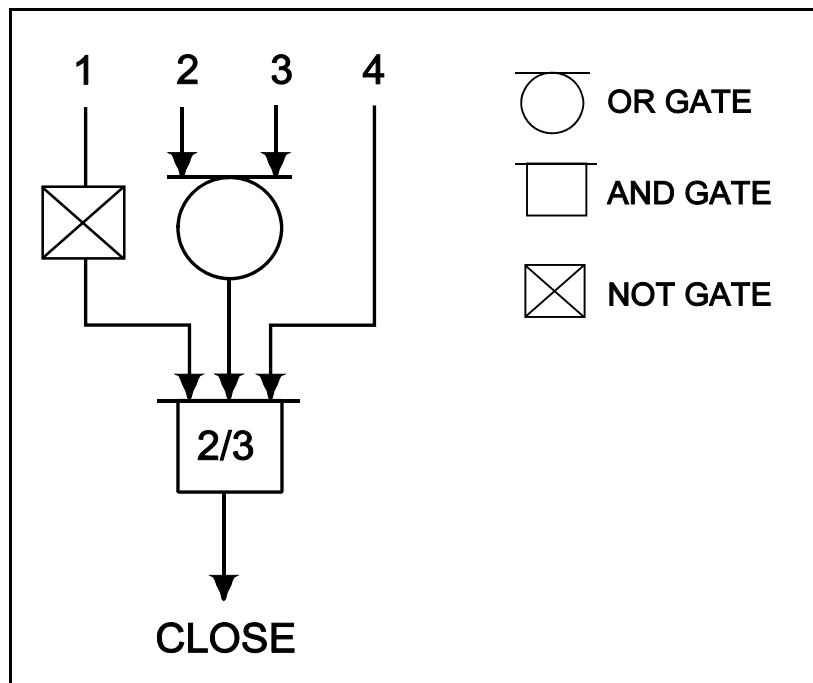
TOPIC:          191003
KNOWLEDGE:   K1.09  [2.4/2.5]
KNOWLEDGE:   K1.08  [2.1/2.6]
QID:            P319    (B316)

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.

ANSWER:  A.

TOPIC:            191003
KNOWLEDGE:    K1.08   [2.1/2.6]
QID:              P5409   (B5408)

Refer to the valve controller logic diagram (see figure below).

Which one of the following combinations of inputs will result in the valve receiving an open signal?

|    | INPUTS | | | |
|----|------|------|------|------|
|    | 1.   | 2.   | 3.   | 4.   |
| A. | On   | Off  | On   | On   |
| B. | Off  | On   | Off  | Off  |
| C. | On   | Off  | Off  | On   |
| D. | Off  | On   | On   | Off  |

ANSWER:  B.
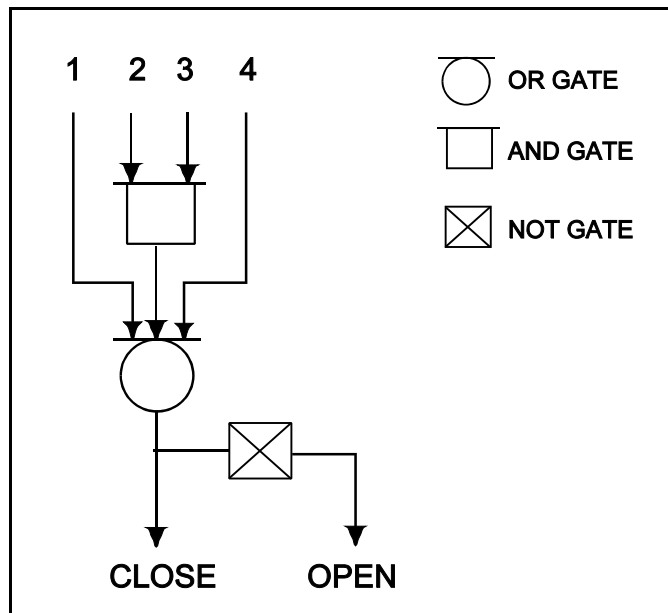
TOPIC:            191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:               P818    (B1317)

The water level in a tank is being controlled by an automatic level controller and is initially at the controller setpoint.  A drain valve is then opened, causing tank level to decrease.  The decreasing level causes the controller to begin to open a makeup water supply valve.  After a few minutes, a new steady-state tank level below the original level is established, with the supply rate equal to the drain rate.

The controller in this system uses _____ control.

A.  proportional integral, and derivative

B.  proportional and integral

C.  proportional only

D.  bistable

ANSWER:  C.

TOPIC:            191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:               P917    (B1015)

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

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

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

C.  increase until the controlled parameter equals the controller set point, 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.

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:            P918    (B2615)

In a proportional controller, the term "offset" refers to the difference between the...

A.   control point and set point.

B.   control point and proportional band.

C.   deadband and set point.

D.   deadband and proportional band.

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:            P1016   (B1915)

The level in a tank is controlled by an automatic control system.  Level is initially at its setpoint.  A drain valve is then opened, causing tank level to begin to decrease.  The decreasing level causes the controller to begin to open a makeup supply valve.   After a few minutes, with the drain valve still open, level is again constant at the setpoint.

The controller in this system uses primarily _____ control.

A.   integral

B.   on-off

C.   derivative

D.   proportional

ANSWER:  A.

TOPIC:          191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P1219   (B1516)

The level in a tank is controlled by an automatic level controller.  Level is initially at the setpoint when a drain valve opens.  When level decreases to 5% below setpoint the level controller opens a makeup supply valve.  After a few minutes level is 5% above setpoint and the makeup valve closes.  With the drain valve still open, level continues to oscillate 5% above and below the setpoint.

The controller in this system uses primarily _____ control.

A.   integral

B.   bistable

C.   derivative

D.   proportional

ANSWER:  B.


TOPIC:          191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P1417   (B2215)

Which one of the following controller types is designed to maintain the measured parameter at the controller set point?

A.   Integral

B.   Proportional

C.   On-Off

D.   Derivative

ANSWER:  A.

TOPIC:            191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:              P2319   (B2315)

The level in a drain collection tank is being controlled by an automatic level controller and is initially at the controller set point.  Flow rate into the tank increases, causing tank level to increase.  The increasing level causes the controller to throttle open a tank drain valve.  After a few minutes, a new, steady-state tank level above the original level is established, with the drain flow rate equal to the supply flow rate.

The controller in this system uses _____ control.

A.   on-off

B.   proportional

C.   proportional plus integral

D.   proportional plus integral plus derivative

ANSWER:  B.

TOPIC:            191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:              P2419   (B2415)

The level in a drain collection tank is being controlled by an automatic level controller and level is initially at the controller set point.  Flow rate into the tank causes tank level to increase.  The increasing level causes the controller to fully open a tank drain valve.  When level decreases below the setpoint, the controller closes the drain valve.  Tank level continues to be controlled in this manner within a narrow band above and below the setpoint.

The controller in this system uses _____ control.

A.   on-off

B.   proportional

C.   proportional plus integral

D.   proportional plus integral plus derivative

ANSWER:  A.

TOPIC:              191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:                   P2519   (B2515)

The temperature of the water in a small outside storage tank is controlled by a set of heaters submerged in the tank.  The heaters energize at a water temperature of 40°F and deenergize at 48°F. When the heater set is energized, the tank heatup rate averages 2°F/minute in the operating range between 40°F and 48°F.

Which one of the following types of control devices is used in the heater control circuit to produce these characteristics?

A.  Bistable

B.  Proportional

C.  Proportional Integral

D.  Proportional Derivative

ANSWER:  A.

TOPIC:           191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:              P2819   (B2815)

The level in a drain collection tank is being controlled by an automatic level controller and is initially at the controller set point.  Flow rate into the tank increases, slowly at first, and then faster until a stable higher flow rate is attained.

As tank level increases, the controller slowly opens a tank drain valve.  The level controller output signal increases both as the tank level increases and as the rate of tank level change quickens.  After a few minutes, a new, steady-state tank level above the original level is established, with the drain flow rate equal to the supply flow rate.

The controller in this system uses _____ control.

A.   proportional only

B.   proportional plus derivative

C.   proportional plus integral

D.   proportional plus integral plus derivative

ANSWER:  B.

TOPIC:          191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:              P2919   (B3116)

The level in a drain collection tank is being controlled by an automatic level controller and is initially at the controller set point.  Flow rate into the tank increases, slowly at first, and then faster until a stable high flow rate is attained.

As tank level increases, the controller slowly opens a tank drain valve.  The level controller output signal increases both as the tank level increases and as the rate of tank level change quickens.  After a few minutes, tank level returns to and remains at the original level with the drain flow rate equal to the supply flow rate.

The controller in this system uses _____ control.

A.   proportional only

B.   proportional plus derivative only

C.   proportional plus integral only

D.   proportional plus integral plus derivative

ANSWER:  D.

TOPIC:          191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P3319   (B3316)

Refer to the drawing of a water storage tank with a level control system (see figure below).  The tank water level is being automatically controlled at 50% by a proportional-integral (PI) controller that positions the drain valve.  Tank water level is currently stable with 500 gpm entering the tank and the drain valve 50% open.

Tank inlet flow rate suddenly increases to 700 gpm and remains constant.  When tank water level stabilizes, level will be _____, and the drain valve position will be _____.

A.   higher than 50%; more open

B.   higher than 50%; the same

C.   50%; more open

D.   50%; the same

ANSWER:  C.
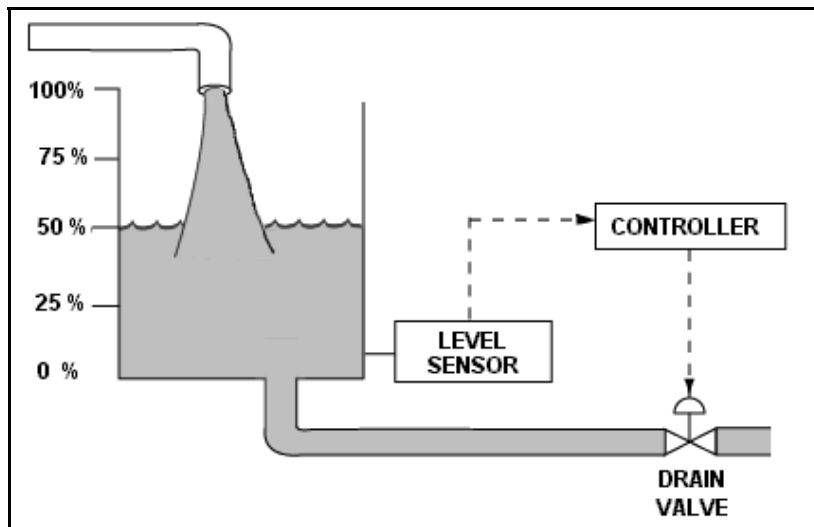
TOPIC:        191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:         P3419   (B3415)

Refer to the drawing of a water storage tank with a level control system (see figure below).  The tank water level is being automatically controlled at 50% by a proportional-integral (PI) controller that positions the drain valve.  Tank water level is currently stable with 500 gpm entering the tank and the drain valve 50% open.

The tank suddenly develops a constant 200 gpm leak, while the input flow rate remains constant at 500 gpm.  When tank water level stabilizes, level will be _____, and the drain valve position will be _____.

A.   50%; more open

B.   50%; more closed

C.   lower than 50%; more open

D.   lower than 50%; more closed

ANSWER:  B.
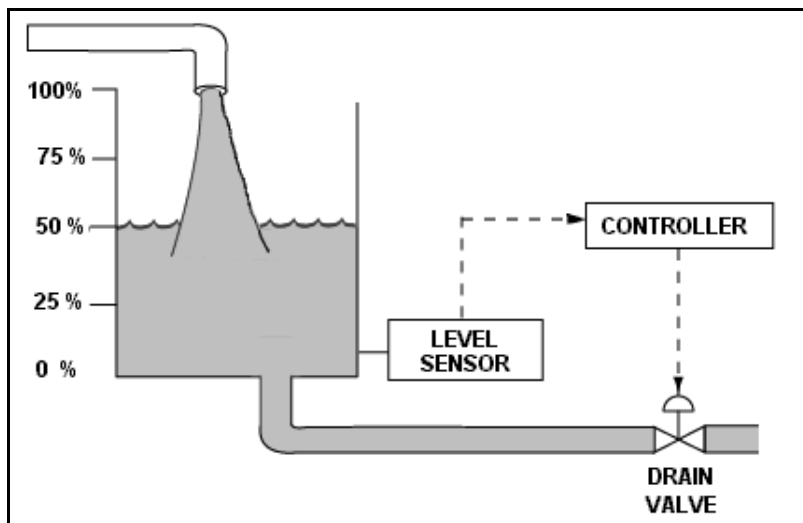
TOPIC:          191003
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P3519   (B3515)

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

The tank water level is being automatically controlled by a proportional-only controller with a setpoint of 50%.  Tank water level is currently stable at 50% with 500 gpm entering the tank and the drain valve 50% open.

The tank suddenly develops a constant 200 gpm leak, while the input flow rate remains constant at 500 gpm.  After the tank water level stabilizes, level will be _____, and the drain valve position will be _____.

A.   50%; more than 50% open

B.   50%; less than 50% open

C.   below 50%; more than 50% open

D.   below 50%; less than 50% open

ANSWER:  D.
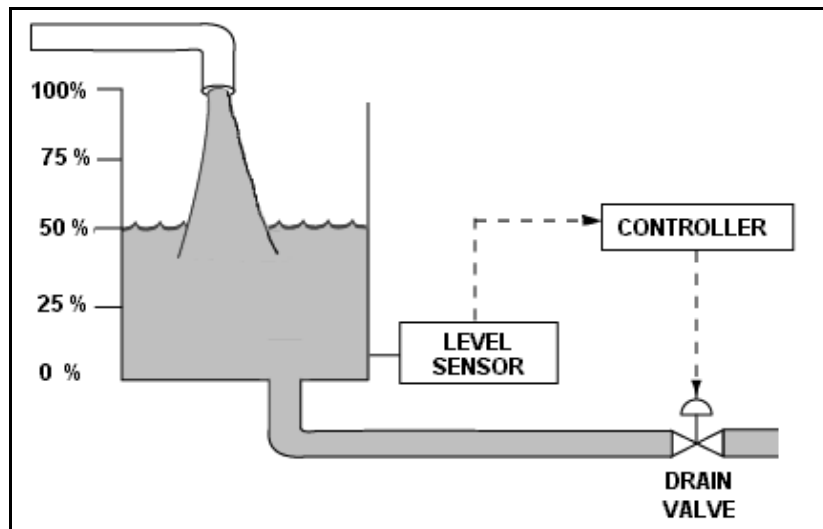
TOPIC:           191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:             P3818   (B3816)

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

The tank water level is being automatically controlled by a proportional-only controller with a level setpoint of 50%.  Tank water level is currently stable at 50% with 500 gpm entering the tank and the drain valve 50% open.

The tank input flow rate suddenly increases to 700 gpm.  After the tank water level stabilizes, level will be _____; and the drain valve position will be _____.

A.   50%; more than 50% open

B.   50%; 50% open

C.   above 50%; more than 50% open

D.   above 50%; 50% open

ANSWER:  C.
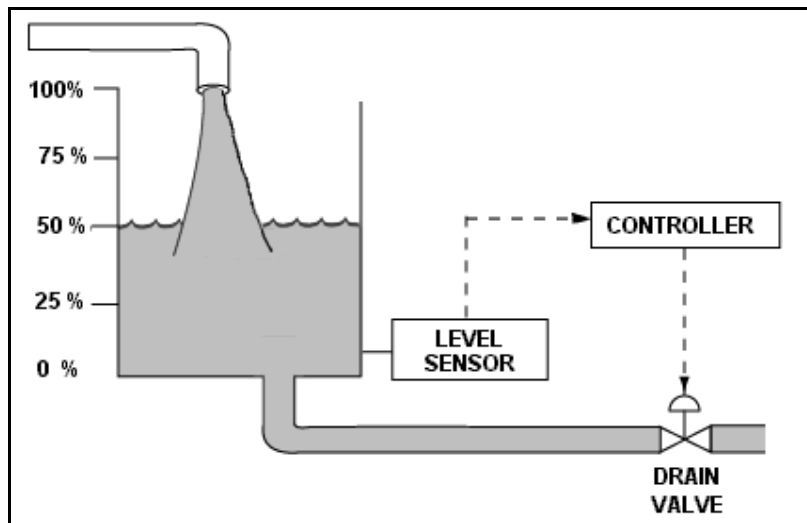
TOPIC:             191003
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:                 P4008

A system pressure controller has the following features:

*   The controller output signal is null when the differential pressure (ΔP) between the pressure setpoint and the actual system pressure is zero.
*   The controller output signal increases linearly with the ΔP.
*   The controller output signal is <u>not</u> affected by the rate of change of the ΔP.
*   The controller output signal is <u>not</u> affected by the length of time the ΔP exists.

Which one of the following lists the type(s) of control used by the controller described above?

A.   Bistable only

B.   Proportional only

C.   Proportional plus integral

D.   Proportional plus derivative

ANSWER:  B.

TOPIC:             191003
KNOWLEDGE:    K1.11   [2.8/2.9]
QID:                 P20

What precaution must be observed when transferring a valve controller from the automatic mode to the manual mode of control?

A.   Ensure that a substantial deviation is established between the automatic and manual valve controller outputs.

B.   Ensure that the automatic and manual valve controller outputs are matched.

C.   Ensure that the automatic valve controller output is increasing before transferring to the manual mode of control.

D.   Ensure that the automatic valve controller output is decreasing before transferring to the manual mode of control.

ANSWER:  B.

TOPIC:           191003
KNOWLEDGE:    K1.11   [2.8/2.9]
QID:             P220    (B1502)

Prior to shifting a valve controller from automatic to manual control, why should the automatic and manual controller output signals be matched?

A.   To ensure the valve will operate in manual control upon demand.

B.   To  ensure valve position indication is accurate in manual control.

C.   To  move the valve to the new position prior to the transfer.

D.   To  prevent a sudden valve repositioning during the transfer.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:            P21

Which one of the following contains indications of cavitation for an operating centrifugal pump?

A.  Low flow rate with low discharge pressure

B.  Low flow rate with high discharge pressure

C.  High motor amps with low discharge pressure

D.  High motor amps with high discharge pressure

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:            P221    (B218)

Which of the following changes in pump operating parameters will <u>directly</u> lead to pump cavitation in a centrifugal pump that is operating at rated conditions in an open system?

A.  Steadily increasing pump inlet temperature

B.  Steadily decreasing pump speed

C.  Steadily increasing pump suction pressure

D.  Steadily decreasing pump recirculation flow

ANSWER:  A.

TOPIC:           191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:             P421

Pump cavitation occurs when vapor bubbles are formed at the eye of a pump impeller...

A.  when the localized flow velocity exceeds sonic velocity for the existing fluid temperature.

B.  when the localized pressure exceeds the vapor pressure for the existing fluid temperature.

C.  and enter a high pressure region of the pump where they collapse, causing damaging pressure pulsations.

D.  and are discharged from the pump where they collapse in downstream piping, causing damaging pressure pulsations.

ANSWER:  C.

TOPIC:           191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:             P524

Which one of the following is a symptom associated with cavitation of a centrifugal pump?

A.  Decreased motor current and pump speed

B.  Decreased pump and motor temperature

C.  Steadily increasing discharge pressure

D.  Increased noise and vibration

ANSWER:  D.

TOPIC:            191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:               P1021

Which one of the following will result in immediate cavitation of a centrifugal pump that is initially operating at normal rated flow?

A.  Recirculation flow path is aligned.

B.  Recirculation flow path is isolated.

C.  Pump suction valve is fully closed.

D.  Pump discharge valve is fully closed.

ANSWER:  C.

TOPIC:            191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:               P1220   (B1218)

Which one of the following describes pump cavitation?

A.  Vapor bubbles are formed when the enthalpy difference between pump discharge and pump suction exceeds the latent heat of vaporization.

B.  Vapor bubbles are formed in the eye of the pump impeller and collapse as they enter higher pressure regions of the pump.

C.  Vapor bubbles are produced when the localized pressure exceeds the vapor pressure at the existing temperature.

D.  Vapor bubbles are discharged from the pump where they collapse on downstream piping and cause localized water hammers.

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:            P1321

Which one of the following is an indication of pump cavitation?

A.  Pump motor amps are pegged high.

B.  Pump discharge pressure indicates zero.

C.  Pump motor amps are fluctuating.

D.  Pump discharge pressure indicates shut-off head.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.01   [3.3/3.5]
QID:            P1520   (B1018)

If a centrifugal pump is started with the discharge valve fully open, versus throttled, the possibility of pump runout will _____ and the possibility of pump cavitation will _____.

A.  increase; decrease

B.  increase; increase

C.  decrease; decrease

D.  decrease; increase

ANSWER:  B.

TOPIC: 191004
KNOWLEDGE: K1.01 [3.3/3.5]
QID: P1820 (B1718)

By starting a centrifugal pump with the discharge valve throttled versus fully open, the possibility of pump runout is _____ , and the possibility of pump cavitation is _____ .

A. increased; decreased

B. increased; increased

C. decreased; decreased

D. decreased; increased

ANSWER: C.

TOPIC: 191004
KNOWLEDGE: K1.02 [3.1/3.4]
QID: P106

A centrifugal pump is started and the following indications are observed:

    Oscillating flow
    Oscillating discharge pressure
    Oscillating amps

These indications are symptoms that the pump is experiencing...

A. excessive thrust.

B. cavitation.

C. runout.

D. wear ring failure.

ANSWER: B.

TOPIC:          191004
KNOWLEDGE:   K1.02   [3.1/3.4]
QID:             P222

The presence of air in a pump casing may result in _____when the pump is started.

A.  vortexing

B.  pump runout

C.  pump overspeed

D.  gas binding

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.02   [3.1/3.4]
QID:             P920

Which one of the following contains indications of a gas/vapor bound motor-operated centrifugal pump that is operating in a cooling water system?

A.  Fluctuating pump discharge pressure, reduced system flow rate, and increased pump motor current

B.  Reduced system flow rate, increased pump motor current, and increased pump noise level

C.  Increased pump motor current, increased pump noise level, and fluctuating pump discharge pressure

D.  Increased pump noise level, fluctuating pump discharge pressure, and reduced system flow rate

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.03   [3.1/3.3]
QID:              P1927   (B1821)

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

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

B.  Install a pump recirculation line from the pump discharge piping to the pump supply piping.

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

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

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:              P23      (B423)

A motor-driven centrifugal pump is operating under no flow conditions.  Which one of the following damaging conditions will <u>first</u> occur during pump operation with no flow?

A.  Pump failure from overspeed

B.  Pump failure from overheating

C.  Motor failure from overspeed

D.  Motor failure from overheating

ANSWER:  B.

TOPIC:         191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:             P109    (B1823)

When a centrifugal pump is operating at shutoff head, it is pumping at _____ capacity and _____ discharge head.

A.  maximum; maximum

B.  maximum; minimum

C.  minimum; maximum

D.  minimum; minimum

ANSWER:  C.

NRC Generic Fundamentals Examination Question Bank--PWR
August 2008

TOPIC:           191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:             P119     (B1319)

Refer to the drawing of a centrifugal pump operating curve (see figure below).

Which point represents pump operation at shutoff head?

A.  Point A

B.  Point B

C.  Point C

D.  Point D

ANSWER:  A.



CENTRIFUGAL PUMP CURVE
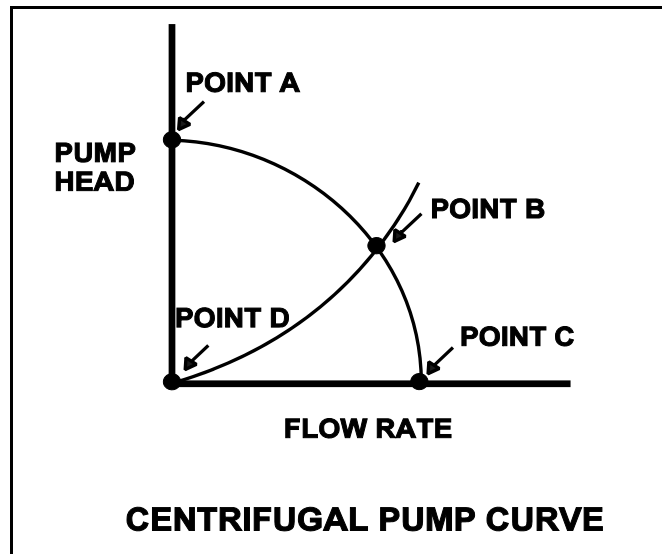
TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P223

Operating a centrifugal pump at shutoff head without recirculation flow can <u>directly</u> result in...

A.  discharge piping overpressure.

B.  suction piping overpressure.

C.  excessive pump leakoff.

D.  pump overheating.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P321     (B319)

A motor-driven centrifugal pump with <u>no</u> recirculation flow path must be stopped when discharge pressure reaches the pump shutoff head to prevent...

A.  overheating of the pump.

B.  overheating of the motor.

C.  bursting of the pump casing.

D.  water hammer in downstream lines.

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:             P1222   (B1181)

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.

ANSWER:  B.

TOPIC:            191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:                P1320   (B1917)

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

The flowpath through valve A is designed to...

A.  prevent pump runout by creating a recirculation flowpath.

B.  provide a small flow rate through the pump during shutoff head conditions.

C.  direct a small amount of water to the pump suction to raise available net positive suction head.

D.  prevent the discharge piping from exceeding design pressure during no-flow conditions.

ANSWER:  B.



**PUMP WITH RECIRCULATION LINE**
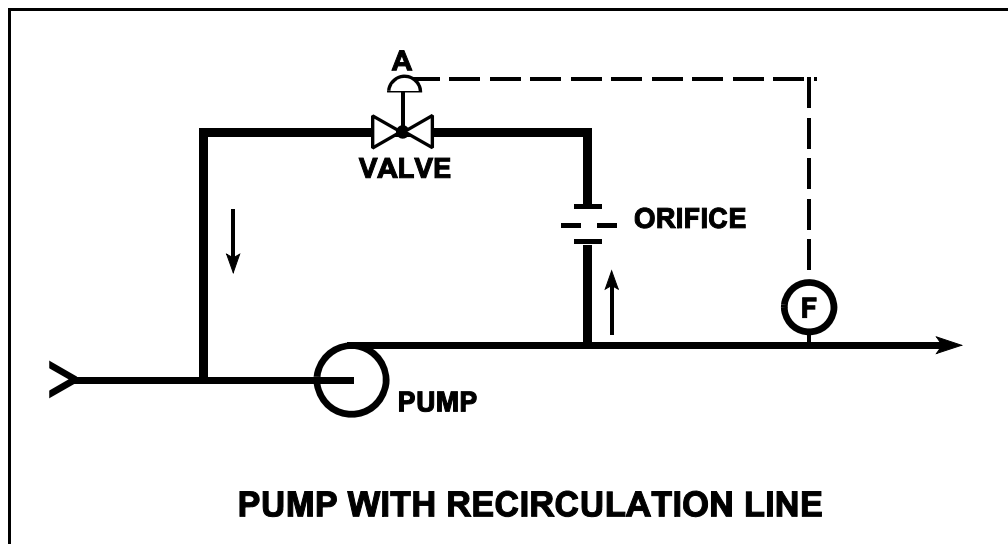
TOPIC:        191004
KNOWLEDGE:  K1.04  [3.3/3.4]
QID:          P1423

Which one of the following is at a relatively high value when a centrifugal pump is operating at shutoff head?

A.  Pump motor current

B.  Pump volumetric flow rate

C.  Available net positive suction head

D.  Required net positive suction head

ANSWER:  C.

TOPIC:        191004
KNOWLEDGE:  K1.04  [3.3/3.4]
QID:          P1523

Which one of the following describes centrifugal pump operating parameters at shutoff head?

A.  High discharge pressure, low flow, low power demand

B.  High discharge pressure, high flow, low power demand

C.  Low discharge pressure, low flow, high power demand

D.  Low discharge pressure, high flow, high power demand

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:              P1621

Which one of the following conditions applies to a centrifugal pump running at shutoff head?

A.  The volumetric flow rate for the pump has been maximized.

B.  Cavitation will occur immediately upon reaching shutoff head.

C.  Available net positive suction head is at a maximum value for the existing fluid conditions.

D.  Pump differential pressure is at a minimum value.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:              P1922

Which one of the following would result from operating a motor-driven centrifugal pump for extended periods of time with the discharge valve shut and no recirculation flow?

A.  No motor damage, but the pump will overheat and may be damaged.

B.  No motor damage, but the pump will overspeed and may be damaged.

C.  No pump damage, but the motor will overspeed and the motor bearings may fail.

D.  No pump damage, but the motor windings will draw excessive current and may fail.

ANSWER:  A.

TOPIC:            191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:               P2019   (B2017)

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

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

A.  The pump will overheat after a relatively short period of time due to a loss of both main flow and recirculation flow.

B.  The pump will overheat after a relatively long period of time due to a loss of main flow only.

C.  The pump will overheat after a relatively long period of time due to a loss of recirculation flow only.

D.  The pump will be able to operate under these conditions indefinitely due to sustained main flow.

ANSWER:  B.



PUMP WITH RECIRCULATION LINE
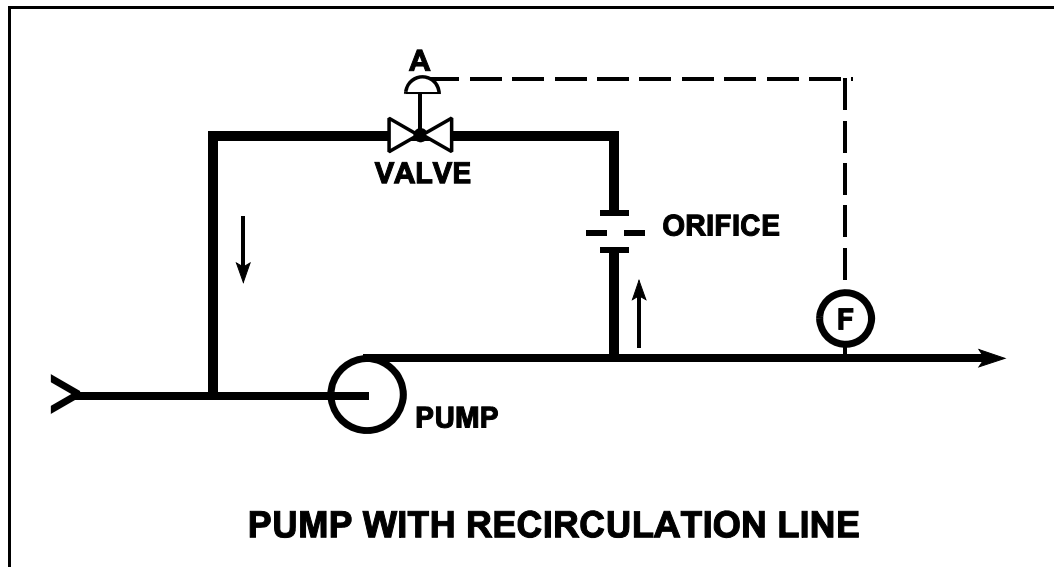
TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:              P2022   (B2018)

A variable-speed centrifugal fire water pump is taking a suction on an open storage tank and discharging through a 4-inch diameter fire hose and through a nozzle located 50 feet above the pump.

Which one of the following will cause the pump to operate at shutoff head?

A.  The fire hose is replaced with a 6-inch diameter fire hose.

B.  The fire hose is replaced with a 2-inch diameter fire hose.

C.  Pump speed is increased until steam formation at the eye of the impeller prevents pump flow.

D.  Pump speed is decreased until pump discharge pressure is insufficient to cause flow.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:             P2221   (B1219)

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

Valve "A" will open when pump...

A.  discharge pressure increases above a setpoint.

B.  discharge pressure decreases below a setpoint.

C.  flow rate increases above a setpoint.

D.  flow rate decreases below a setpoint.

ANSWER:  D.
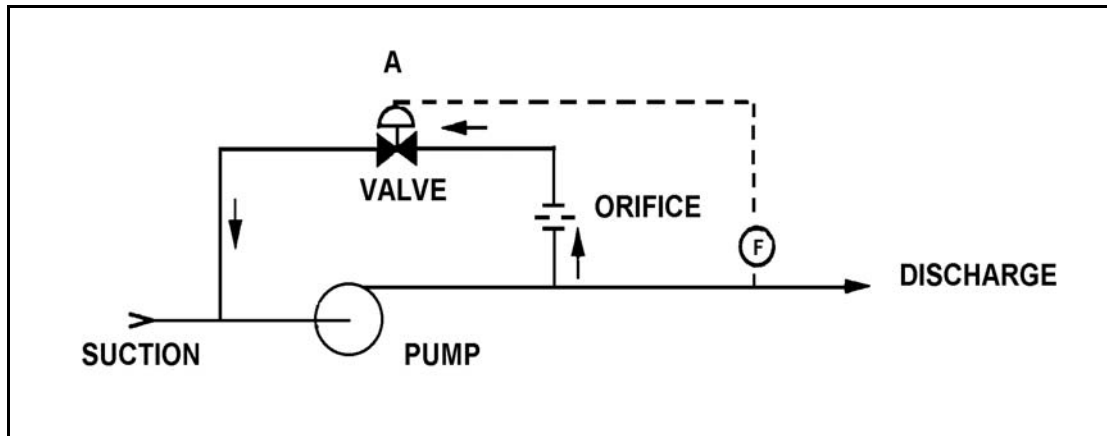
TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P2322   (B520)

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose.  Which one of the following will cause the pump to operate at shutoff head?

A.  Suction temperature is increased to the point that gas binding occurs.

B.  Suction pressure is adjusted until available net positive suction head is reduced to zero feet.

C.  Pump speed is adjusted to the value at which cavitation occurs.

D.  The fire hose nozzle is raised to an elevation that prevents any flow.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P2721   (B2721)

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose.  Which one of the following will cause the pump to operate at shutoff head?

A.  A firefighter inadvertently severs the fire hose.

B.  The fire hose becomes completely crimped in a fire door.

C.  Fire water storage tank level drops below the pump suction tap.

D.  A firefighter adjusts the fire hose nozzle spray pattern from "deluge" to "fog."

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P2820   (B3320)

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose.  Which one of the following will cause the pump to operate at shutoff head?

A.  A firefighter inadvertently severs the fire hose.

B.  The fire hose becomes partially crimped in a fire door.

C.  Fire water storage tank level drops below the pump suction tap.

D.  A firefighter adjusts the fire hose nozzle spray pattern from "deluge" to "off".

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.04   [3.3/3.4]
QID:            P3122   (B2225)

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

Valve "A" will close when pump...

A.  discharge pressure increases above a setpoint.

B.  discharge pressure decreases below a setpoint.

C.  flow rate increases above a setpoint.

D.  flow rate decreases below a setpoint.

ANSWER:  C.



PUMP WITH RECIRCULATION LINE
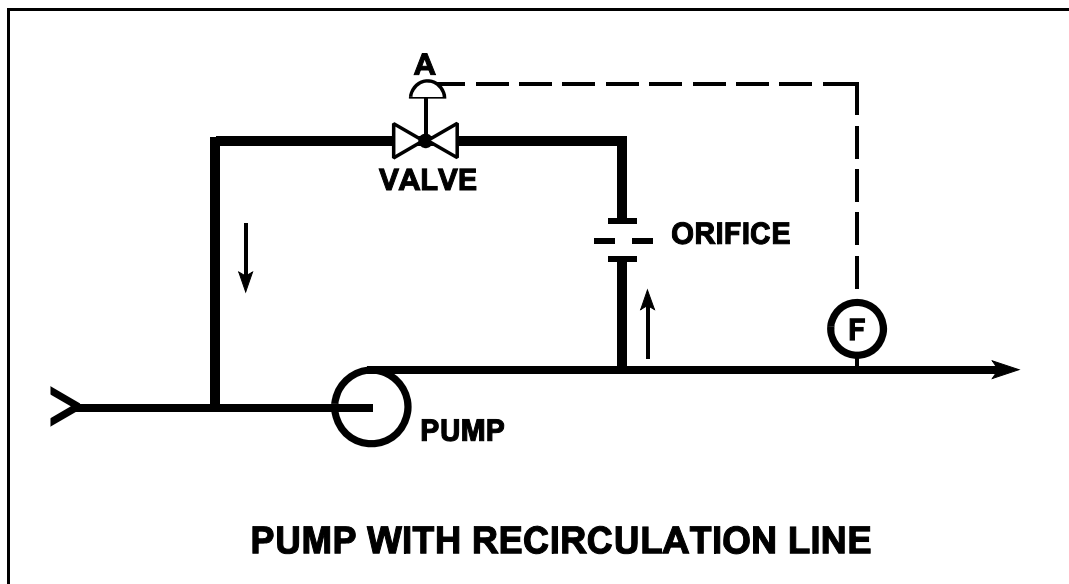
TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:             P322    (B324)

The available net positive suction head for a pump may be expressed as...

A.  suction pressure minus saturation pressure of the fluid being pumped.

B.  suction pressure plus discharge pressure.

C.  discharge pressure minus saturation pressure of the fluid being pumped.

D.  discharge pressure minus suction pressure.

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:             P1120   (B121)

Which one of the following operations will cause a decrease in available net positive suction head for an operating centrifugal pump?

A.  Decreasing the inlet fluid temperature

B.  Increasing the pump discharge pressure

C.  Increasing the pump suction pressure

D.  Throttling open the pump discharge valve

ANSWER:  D.

TOPIC:        191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:          P1221   (B1621)

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

The available net positive suction head for the centrifugal pump will be increased by...

A.  opening surge tank makeup valve "A" to raise tank level.

B.  throttling heat exchanger service water valve "B" more closed.

C.  throttling pump discharge valve "C" more open.

D.  throttling pump suction valve "D" more closed.

ANSWER:  A.



COOLING WATER SYSTEM
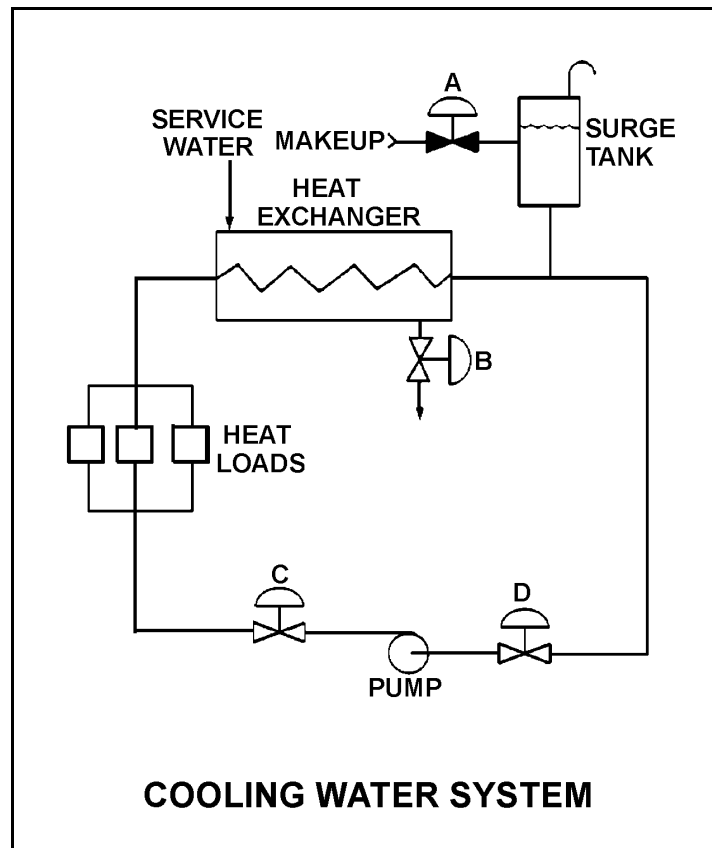
TOPIC:        191004
KNOWLEDGE:  K1.06   [3.2/3.3]
QID:          P1521   (B1918)

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

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

A.  opening surge tank makeup valve "A" to raise tank level.

B.  throttling heat exchanger service water valve "B" more open.

C.  throttling pump discharge valve "C" more open.

D.  reducing the heat load on the cooling water system.

ANSWER:  C.



COOLING WATER SYSTEM
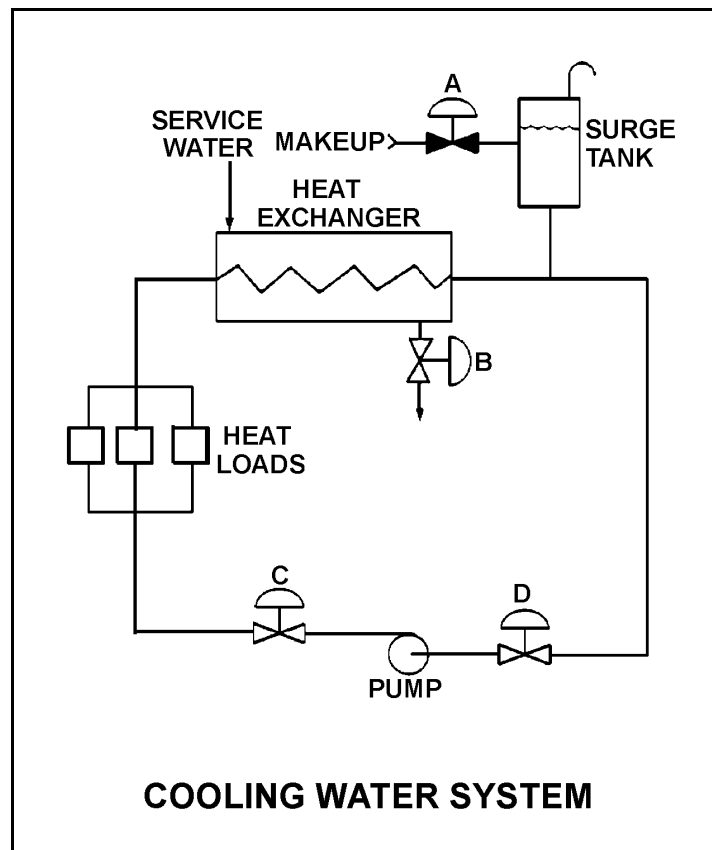
TOPIC:            191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:                P1822   (B2119)

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

Which one of the following will increase available net positive suction head for the centrifugal pump?

A.  Draining the surge tank to decrease level by 10%.

B.  Positioning heat exchanger service water valve "B" more closed.

C.  Positioning pump discharge valve "C" more closed.

D.  Positioning pump suction valve "D" more closed.

ANSWER:  C.



**COOLING WATER SYSTEM**
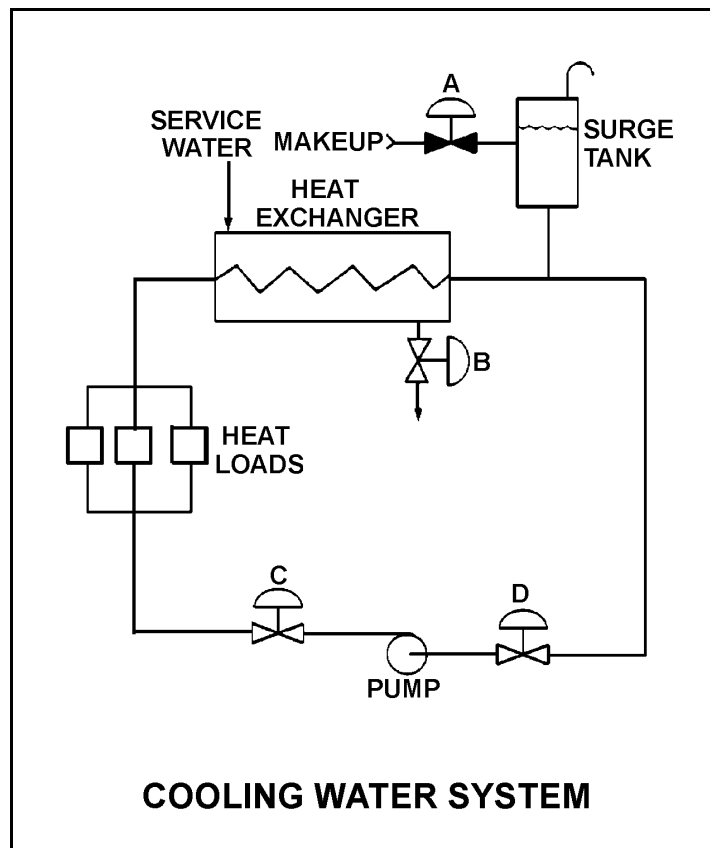
TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:              P2222   (B2518)

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

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

A.  increasing surge tank level by 5 percent.

B.  throttling heat exchanger service water valve "B" more open.

C.  throttling pump discharge valve "C" more closed.

D.  increasing the heat loads on the cooling water system.

ANSWER:  D.
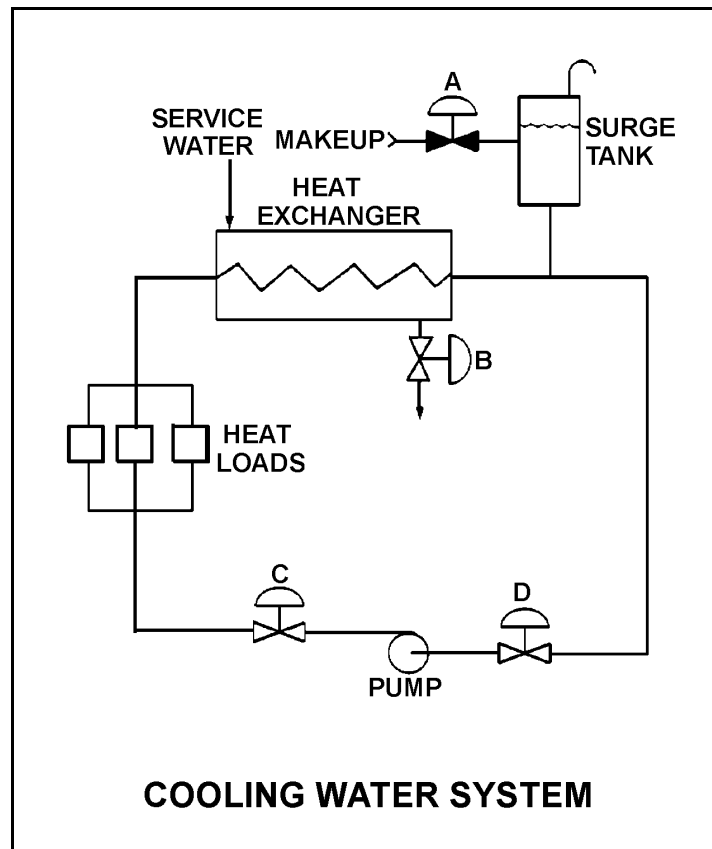
TOPIC:        191004
KNOWLEDGE:  K1.06   [3.2/3.3]
QID:          P2323   (B2319)

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

Which one of the following will decrease available net positive suction head for the centrifugal pump?

A.  Adding water to the surge tank to raise level by 10%.

B.  Positioning heat exchanger service water valve "B" more open.

C.  Positioning pump discharge valve "C" more open.

D.  Reducing heat loads on the cooling water system by 10%.

ANSWER:  C.
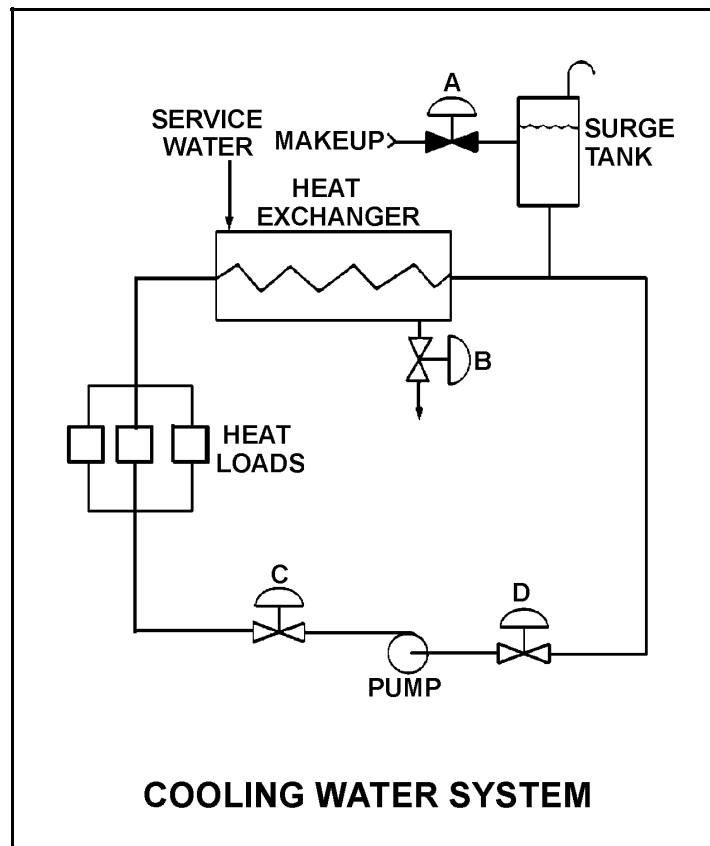
TOPIC:          191004
KNOWLEDGE:   K1.06  [3.2/3.3]
QID:            P2621  (B2621)

A cooling water pump is operating with the following pump suction parameters:

    Suction Temperature:  124°F
    Suction Pressure:      11.7 psia

What is the approximate available net positive suction head (NPSH) for the pump? (Neglect the contribution of the suction fluid velocity to NPSH.)

A.  23 feet

B.  27 feet

C.  31 feet

D.  35 feet

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.06  [3.2/3.3]
QID:            P2722  (B2722)

A centrifugal pump is operating at maximum design flow rate, taking suction on a vented water storage tank and discharging through two parallel valves.  Valve "A" is fully open and valve "B" is half open.

Which one of the following will occur if valve "B" is fully closed?

A.  The pump will operate at shutoff head.

B.  The pump will operate at runout conditions.

C.  The pump available net positive suction head will increase.

D.  The pump required net positive suction head will increase.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P2921   (B2920)

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

Which one of the following will increase the available net positive suction head for the centrifugal pump?

A.  Draining the surge tank to decrease level by 10%.

B.  Positioning the service water valve "B" more closed.

C.  Positioning the pump discharge valve "C" more open.

D.  Reducing the heat loads on the cooling water system.

ANSWER:  D.



**COOLING WATER SYSTEM**
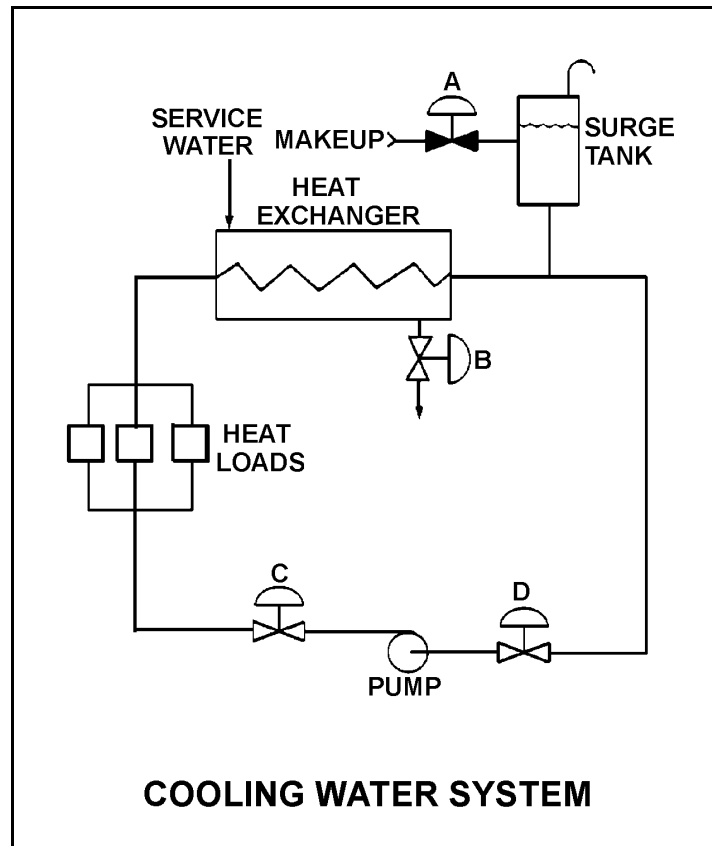
TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P3020   (B3022)

A centrifugal pump is needed to take suction on a hot water storage tank and deliver high pressure hot water to a water spray system.  To minimize axial thrust on the pump shaft, the pump should have _____ stage(s); and to maximize the available NPSH at the impeller inlet, the pump should be _____ suction.

A.  a single; single

B.  a single; double

C.  multiple opposed; single

D.  multiple opposed; double

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P3221   (B3219)

A centrifugal pump is taking suction on an open storage tank that has been filled to a level of 40 feet with 10,000 gallons of 60°F water.  The pump is located at the base of the tank, takes a suction from the bottom of the tank, and discharges through a fire hose.

Given:

•   The pump is currently operating at its design flow rate of 200 gpm and a total developed head of 150 feet.
•   The pump requires 4 feet of net positive suction head (NPSH).

How will the centrifugal pump flow rate be affected as the water storage tank level decreases?

A.  Flow rate will remain constant until the pump begins to cavitate at a tank level of about 4 feet.

B.  Flow rate will remain constant until the pump becomes air bound when the tank empties.

C.  Flow rate will gradually decrease until the pump begins to cavitate at a tank level of about 4 feet.

D.  Flow rate will gradually decrease until the pump becomes air bound when the tank empties.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:             P4010   (B4011)

Refer to the drawing below of a centrifugal pump taking suction from the bottom of an open storage tank containing water at 66°F.  Pump and water level elevations are indicated in the figure.  Assume standard atmospheric pressure.

Assuming that pump suction fluid velocity head loss is negligible, what is the approximate value of net positive suction head available to the pump.

A.  6 feet

B.  13 feet

C.  20 feet

D.  25 feet

ANSWER:  C.
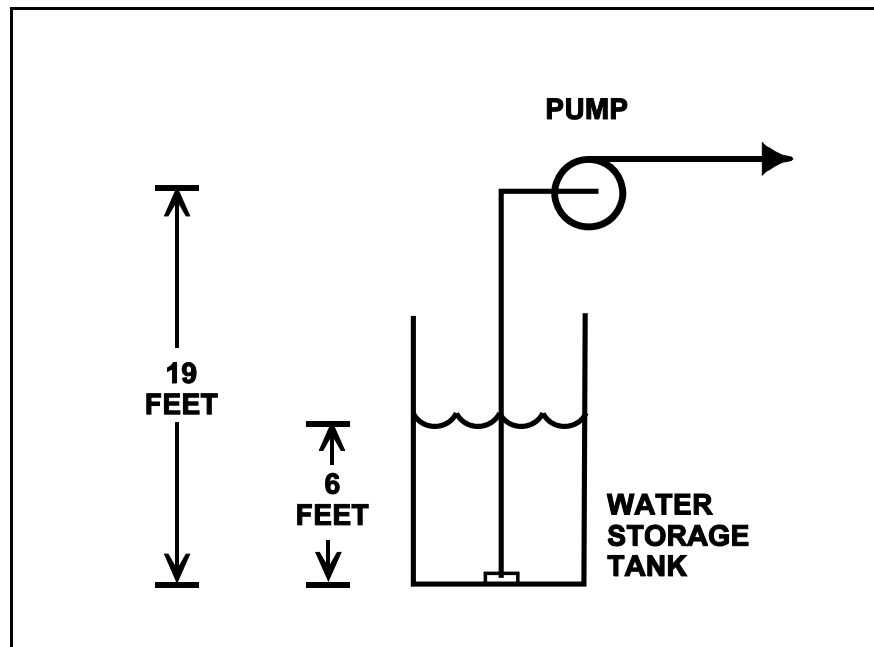
TOPIC:        191004
KNOWLEDGE:  K1.06  [3.2/3.3]
QID:          P4110  (B4113)

Refer to the drawing of an elevated centrifugal pump taking suction from the bottom of an open storage tank containing water at 66°F (see figure below).  Assume standard atmospheric pressure.

The pump requires 4.0 ft-lbf/lbm of net positive suction head (NPSH).  Assume that pump suction fluid velocity head loss is negligible.

If tank water level is allowed to decrease continuously, at what approximate water level will the pump begin to cavitate?

A.  34 feet

B.  29 feet

C.  21 feet

D.  16 feet

ANSWER:  C.
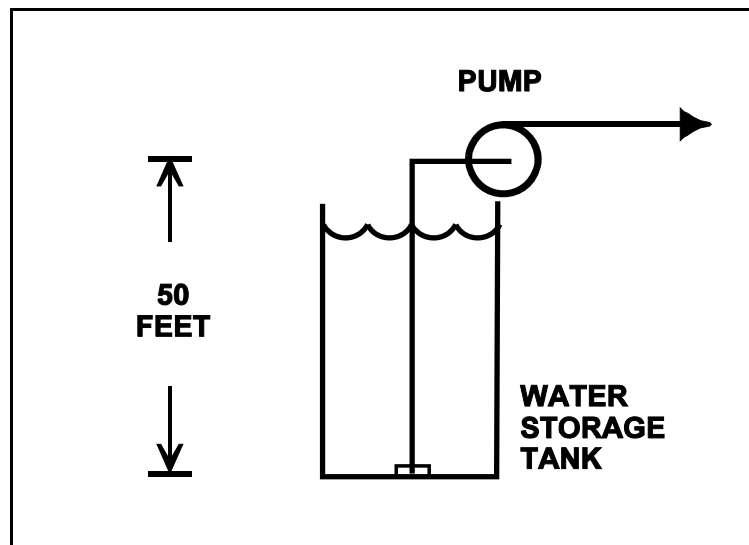
TOPIC:            191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:                P4410   (B4410)

Refer to the drawing below of a centrifugal pump taking suction from the bottom of an open storage tank containing water at 66°F.  Pump and water level elevations are indicated in the figure.  Assume standard atmospheric pressure.

Assuming that pump suction fluid velocity head loss is negligible, what is the approximate value of net positive suction head available to the pump.

A.  6 feet

B.  12 feet

C.  39 feet

D.  45 feet

ANSWER:  D.
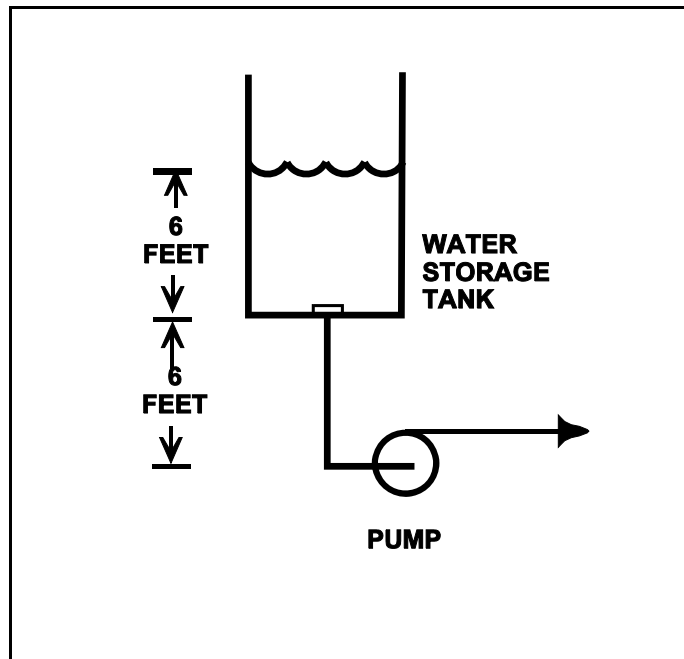
TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P5211   (B5210)

Consider a centrifugal pump that is taking suction from the bottom of an open water storage tank. (See figure below.)

Given:

 The tank contains 60°F water.
 The eye of the pump impeller is located 50 feet above the bottom of the tank.
 The pump requires a minimum net positive suction head of 4 feet.

Which one of the following describes the effect on pump operation if tank water level is allowed to continuously decrease?

A.  The pump will operate normally until tank water level decreases below approximately 20 feet, at which time the pump will cavitate.

B.  The pump will operate normally until tank water level decreases below approximately 16 feet, at which time the pump will cavitate.

C.  The pump will operate normally until the pump suction becomes uncovered, at which time the pump will cavitate.

D.  The pump will operate normally until the pump suction becomes uncovered, at which time the pump will become air bound.

ANSWER:  A.
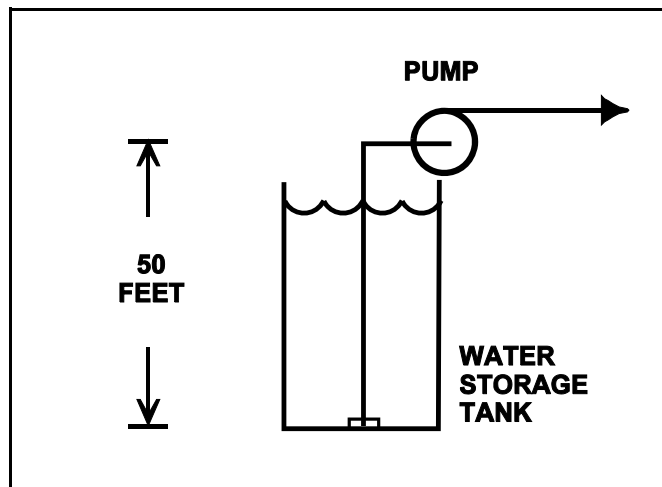
TOPIC: 191004
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P5511 (B5510)

Refer to the drawing of a steam condenser, hotwell, and condensate pump (see figure below).

Given the following:

- The eye of the pump impeller is located 6.0 feet below the bottom of the hotwell.
- The pump requires 10.0 ft-lbf/lbm of net positive suction head (NPSH).
- Condenser pressure is 1.2 psia.
- Hotwell water temperature is 90°F.
- Fluid velocity and friction head losses are zero.

What is the minimum hotwell water level necessary to provide the required NPSH?

A. 1.2 feet

B. 2.8 feet

C. 4.0 feet

D. 5.2 feet

ANSWER: B.
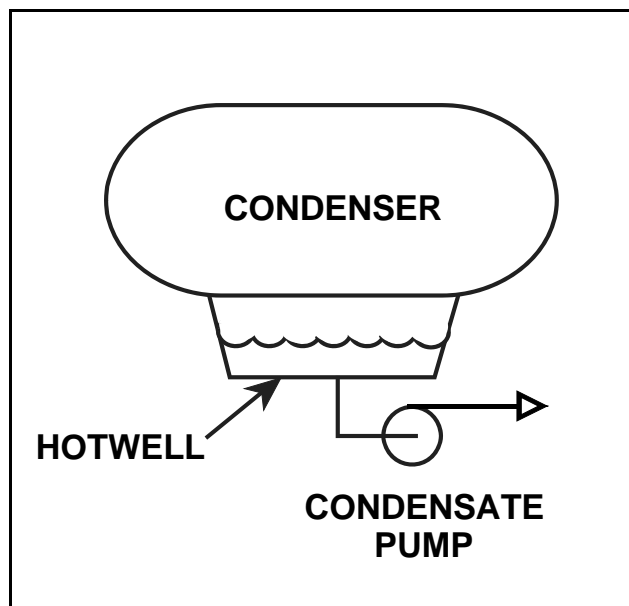
TOPIC:          191004
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P5611   (B5610)

A centrifugal pump is taking suction on a water storage tank and delivering the makeup water to a cooling water system.  The pump will have the lowest net positive suction head requirement if the pump is operated at a relatively _____ speed with a _____ discharge flow control valve.

A.  high; fully open

B.  high; throttled

C.  low; fully open

D.  low; throttled

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P24

Shutting the discharge valve on an operating centrifugal pump will cause the motor amps to _____ and the pump discharge pressure to _____.

A.  increase, increase

B.  decrease, increase

C.  increase, decrease

D.  decrease, decrease

ANSWER:  B.

TOPIC:              191004
KNOWLEDGE:    K1.07   [2.9/2.9]
QID:                P117

When starting an ac motor-driven centrifugal pump, the response of motor current will be...

A.  low starting amps, increasing to a higher equilibrium running amperage.

B.  low starting amps, remaining at a low equilibrium running amperage.

C.  high starting amps, decreasing to a lower equilibrium running amperage.

D.  high starting amps, remaining at a high equilibrium running amperage.

ANSWER:  C.

TOPIC:              191004
KNOWLEDGE:    K1.07   [2.9/2.9]
QID:                P224

A constant-speed radial-flow centrifugal pump motor draws the <u>least</u> current when the pump is...

A.  at runout conditions.

B.  at operating conditions.

C.  accelerating to normal speed during start.

D.  at shutoff head.

ANSWER:  D.

TOPIC:            191004
KNOWLEDGE:  K1.07   [2.9/2.9]
QID:              P424

A centrifugal pump is circulating water at 100°F in a cooling water system.  After several hours the water temperature has increased to 150°F.  Assuming system flow rate (gpm) is constant, pump motor amps will have _____ because _____.

A.  decreased; water density has decreased

B.  decreased; water volume has increased

C.  increased; water density has decreased

D.  increased; water volume has increased

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P821

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

The pump is circulating 200°F water.  Several hours later, after system cooldown and no lineup changes, the pump is circulating 120°F water.

During the system cooldown, pump motor current has...

A.  decreased because water density has increased.

B.  increased because water density has increased.

C.  decreased because pump motor efficiency has decreased.

D.  increased because pump motor efficiency has decreased.

ANSWER:  B.
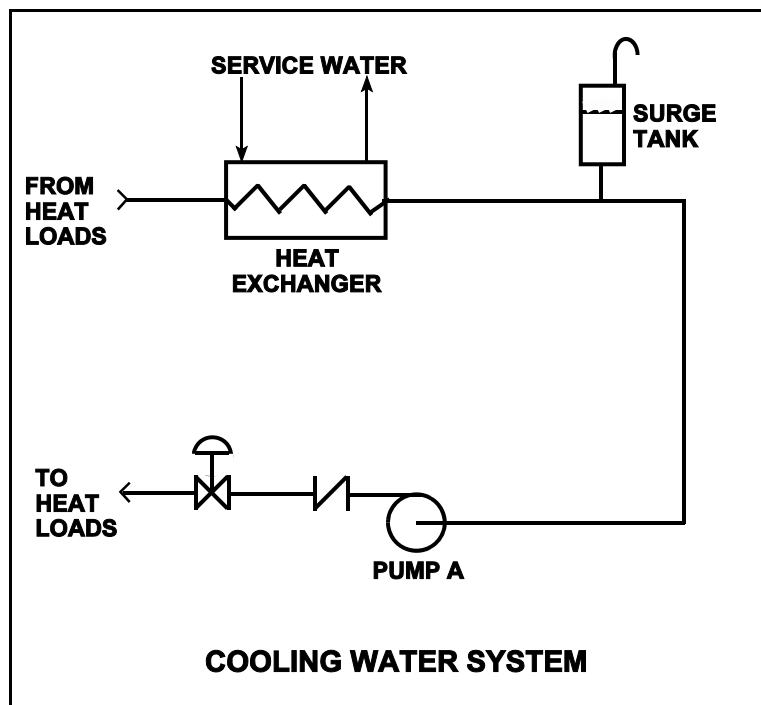
TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P923

A centrifugal pump is operating in a closed system with all valves fully open.  If the pump discharge valve is throttled 75% closed, pump motor current will...

A.  increase and stabilize at a higher value.

B.  decrease and stabilize at a lower value.

C.  increase briefly, then return to original value.

D.  decrease briefly, then return to original value.

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P1223

Which one of the following centrifugal pump operating conditions will result in the most current being drawn by the pump ac motor?

A.  Pump discharge head is at shutoff head.

B.  The pump is operating at minimum flow.

C.  Pump discharge head is at design head.

D.  The pump is operating at runout.

ANSWER:  D.

TOPIC:            191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P1420   (B2219)

A centrifugal pump is circulating water at 150°F in a cooling water system.  After several hours the water temperature has decreased to 100°F.  Assuming system flow rate (gpm) is constant, pump motor amps will have _____ because _____ has increased.

A.  increased; water density

B.  decreased; water density

C.  increased; motor efficiency

D.  decreased; motor efficiency

ANSWER:  A.

TOPIC:            191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P1622   (B922)

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

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

A.  84 amps

B.  96 amps

C.  104 amps

D.  116 amps

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P1824   (B419)

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

The centrifugal pump is circulating water at 100°F.  After several hours the water temperature has increased to 200°F.  Assuming system flow rate (gpm) is constant, pump motor amps will have _____ because _____.

A.  decreased; water density has decreased

B    increased; water density has decreased

C.  decreased; pump efficiency has increased

D.  increased; pump efficiency has increased

ANSWER:  A.

SERVICE WATER

SURGE TANK

FROM HEAT LOADS

HEAT EXCHANGER

TO HEAT LOADS

PUMP A

**COOLING WATER SYSTEM**

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P1924   (B115)

A constant-speed radial-flow centrifugal pump motor draws the <u>least</u> current when the pump is...

A.  at maximum rated flow conditions.

B.  operating on recirculation flow only.

C.  accelerating to normal speed during start.

D.  at shutoff head with no recirculation flow.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P2023   (B2020)

A reactor coolant pump (RCP) is circulating reactor coolant at 100°F.  After several hours the reactor coolant temperature has increased to 150°F.

Assuming coolant flow rate (gpm) is constant, RCP motor amps will have _____ because _____.

A.  decreased; coolant density has decreased

B.  decreased; system head losses have increased

C.  increased; coolant density has increased

D.  increased; system head losses have decreased

ANSWER:  A.

TOPIC:              191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:                   P2123   (B622)

A typical radial-flow centrifugal pump is operating at rated conditions in an open system with all valves fully open.  If the pump discharge valve is throttled to 50% closed, pump discharge pressure will _____ and pump motor current will _____.

A.  decrease; decrease

B.  decrease; increase

C.  increase; increase

D.  increase; decrease

ANSWER:  D.

TOPIC:              191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:                   P2124   (B2423)

A centrifugal pump in a cooling water system is circulating water at 180°F with a motor current of 200 amps.  After several hours, system temperature has changed such that the water density has increased by 3%.

Assuming pump head remains the same, which one of the following is the new pump motor current?

A.  203 amps

B.  206 amps

C.  218 amps

D.  236 amps

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P2520   (B2520)

A constant-speed centrifugal pump motor draws the most current when the pump is...

A.  at maximum rated flow conditions.

B.  operating at runout flow.

C.  accelerating to normal speed during start.

D.  at shutoff head with no recirculation flow.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P2821   (B2822)

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.

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P2925   (B2921)

A centrifugal pump is circulating water at 180°F with a pump motor current of 200 amps.  After several hours, system temperature has changed such that the water density has increased by 6%.

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

A.  203 amps

B.  206 amps

C.  212 amps

D.  224 amps

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P3822   (B3820)

An ac motor-driven centrifugal water pump was just started.  During the start, motor current remained peaked for 2 seconds, and then decreased and stabilized at about one-fifth the standard running current.  Normally, the starting current peak lasts about 4 seconds.

Which one of the following could have caused the abnormal start indications above?

A.  The pump shaft was initially seized and the motor breaker opened.

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

C.  The pump was initially air bound, and then primed itself after 2 seconds of operation.

D.  The coupling between the motor and pump shafts was left unfastened after maintenance.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P4811   (B4811)

A centrifugal cooling water pump is driven by an ac induction motor.  The pump can supply cooling water to several heat loads, all of which are in parallel alignment.  The following pump conditions initially exist:

    Pump motor current:          100 amps
    Pump flow rate:              400 gpm
    Pump suction temperature:   70°F

Four hours later, the motor is drawing 95 amps.  Which one of the following could be responsible for the observed decrease in motor amps?

A.  The temperature of the cooling water being pumped decreased to 60°F with <u>no</u> change in pump flow rate.

B.  The temperature of the cooling water being pumped increased to 80°F with <u>no</u> change in pump flow rate.

C.  Cooling water flow was established to an additional heat load with <u>no</u> change in the temperature of the cooling water being pumped.

D.  Cooling water flow was isolated from an out-of-service heat load with <u>no</u> change in the temperature of the cooling water being pumped.

ANSWER:  D.


TOPIC:          191004
KNOWLEDGE:   K1.08   [2.4/2.6]
QID:            P225

Many larger centrifugal pumps are started with their discharge valves <u>closed</u> to prevent...

A.  cavitation in the pump.

B.  lifting the discharge relief valve.

C.  loss of recirculation (miniflow).

D.  excessive current in the pump motor.

ANSWER:  D.

TOPIC:           191004
KNOWLEDGE:   K1.08   [2.4/2.6]
QID:             P1325   (B1822)

Some large centrifugal pumps are interlocked so that the pump will not start unless its discharge valve is at least 90% fully closed.  This interlock is provided to minimize the...

A.  pump discharge pressure.

B.  heating of the pumped fluid.

C.  cavitation at the pump suction.

D.  duration of the pump motor starting current.

ANSWER:  D.

TOPIC:           191004
KNOWLEDGE:   K1.08   [2.4/2.6]
QID:             P2622   (B821)

Which one of the following contains two reasons for starting a typical radial-flow centrifugal pump with the discharge piping full of water and the discharge valve shut?

A.  Prevent pump runout and prevent motor overspeed

B.  Prevent pump runout and ensure lubrication of pump seals

C.  Prevent water hammer and ensure adequate pump recirculation flow

D.  Prevent water hammer and prevent excessive starting current

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P323

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below) in which pumps A and B are identical single-speed centrifugal pumps and only pump A is operating.

If pump B is started, system flow rate will be _____ and common pump discharge pressure will be _____.

A.  the same; higher

B.  higher; the same

C.  the same; the same

D.  higher; higher

ANSWER:  D.



**COOLING WATER SYSTEM**

**CENTRIFUGAL PUMP OPERATING CURVE**
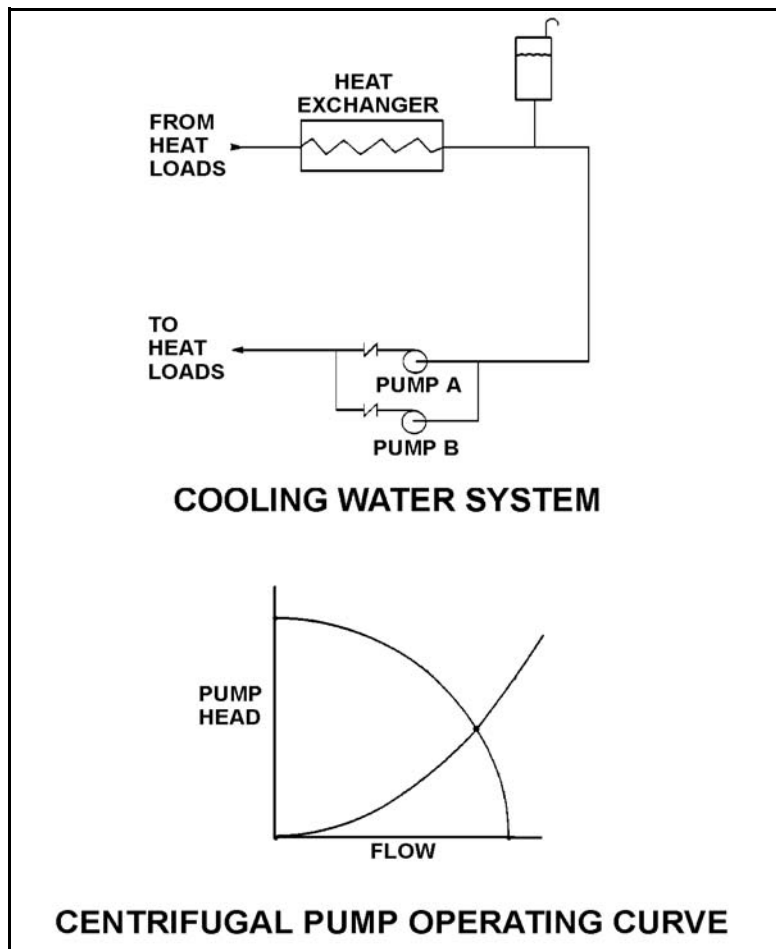
TOPIC:           191004
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:             P1823

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below).

Pumps A and B are identical single-speed centrifugal pumps, and only pump A is operating.  If pump B is started, after the system stabilizes system flow rate will be...

A.  twice the original flow.

B.  the same as the original flow.

C.  less than twice the original flow.

D.  more than twice the original flow.

ANSWER:  C.
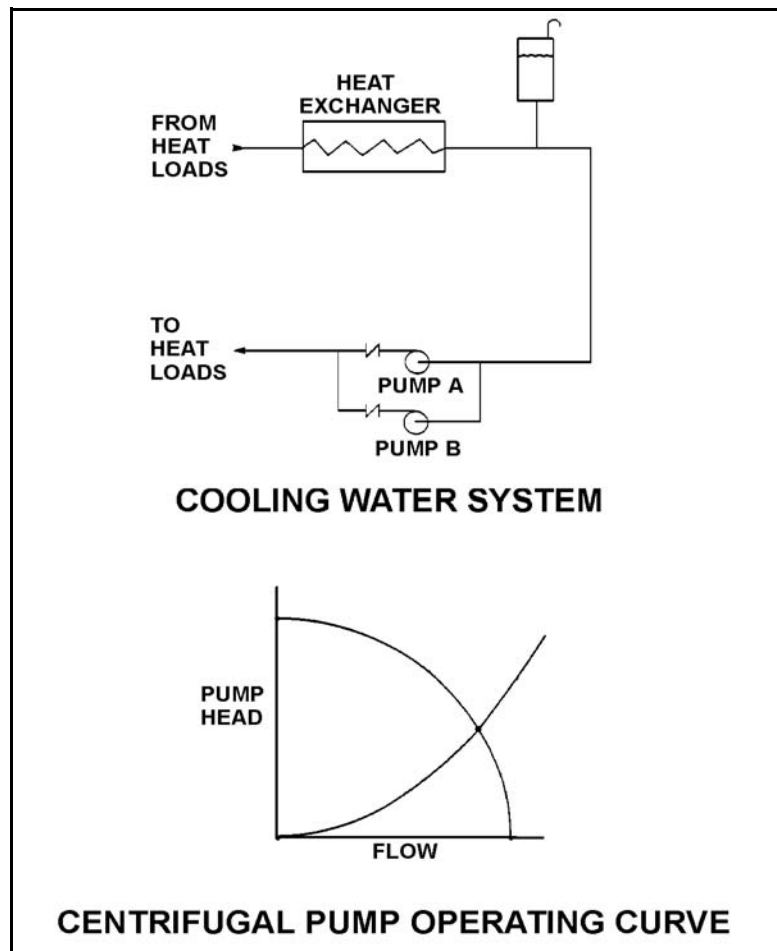
TOPIC:          191004
KNOWLEDGE:   K1.09   [2.4/2.5]
QID:            P2223

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

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

A.  minimum; minimum

B.  minimum; maximum rated

C.  maximum rated; minimum

D.  maximum rated; maximum rated

ANSWER:  B.
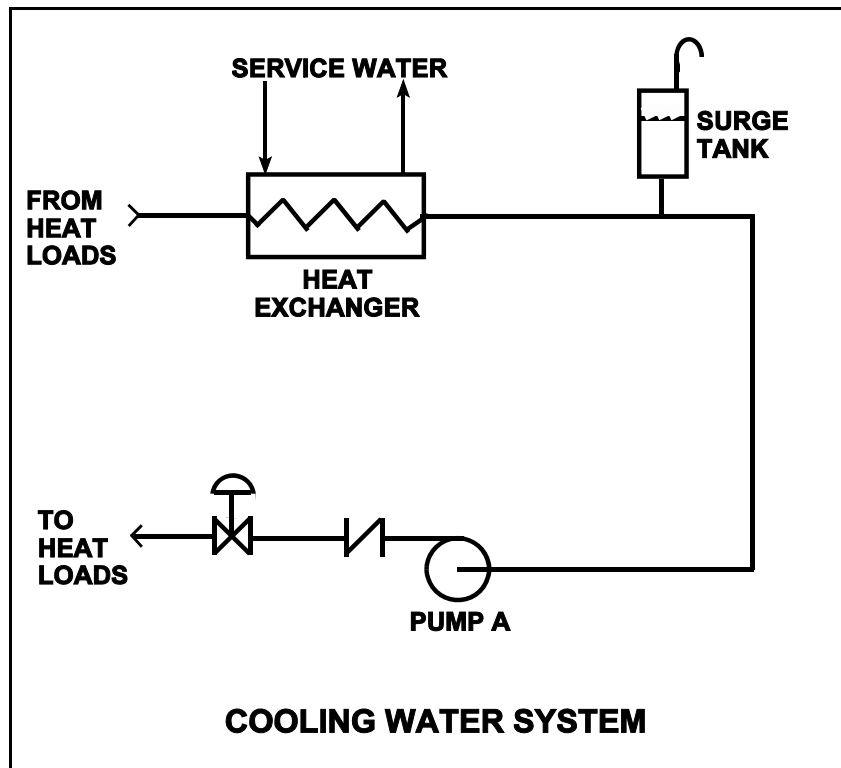
TOPIC:        191004
KNOWLEDGE:    K1.09   [2.4/2.5]
QID:          P2324

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

Pumps A and B are identical single-speed centrifugal pumps and both pumps are operating.  If pump B trips, after the system stabilizes, system flow rate will be...

A.  more than one-half the original flow.

B.  one-half the original flow.

C.  the same; only the pump head will change.

D.  less than one-half the original flow.

ANSWER:  A.
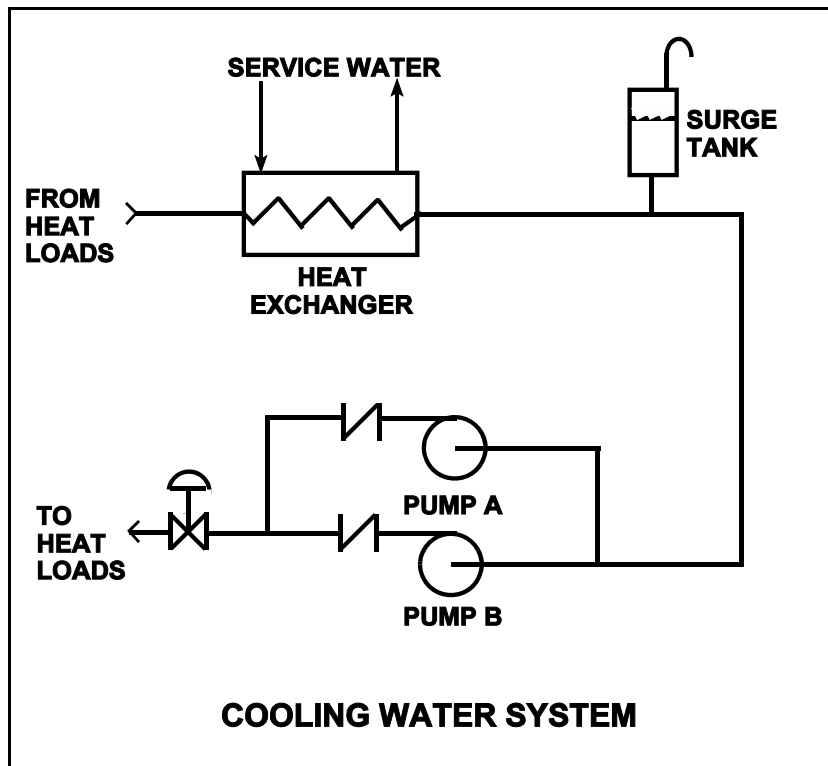
TOPIC:            191004
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:              P324

Which one of the following is an indication of pump runout?

A.  Low pump flow rate

B.  High pump vibration

C.  Low pump motor current

D.  High pump discharge pressure

ANSWER:  B.

TOPIC:            191004
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:              P823

Which one of the following is an indication of pump runout?

A.  High discharge pressure

B.  Low pump motor current

C.  High pump flow rate

D.  Pump flow reversal

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P1123   (B1920)

Which one of the following describes typical radial-flow centrifugal pump runout conditions?

A.  High discharge pressure, low flow, high power demand

B.  High discharge pressure, high flow, low power demand

C.  Low discharge pressure, low flow, low power demand

D.  Low discharge pressure, high flow, high power demand

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P1623   (B1323)

A centrifugal pump is operating at its maximum design flow rate, delivering water through two parallel valves.  Valve "A" is half open, and valve "B" is one quarter open.

Which one of the following will occur if both valves are fully opened?

A.  The pump will operate at shutoff head.

B.  The pump available net positive suction head will increase.

C.  The pump required net positive suction head will decrease.

D.  The pump will operate at runout conditions.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P1721   (B1024)

Refer to the drawing of a centrifugal pump operating curve (see figure below).

Which point represents pump operation at runout conditions?

A.  Point A

B.  Point B

C.  Point C

D.  Point D

ANSWER:  C.

TOPIC:         191004
KNOWLEDGE:  K1.12   [2.5/2.7]
QID:             P3910   (B3910)

Refer to the drawing of a cooling water system in which only centrifugal pump A is operating and the common pump discharge valve is currently 90% open (see figure below).

An abnormal total heat load on the cooling water system is causing pump A to approach operation at runout conditions.  Which one of the following will cause pump A to operate farther away from runout conditions?  (Assume that satisfactory available net positive suction head is maintained at all times.)

A.  Starting pump B.

B.  Positioning the discharge valve to 100% open.

C.  Raising the water level in the surge tank by 2 feet.

D.  Decreasing heat exchanger service water flow rate by 10%.

ANSWER:  A.
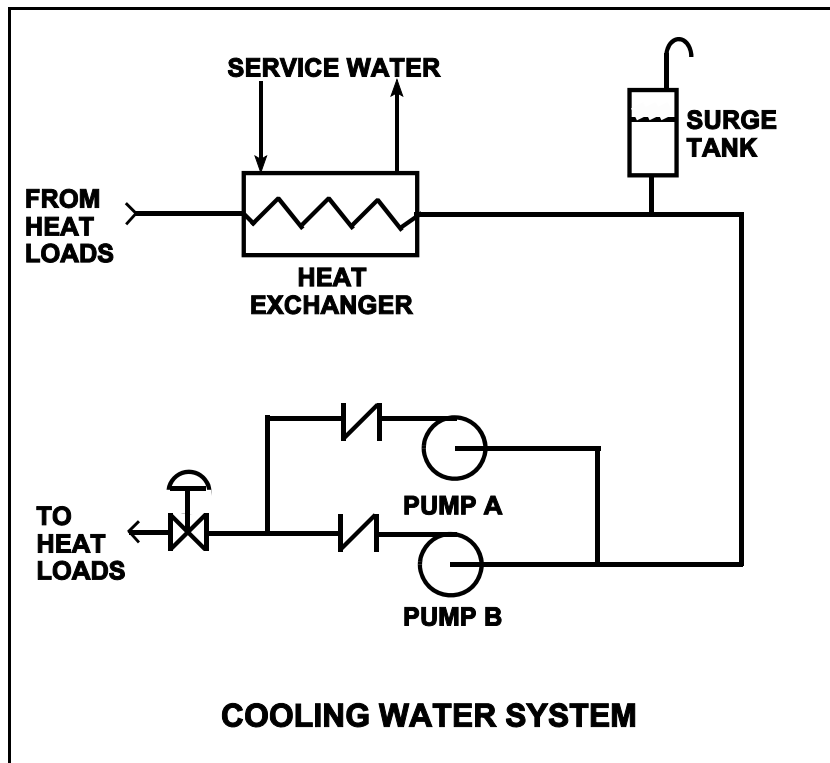
TOPIC:      191004
KNOWLEDGE:  K1.12  [2.5/2.7]
QID:         P5111  (B5111)

A flow-limiting venturi in the discharge piping of a centrifugal pump decreases the potential for the pump to experience...

A.  runout

B.  reverse flow

C.  shutoff head

D.  water hammer

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P623    (B1423)

Refer to the drawing of a lube oil temperature control system and the associated centrifugal pump operating curve (see figure on the following page).

If the pump is operating at point B on the operating curve, how will the operating point change if the temperature control valve modulates farther open?

A.  Operating point B will be located on curve 1 closer to point E.

B.  Operating point B will be located on curve 1 closer to point D.

C.  Operating point B will be located on curve 2 closer to point A.

D.  Operating point B will be located on curve 2 closer to point C.

ANSWER:  D.



LUBE OIL TEMPERATURE CONTROL SYSTEM

CENTRIFUGAL PUMP OPERATING CURVE

TOPIC:              191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:                   P723    (B722)

Refer to the drawing of a lube oil temperature control system and the associated centrifugal pump operating curve (see figure below).

The pump is operating at point B on the operating curve.  If the temperature control valve modulates farther closed, operating point B will be located on curve _____, closer to point _____. (The options below assume that curves 1 and 2 are exactly as shown in the figure.)

A.  1; D

B.  2; A

C.  1; E

D.  2; C

ANSWER:  B.



LUBE OIL TEMPERATURE CONTROL SYSTEM



CENTRIFUGAL PUMP OPERATING CURVE
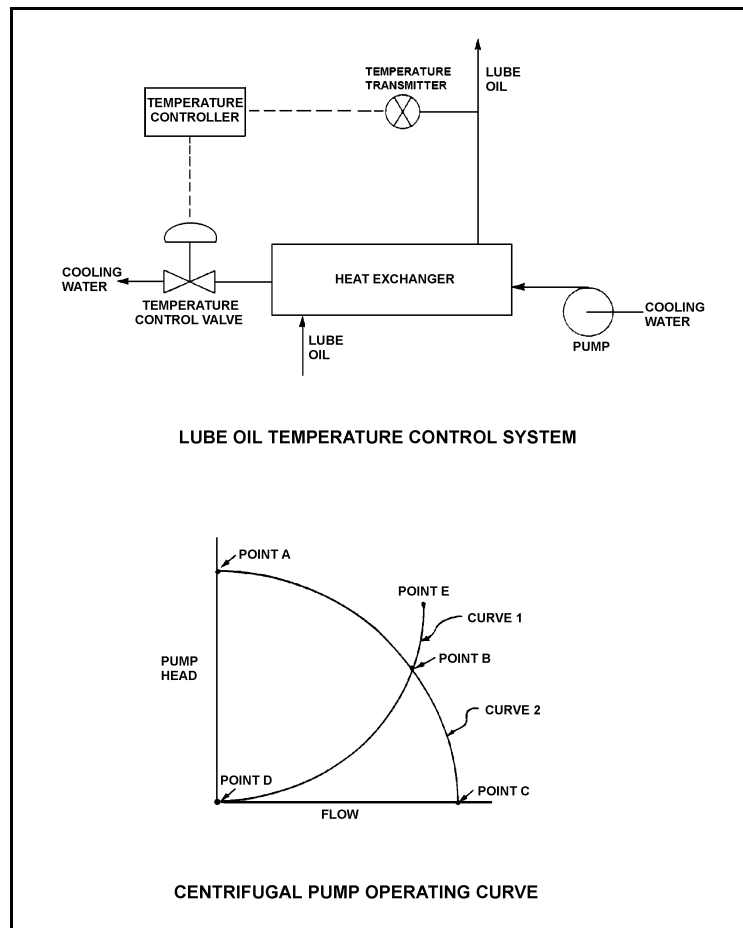
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P824

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

A centrifugal pump in a closed system is operating with a partially open discharge valve.  The discharge valve is then opened fully.  Which set of curves illustrates the initial and final operating conditions?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  D.
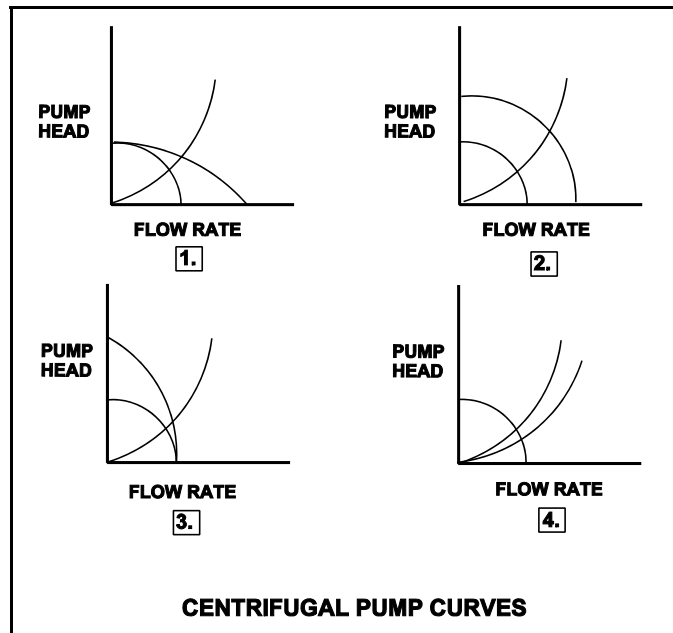
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P926    (B1578)

Refer to the drawing of four sets of centrifugal pump operating curves (see figure below).  Each set of curves shows the combination of two pump/system operating conditions.

Two identical constant-speed centrifugal pumps are operating in series in an open system when one pump trips.

Which set of operating curves depicts the "before" and "after" conditions described above?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  C.
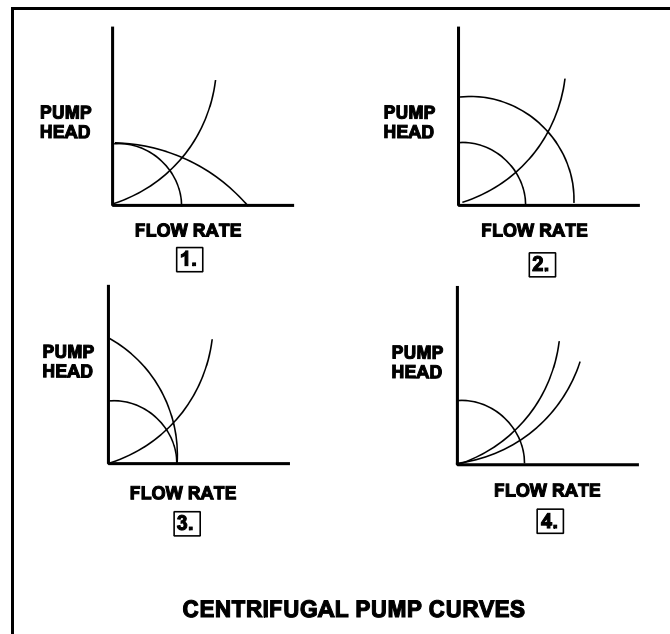
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:             P1324   (B2179)

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

A centrifugal pump is operating in a cooling water system.  Another identical centrifugal pump is started in series with the first.  Which set of curves illustrates the resulting change in system parameters?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  C.



**CENTRIFUGAL PUMP CURVES**
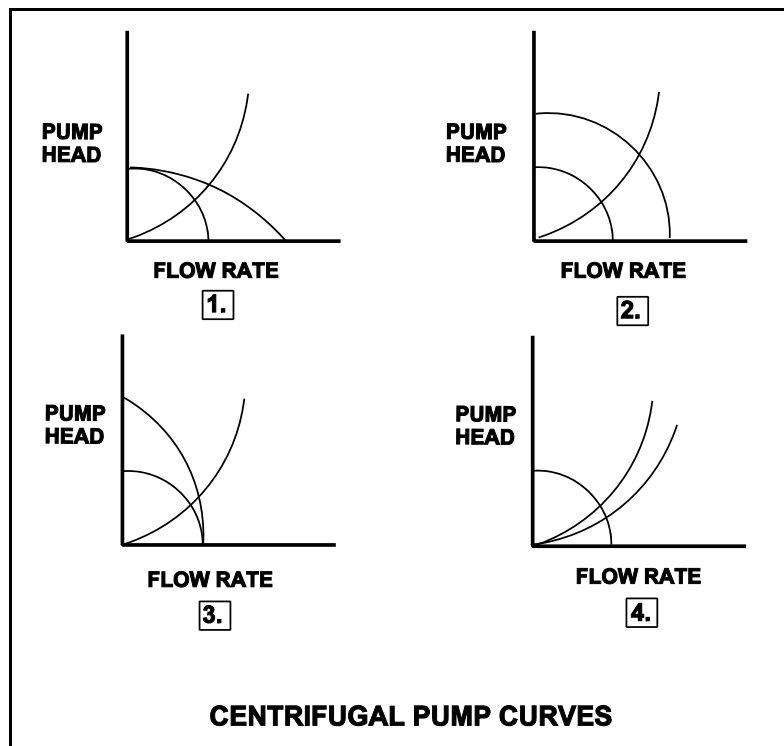
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P1524   (B2480)

Refer to the drawing of four sets of centrifugal pump operating curves (see figure below).  Each set of curves shows the results of a change in pump/system operating conditions.

Two identical constant-speed centrifugal pumps are operating in parallel in an open system when one pump trips.

Which set of operating curves depicts the "before" and "after" conditions described above?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  A.
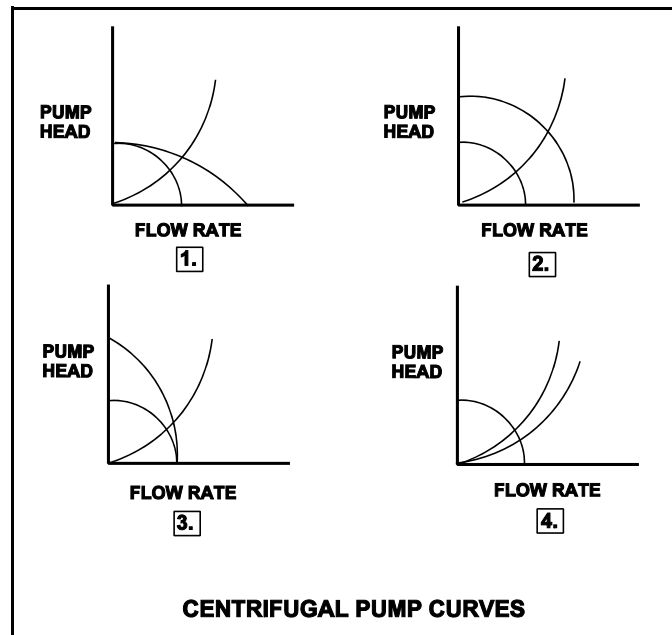
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P1624   (B2279)

Refer to the drawing of four sets of centrifugal pump operating curves (see figure below).  Each set of curves shows the results of a change in pump/system operating conditions.

One constant-speed centrifugal pump is operating in an open system when a second identical centrifugal pump is started in parallel.

Which set of operating curves depicts the "before" and "after" conditions described above?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  A.
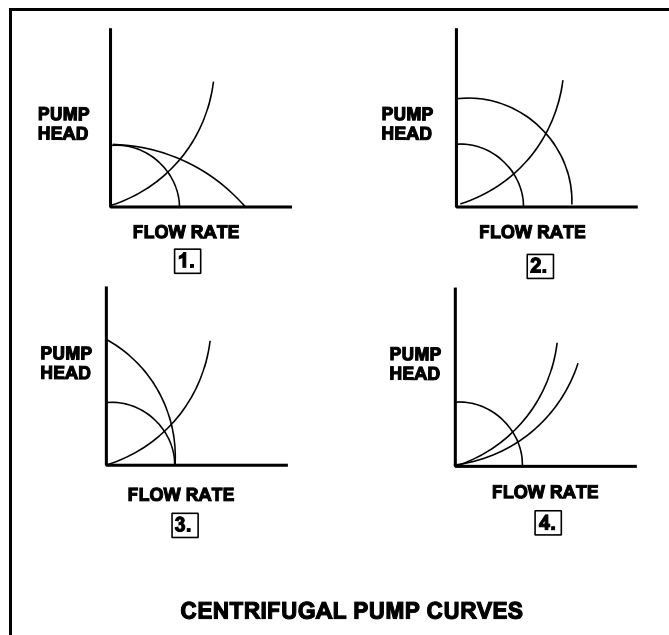
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P1724   (B1780)

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

A centrifugal pump is initially operating in a closed water system and discharging through a heat exchanger.  A second heat exchanger, in parallel with the first, is then placed in service.

Which set of curves illustrates the initial and final operating conditions?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  D.
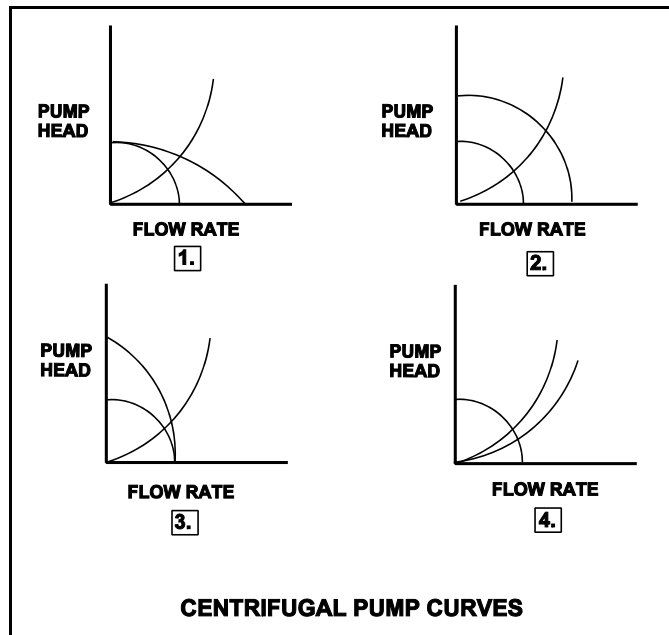
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P1921   (B925)

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

Which one of the following determines the general shape of the curve from point C to point D?

A.  The pump flow losses due to the decrease in available net positive suction head as the system flow rate increases.

B.  The pump flow losses due to back leakage through the clearances between the pump impeller and casing as the D/P across the pump increases.

C.  The frictional and throttling losses in the piping system as the system flow rate increases.

D.  The frictional losses between the pump impeller and its casing as the differential pressure (D/P) across the pump increases.

ANSWER:  C.
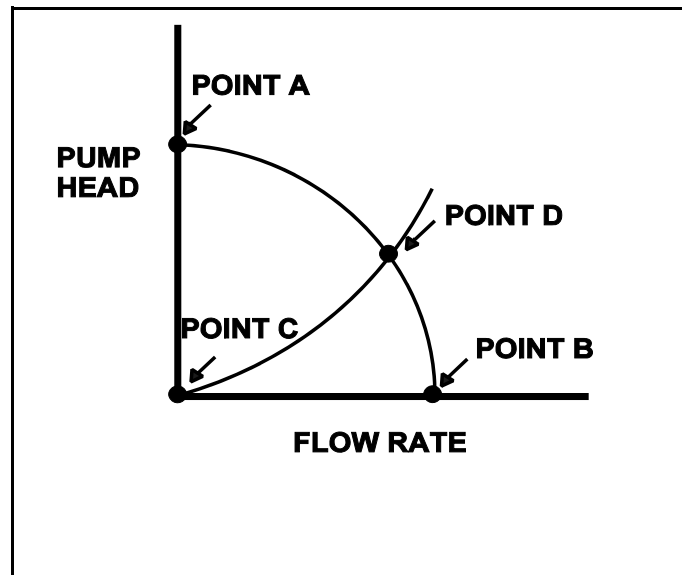
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:              P2325   (B2323)

Refer to the drawing of a centrifugal pump operating curve (see figure below).

A centrifugal pump is currently 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 _____.  (Assume that no other changes occur in the system.)

A.  1; D

B.  2; A

C.  1; E

D.  2; C

ANSWER:  A.



CENTRIFUGAL PUMP OPERATING CURVE
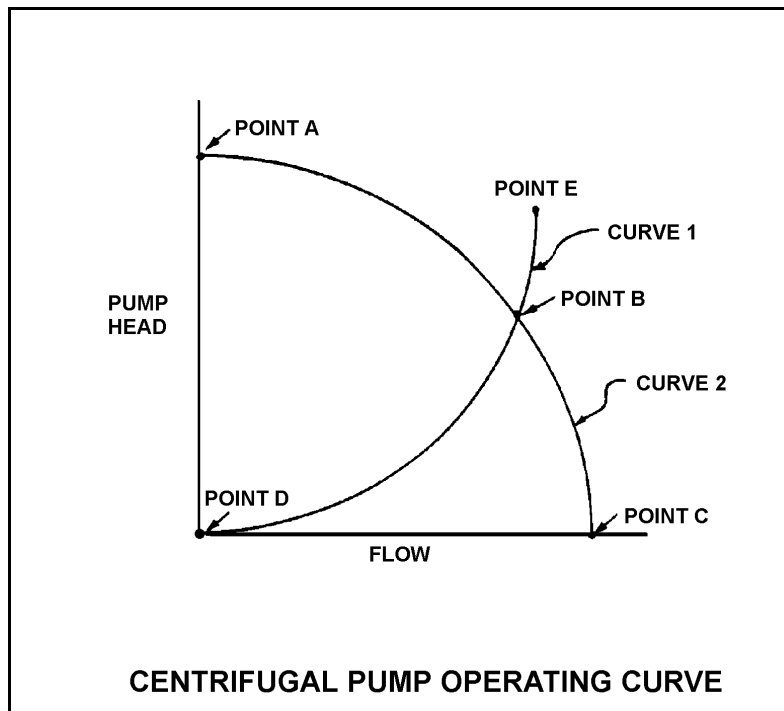
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P2422   (B2422)

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

The pump is operating with the temperature control valve one-half open.  If the temperature control valve modulates farther closed, system head loss will _____ and pump head will _____.

A.  increase, decrease

B.  increase, increase

C.  decrease, decrease

D.  decrease, increase

ANSWER:  B.



**LUBE OIL TEMPERATURE CONTROL SYSTEM**
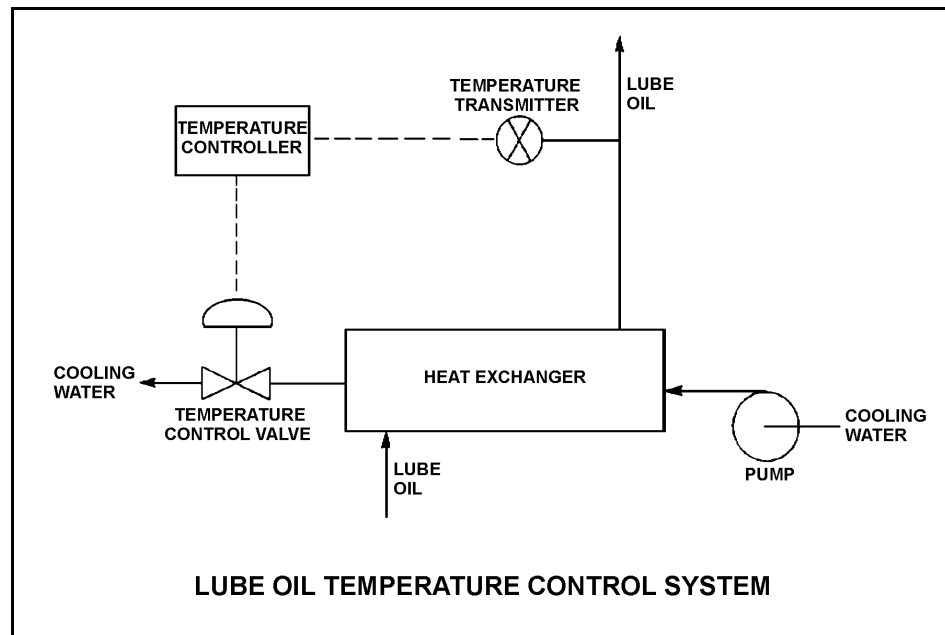
TOPIC:           191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:              P2523   (B2524)

Refer to the drawing of a lube oil temperature control system and the associated centrifugal pump operating curve (see figure below).

If the pump is operating at point B on the operating curve, how will the operating point change if the temperature controller setpoint is decreased by 10°F?

A.  Operating point B will be located on curve 1 closer to point E.

B.  Operating point B will be located on curve 1 closer to point D.

C.  Operating point B will be located on curve 2 closer to point A.

D.  Operating point B will be located on curve 2 closer to point C.

ANSWER:  D.



LUBE OIL TEMPERATURE CONTROL SYSTEM



CENTRIFUGAL PUMP OPERATING CURVE
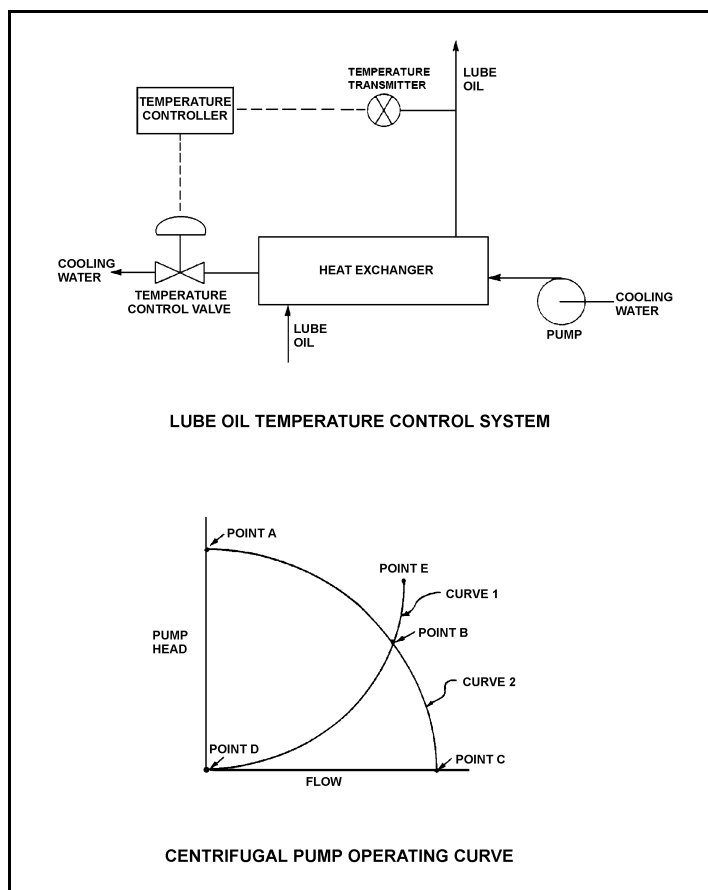
TOPIC:              191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:                   P2723   (B2718)

Refer to the drawing showing two operating points for the same centrifugal pump (see figure below).

Operating point A was generated from pump performance data taken six months ago.  Current pump performance data was used to generate operating point B.  Which one of the following would cause the observed difference between operating points A and B?

A.  The pump discharge valve was more open when data was collected for operating point A.

B.  The pump discharge valve was more closed when data was collected for operating point A.

C.  The pump internal components have worn since data was collected for operating point A.

D.  The system piping head loss has increased since data was collected for operating point A.

ANSWER:  C.



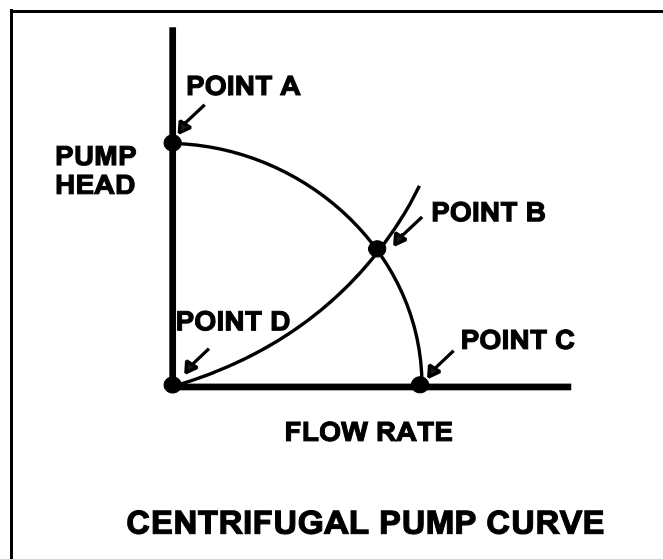CENTRIFUGAL PUMP OPERATING POINTS
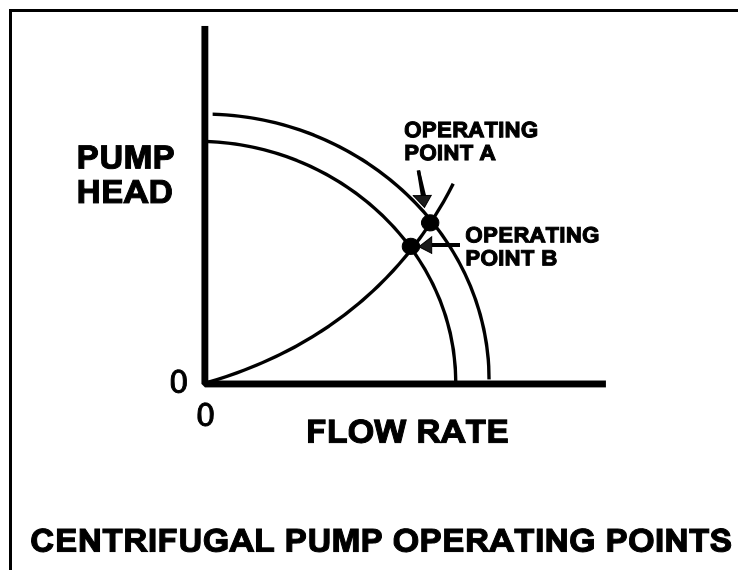
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:             P2823   (B2879)

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

A two-speed centrifugal pump is operating in low speed in a cooling water system and discharging through a heat exchanger.  The pump is then switched to high speed.

Which set of curves illustrates the initial and final operating conditions?

A.  1.

B.  2.

C.  3.

D.  4.

ANSWER:  B.



CENTRIFUGAL PUMP CURVES
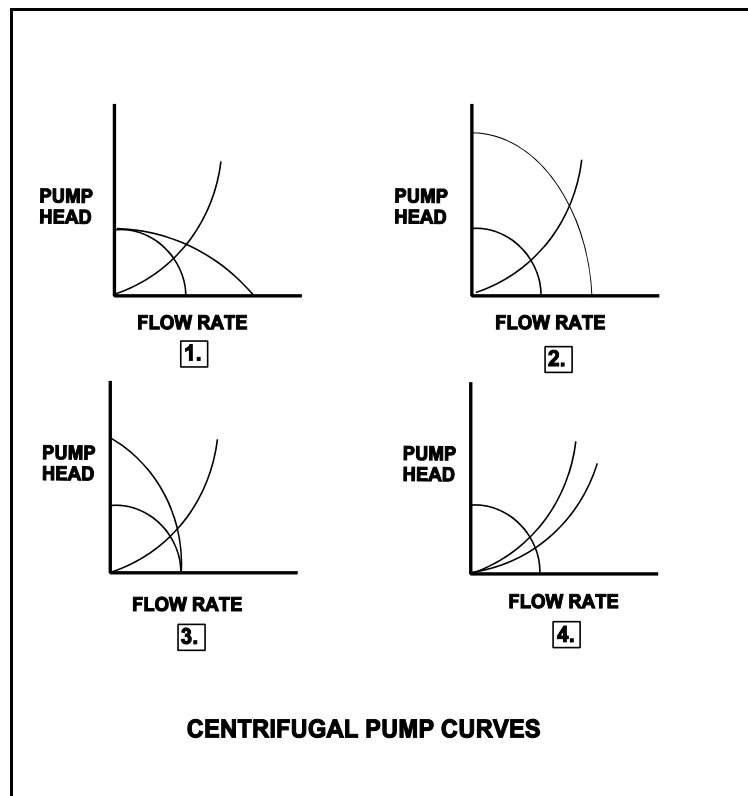
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:             P2923   (B3579)

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

A two-speed centrifugal pump is operating at fast speed in a cooling water system and discharging through a heat exchanger.  The pump is then switched to slow speed.

Which set of curves illustrates the initial and final operating conditions?

A.  1.

B.  2.

C.  3.

D.  4.
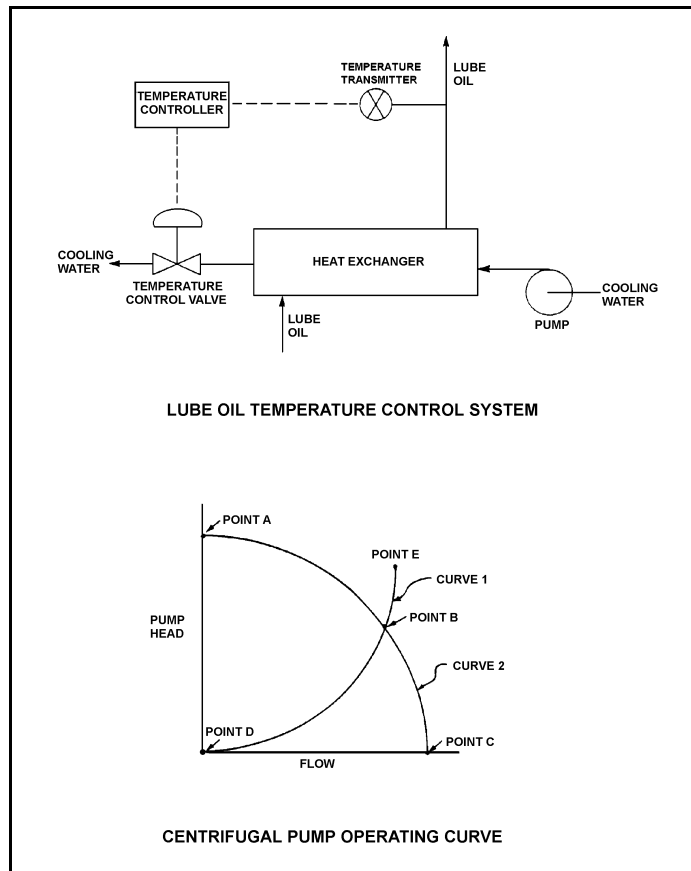
ANSWER:  B.



CENTRIFUGAL PUMP CURVES
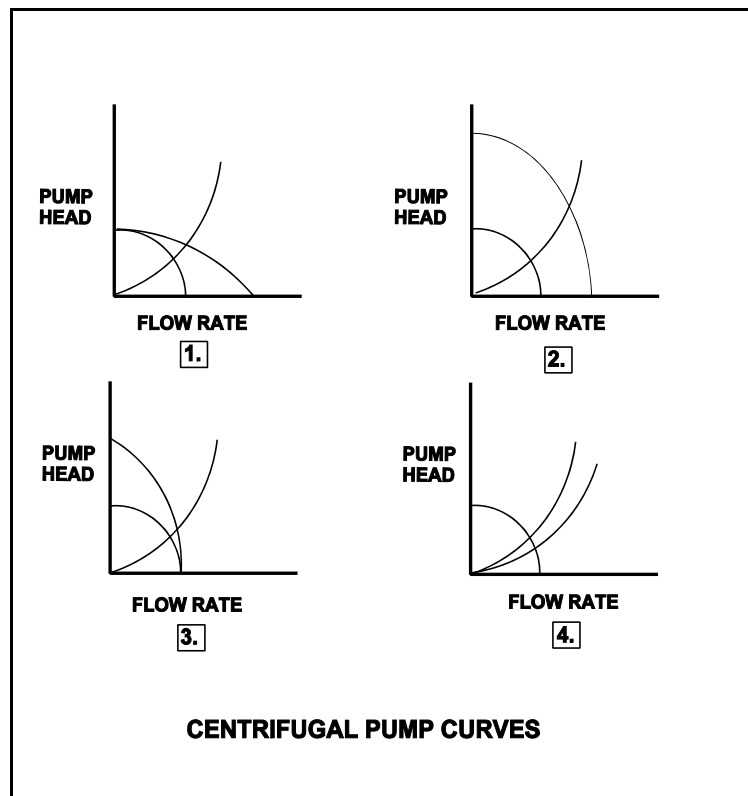
TOPIC:            191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:              P3323   (B1020)

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below).  Pumps A and B are identical single-speed centrifugal pumps and initially only pump A is operating.

Pump B is then started.  After the system stabilizes, system flow rate will be...

A.  the same as the initial flow rate.

B.  less than twice the initial flow rate.

C.  twice the initial flow rate.

D.  more than twice the initial flow rate.

ANSWER:  B.



**COOLING WATER SYSTEM**

**CENTRIFUGAL PUMP OPERATING CURVE**
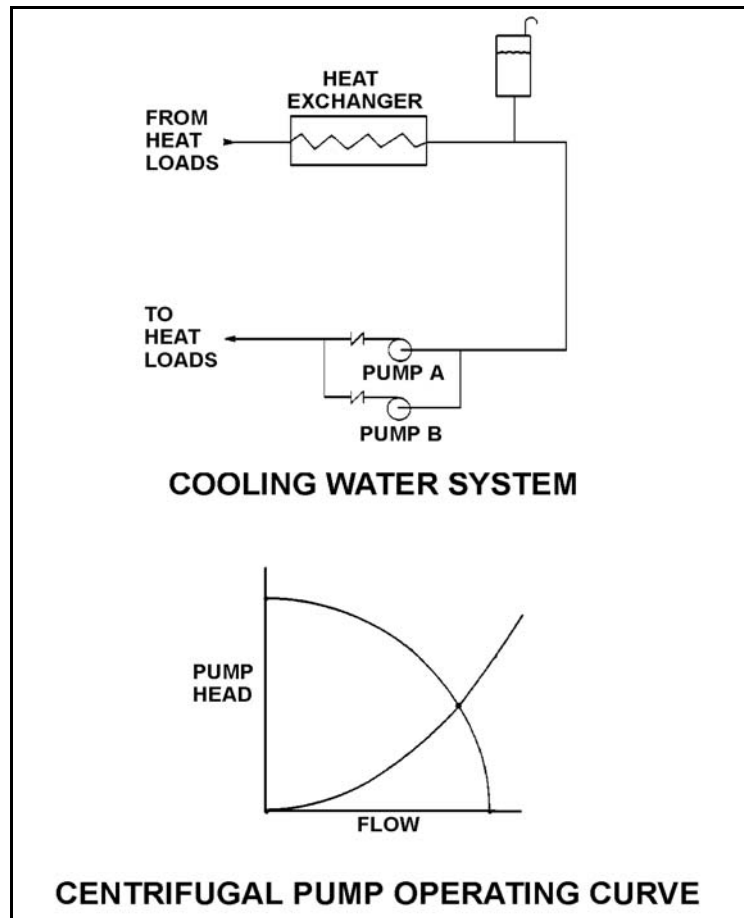
TOPIC:          191004
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:            P4211   (B4211)

Refer to the drawing of an operating cooling water system (see figure below).  As depicted in the drawing, only two of the three system heat loads are currently in service.

Which one of the following changes to the cooling water system will result in a higher cooling water pump flow rate <u>and</u> a reduced pump discharge head?

A.  Increase pump speed by 20%.

B.  Decrease pump speed by 20%.

C.  Isolate one of the two in-service heat loads.

D.  Place the third system heat load in service.

ANSWER:  D.



**COOLING WATER SYSTEM**
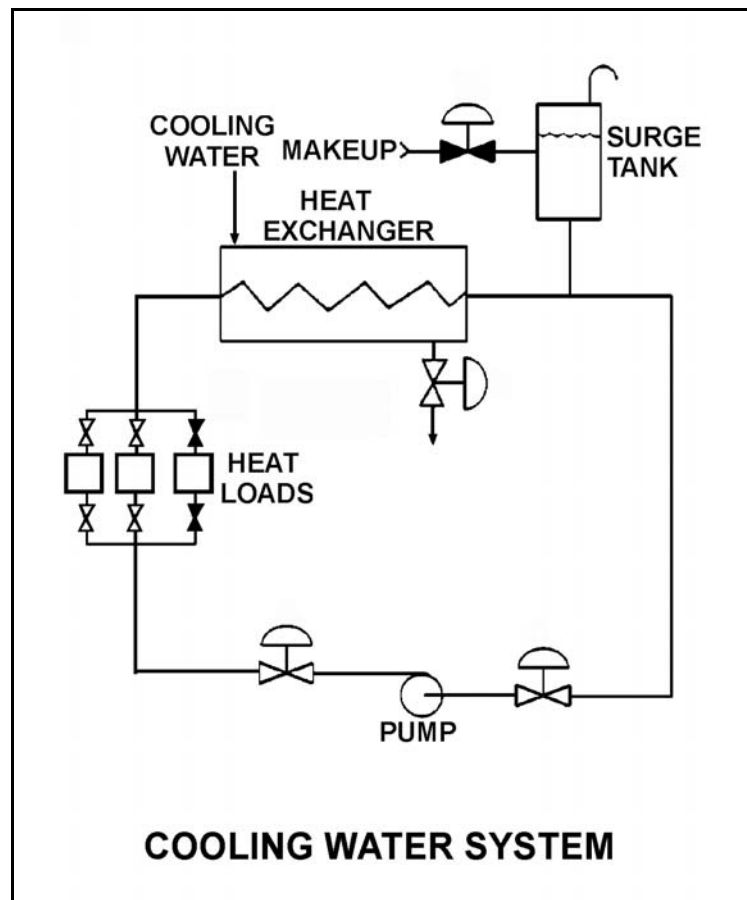
TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P114    (B2223)

A motor-driven centrifugal pump is operating in an open system with its discharge valve throttled to 50% open.  If the discharge valve is fully opened, available net positive suction head (NPSH) will _____ and required NPSH will _____.

A.  remain the same; increase

B.  remain the same; remain the same

C.  decrease; increase

D.  decrease; remain the same

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P325    (B322)

Increasing the flow rate through a centrifugal pump by throttling open the discharge valve will cause pump head to...

A.  increase and stabilize at a higher value.

B.  decrease and stabilize at a lower value.

C.  remain constant.

D   increase, then decrease following the pump's efficiency curve.

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.15
QID:            P724     (B723)

A centrifugal pump is operating at rated conditions in an open system.  If the pump recirculation valve is opened farther, pump discharge pressure will _____ and pump flow rate will _____.

A.  increase; decrease

B.  decrease; increase

C.  increase; increase

D.  decrease; decrease

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P1421   (B1421)

A centrifugal pump is operating at rated conditions in an open system with all valves fully open.  If the pump discharge valve is throttled to 50%, pump suction pressure will _____ and pump discharge pressure will _____.

A.  increase; decrease

B.  decrease; increase

C.  increase; increase

D.  decrease; decrease

ANSWER:  C.

TOPIC:            191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:              P2025   (B2019)

A variable-speed centrifugal pump is operating at rated speed in an open system.  If the pump speed is decreased by 50%, available net positive suction head (NPSH) will _____ and required NPSH will _____.

A.  increase; decrease

B.  increase; remain the same

C.  decrease; decrease

D.  decrease; remain the same

ANSWER:  A.

TOPIC:            191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:              P2224   (B521)

A motor-driven centrifugal pump is operating in an open system with its discharge valve throttled to 50%.  How will the pump be affected if the discharge valve is fully opened?

A.  Total developed head decreases, and motor current decreases.

B.  Total developed head increases, and available net positive suction head decreases.

C.  The potential for pump cavitation decreases, and pump differential pressure decreases.

D.  Available net positive suction head decreases, and pump differential pressure decreases.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P2424   (B2420)

A variable speed motor-driven centrifugal pump is operating at 50% speed in an open system.  If the pump speed is increased to 100%, available net positive suction head (NPSH) will _____ and required NPSH will _____.

A.  increase; remain the same

B.  increase; increase

C.  decrease; remain the same

D.  decrease; increase

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P2624   (B2622)

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.

ANSWER:  C.

TOPIC:        191004
KNOWLEDGE:  K1.15  [2.6/2.8]
QID:         P3623  (B3623)

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

Given:

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

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

A.  86 feet

B.  101 feet

C.  116 feet

D.  135 feet

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P3912   (B3911)

A centrifugal firewater pump is operating to pressurize a fire main.  The pump takes suction from a water reservoir.  A fire hose connected to the fire main is being used to suppress an elevated fire.

Given:

- The eye of the pump impeller is located 5 feet above the reservoir water level.
- The pump has a design shutoff head of 120 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60°F.

At which one of the following elevations above the eye of the pump impeller will the fire hose spray nozzle first be <u>unable</u> to provide flow?  (Disregard all sources of system frictional head loss.)

A.  111 feet

B.  116 feet

C.  121 feet

D.  126 feet

ANSWER:  B.

TOPIC:           191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:             P4313   (B4312)

A centrifugal firewater pump is operating to pressurize a fire main.  The pump takes suction from a vented water storage tank.  A fire hose connected to the fire main is being used to suppress an elevated fire.

Given:

• The eye of the pump impeller is located 30 feet below the tank water level.
• The pump has a design shutoff head of 120 feet.
• The required net positive suction head (NPSH) for the pump is 15 feet.
• The tank water temperature is 60°F.

At which one of the following elevations above the eye of the pump impeller will the fire hose spray nozzle first be <u>unable</u> to provide flow?  (Disregard all sources of system frictional head loss.)

A.  106 feet

B.  121 feet

C.  136 feet

D.  151 feet

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:             P4712   (B4710)

A motor-driven centrifugal cooling water pump is operating in an open system with its discharge valve fully open.  If the discharge valve is repositioned to 50% open, the pump's available net positive suction head (NPSH) will _____ and the pump's required NPSH will _____.

A.  remain the same; decrease

B.  remain the same; remain the same

C.  increase; decrease

D.  increase; remain the same

ANSWER:  C.


TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:             P4912   (B4911)

A centrifugal firewater pump is operating to pressurize a fire main.  The pump takes suction from a water reservoir.  A fire hose connected to the fire main is being used to suppress an elevated fire.

Given:

- The eye of the pump impeller is located 15 feet below the reservoir water level.
- The pump has a design shutoff head of 120 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60°F.

At which one of the following elevations above the reservoir water level will the fire hose spray nozzle first be <u>unable</u> to provide flow?  (Disregard all sources of system frictional head loss.)

A.  91 feet

B.  106 feet

C.  121 feet

D.  136 feet

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.15   [2.5/2.8]
QID:            P5412   (B5412)

A motor-driven centrifugal pump is operating in a closed-loop cooling water system and is unable to achieve its rated volumetric flow rate due to cavitation.  Which one of the following will enable the pump to achieve a higher volumetric flow rate before cavitation occurs?

A.  Operate the system at a higher pressure.

B.  Operate the system at a higher temperature.

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

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

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.16   [2.8/2.9]
QID:            P624

Which one of the following specifies the proper pump discharge valve position and the basis for that position when starting a large radial-flow centrifugal pump?

A.  Discharge valve fully open to reduce motor power requirements

B.  Discharge valve throttled to reduce motor power requirements

C.  Discharge valve fully open to ensure adequate pump net positive suction head

D.  Discharge valve throttled to ensure adequate pump net positive suction head

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.16   [2.8/2.9]
QID:            P1725   (B1722)

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

A.  The motor breaker will trip on instantaneous overcurrent.

B.  The motor will not turn and will emit a humming sound.

C.  The pump will rotate in the reverse direction with reduced or no flow rate.

D.  The pump will rotate in the normal direction with reduced flow rate.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.20   [2.8/2.8]
QID:            P25

If the speed of a positive displacement pump is increased, the available net positive suction head will _____ and the probability of cavitation will _____.

A   increase; increase

B.  decrease; decrease

C.  increase; decrease

D.  decrease; increase

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:   K1.20   [2.8/2.8]
QID:            P226

An increase in positive displacement pump speed will cause the available net positive suction head for the pump to...

A.  decrease due to the increase in fluid flow.

B.  decrease due to the increase in fluid discharge pressure.

C.  increase due to the increase in fluid discharge pressure.

D.  increase due to the increase in fluid flow.

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.20   [2.8/2.8]
QID:            P1025

The minimum required net positive suction head for a typical positive displacement pump will increase the most if the pump...

A.  motor speed increases from 1,200 rpm to 1,600 rpm.

B.  discharge pressure decreases from 100 psig to 50 psig.

C.  suction temperature increases from 75°F to 85°F.

D.  discharge valve is positioned from 90% open to fully open.

ANSWER:  A.

TOPIC:         191004
KNOWLEDGE:   K1.21   [3.0/3.1]
QID:           P1425   (B1125)

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

A.  On the pump suction piping upstream of the suction isolation valve.

B.  On the pump suction piping downstream of the suction isolation valve.

C.  On the pump discharge piping upstream of the discharge isolation valve.

D.  On the pump discharge piping downstream of the discharge isolation valve.

ANSWER:  C.

TOPIC:         191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:           P326    (B323)

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.

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:             P826    (B1123)

If the fully-open discharge valve of a reciprocating positive displacement pump is throttled closed approximately 10%, pump flow rate will _____ and pump head will _____.  (Assume "ideal" pump response.)

A.  decrease; increase

B.  remain constant; increase

C.  decrease; remain constant

D.  remain constant; remain constant

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:             P925

A variable-speed positive displacement pump is operating at 100 rpm with a flow rate of 60 gpm in an open system.  To decrease pump flow rate to 30 gpm, pump speed must be decreased to approximately...

A.  25 rpm.

B.  35 rpm.

C.  50 rpm.

D.  71 rpm.

ANSWER:  C.

TOPIC:           191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P1026

Which one of the following conditions will result in the greatest increase in volumetric flow rate through a positive displacement pump?

A.  Doubling the pump speed

B.  Doubling pump net positive suction head

C.  Reducing downstream system pressure by one-half

D.  Positioning the discharge valve from half open to full open

ANSWER:  A.

TOPIC:           191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P1126

Which one of the following describes single-speed pump operating characteristics?

A.  Centrifugal pumps deliver a variety of flow rates at a constant head.

B.  Centrifugal pumps deliver a constant head over a variety of flow rates.

C.  Positive displacement pumps deliver a variety of flow rates at a constant head.

D.  Positive displacement pumps deliver a constant flow rate over a variety of heads.

ANSWER:  D.

TOPIC:          191004
KNOWLEDGE:  K1.22  [2.3/2.5]
QID:            P1526  (B1525)

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

    PDP speed                  = 480 rpm
    PDP discharge pressure  = 1,000 psig
    PDP suction pressure     = 10 psig
    PDP flow rate           = 60 gpm

Which one of the following changes will cause PDP flow rate to exceed 100 gpm?

A.  PDP speed is increased to 900 rpm.

B.  A second identical discharge path is opened.

C.  PDP suction pressure is increased to 40 psig.

D.  Downstream system pressure is decreased to 500 psig.

ANSWER:  A.


TOPIC:          191004
KNOWLEDGE:  K1.22  [2.3/2.5]
QID:            P1726  (B1919)

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

ANSWER:  B.

TOPIC:            191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P2126  (B1824)

A variable-speed positive displacement pump is operating at 100 rpm with a flow rate of 60 gpm in an open system.  To decrease pump flow rate to 25 gpm, pump speed must be decreased to approximately...

A.  17 rpm.

B.  33 rpm.

C.  42 rpm.

D.  64 rpm.

ANSWER:  C.

TOPIC:            191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P2526  (B2525)

Which one of the following conditions will result in the greatest increase in volumetric flow rate in a water system with one positive displacement pump operating at 400 rpm and a discharge pressure of 100 psig?

A.  Increasing pump speed to 700 rpm.

B.  Decreasing pump discharge pressure to 40 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.

ANSWER:  D.

TOPIC:            191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P2626   (B2624)

A section of reactor coolant piping is being hydrostatically tested to 2,900 psig using a positive displacement pump.  The operating characteristics of the positive displacement pump are shown below, identifying ideal, expected, and actual pump performance.

Which one of the following could cause the observed difference between the expected and the actual pump performance?

A.  Pump internal leakage is greater than expected.

B.  Reactor coolant piping boundary valve leakage is greater than expected.

C.  Available NPSH has decreased more than expected, but remains slightly above required NPSH.

D.  A relief valve on the pump discharge piping has opened prior to its setpoint of 2,900 psig.

ANSWER:  A.



POSITIVE DISPLACEMENT PUMP CURVE
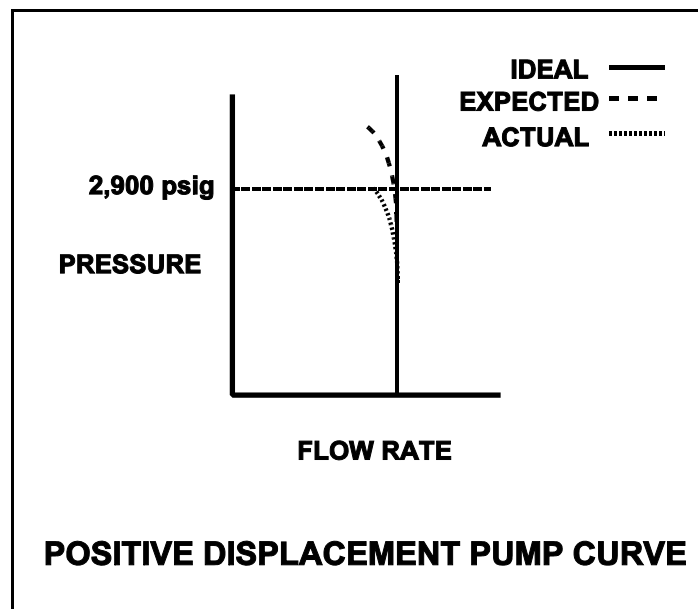
TOPIC:          191004
KNOWLEDGE:   K1.22  [2.3/2.5]
QID:            P2726  (B2724)

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 40 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

ANSWER:  A.

TOPIC:          191004
KNOWLEDGE:   K1.22  [2.3/2.5]
QID:            P2926  (B2925)

An ideal (no slip) reciprocating positive displacement pump is operating in an open system to provide makeup water to a coolant system that is being maintained at 800 psig.  The discharge valve of the pump is full open.

If the pump discharge valve is subsequently throttled to 80% open, pump flow rate will _____ and pump head will _____.

A.  decrease; increase

B.  decrease; remain constant

C.  remain constant; increase

D.  remain constant; remain constant

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:            P3024   (B3025)

A pump is needed to supply fuel oil from a day tank to a diesel engine fuel injection system.  The pump must maintain a nearly constant flow rate with a minimum of discharge pressure fluctuations as system pressure varies between 200 psig and 1,900 psig.

Which one of the following types of pumps would typically be used in this application?

A.  Axial flow centrifugal

B.  Radial flow centrifugal

C.  Rotary positive displacement

D.  Reciprocating positive displacement

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:            P3525   (B1680)

An ideal positive displacement pump is pumping to a system operating at 100 psig.  Assume pump speed is constant, zero pump slip, and pump backpressure remains within normal pump operating limits.

If system pressure increases to 200 psig, the pump head will _____; and pump flow rate will _____.

A.  increase; remain the same

B.  increase; decrease

C.  remain the same; remain the same

D.  remain the same; decrease

ANSWER:  A.

TOPIC:         191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:           P5012   (B5013)

Use the following drawing of system and pump operating curves for a positive displacement pump with discharge relief valve protection to answer the following question.

A positive displacement pump is initially supplying water at 40 gpm with a pump discharge pressure of 400 psia.  Then, pump speed is increased until pump flow rate is 80 gpm.  What is the pump discharge pressure at the new pump flow rate of 80 gpm?

A.  800 psia

B.  1,000 psia

C.  1,200 psia

D.  1,600 psia
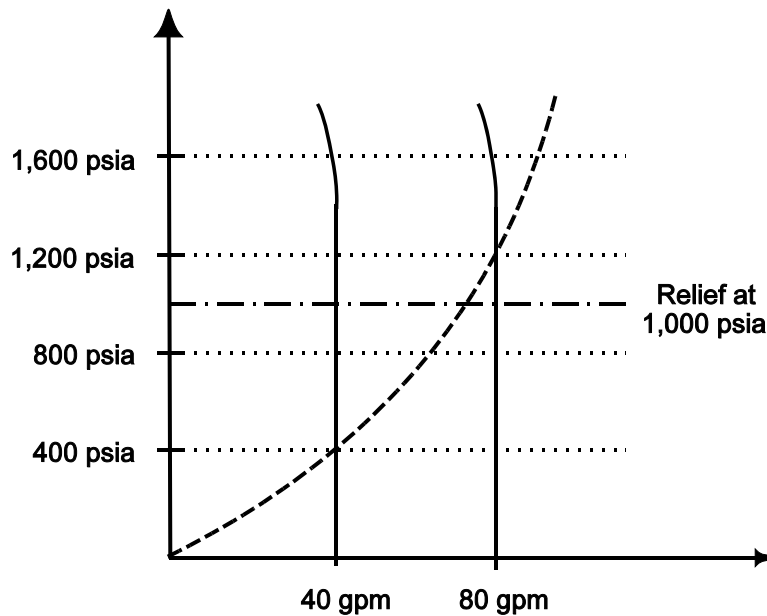
ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.22   [2.3/2.5]
QID:              P5313   (B5313)

Use the following drawing of system and pump operating curves for an operating positive
displacement pump with relief valve protection to answer the following question.

A positive displacement pump is initially supplying water at 40 gpm with a pump discharge pressure
of 200 psia.  Then, pump speed is increased until pump flow rate is 80 gpm.  What is the pump
discharge pressure at the new pump flow rate of 80 gpm?

A.  400 psia

B.  800 psia

C.  1,000 psia

D.  1,600 psia

ANSWER:  B.
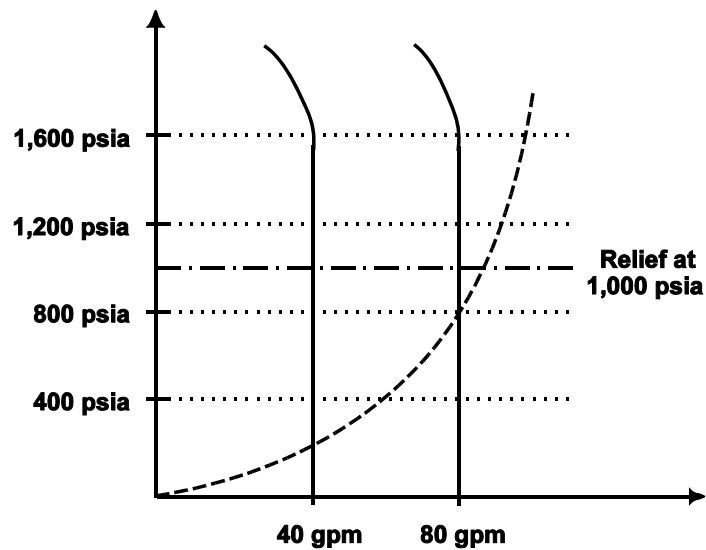
TOPIC:            191004
KNOWLEDGE:   K1.23   [2.8/2.9]
QID:              P526

When starting a positive displacement pump, why must the pump discharge valve be fully open?

A.  Prevents pump cavitation.

B.  Reduces motor starting current.

C.  Minimizes the potential for water hammer.

D.  Ensures integrity of the pump and system piping.

ANSWER:  D.

TOPIC:            191004
KNOWLEDGE:   K1.24   [3.0/3.1]
QID:              P626    (B2425)

What is the purpose of the safety/relief valve located between the pump outlet and the discharge isolation valve of most positive displacement pumps?

A.  Protect the pump and suction piping from overpressure if the discharge valve is open during system startup.

B.  Protect the pump and suction piping from overpressure if the suction valve is closed during pump operation.

C.  Protect the pump and discharge piping from overpressure if the discharge valve is closed during pump operation.

D.  Protect the pump and discharge piping from overpressure due to thermal expansion of pump contents when the pump is stopped with its suction valve closed.

ANSWER:  C.

TOPIC:          191004
KNOWLEDGE:   K1.24   [3.0/3.1]
QID:            P1722   (B1724)

A positive displacement pump should be started with its suction valve _____ and its discharge valve _____.

A.  fully open; throttled

B.  fully open; fully open

C.  throttled; throttled

D.  throttled; fully open

ANSWER:  B.

TOPIC:          191004
KNOWLEDGE:   K1.24   [3.0/3.1]
QID:            P1923   (B525)

A positive displacement pump should be started with its suction valve _____ and its discharge valve _____.

A.  open; open

B.  open; closed

C.  closed; open

D.  closed; closed

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:            P26

Reactor coolant pump motor amps will _____ if the rotor is <u>locked</u> and the motor speed will _____ if the rotor <u>shears</u>.

A.  increase, increase

B.  increase, decrease

C.  decrease, increase

D.  decrease, decrease

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:            P227

A nuclear power plant is operating normally at 80% power when a reactor coolant pump (RCP) shaft seizes.  Which one of the following indications would <u>not</u> accompany the seized shaft?

A.  Reactor coolant system pressure transient.

B.  Decreased flow rate in the associated reactor coolant loop.

C.  Decreased flow rate in the remaining reactor coolant loop(s).

D.  Increased current to the affected RCP with possible breaker trip.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P327

A nuclear power plant is operating at 100% power when a reactor coolant pump (RCP) malfunction occurs.  Thirty seconds after the malfunction, which one of the following can be used by an operator to determine whether the malfunction is a locked RCP rotor or a sheared RCP rotor? (Assume no operator action is taken.)

A.  Reactor trip status

B.  Loop flow indications

C.  RCP ammeter indications

D.  Loop differential temperature indications

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P1127

During a locked reactor coolant pump (RCP) rotor event, RCP current will...

A.  increase due to the increased rotor torque.

B.  increase due to the increased stator counter electromotive force (CEMF).

C.  decrease due to the decreased pump flow.

D.  decrease due to the increased rotor CEMF.

ANSWER:  A.

TOPIC:            191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P1427   (B2626)

A nuclear power plant is operating at full power when a reactor coolant pump experiences a locked rotor.  How will pump ammeter indication respond?

A.  Decreases immediately to zero due to breaker trip

B.  Decreases immediately to no-load motor amps

C.  Increases immediately to many times running current, then decreases to no-load motor amps

D.  Increases immediately to many times running current, then decreases to zero upon breaker trip

ANSWER:  D.

TOPIC:            191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P2127   (B1326)

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

A.  Decreases due to decreased pump flow

B.  Decreases due to increased counter electromotive force

C.  Increases due to decreased pump flow

D.  Increases due to decreased counter electromotive force

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P2827   (B1726)

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

A.  Decreases due to decreased pump work

B.  Decreases due to decreased counter electromotive force

C.  Increases due to increased pump work

D.  Increases due to increased counter electromotive force

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.01   [2.8/3.1]
QID:              P3127   (B2826)

A motor-driven centrifugal pump exhibits indications of pump failure while being started in an idle cooling water system.  Assuming the pump motor breaker does <u>not</u> trip, which one of the following pairs of indications would be observed if the pump failure is a locked impeller shaft?

A.  Lower than normal running current with zero system flow rate

B.  Lower than normal running current with a fraction of normal system flow rate

C.  Excessive duration of starting current peak with zero system flow rate

D.  Excessive duration of starting current peak with a fraction of normal system flow rate

ANSWER:  C.

TOPIC:              191005
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:                P27

If the generator bearings on a motor-generator begin to overheat from excessive friction, which one of the following will occur next?

A.  Generator current will begin to increase.

B.  Generator windings will begin to heat up.

C.  Motor current will begin to decrease.

D.  Motor windings will begin to heat up.

ANSWER:  D.

TOPIC:              191005
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:                P344    (B340)

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

A.  sustained overcurrent by opening the motor breaker or motor line contacts.

B.  sustained overcurrent by opening contacts in the motor windings.

C.  instantaneous overcurrent by opening the motor breaker or motor line contacts.

D.  instantaneous overcurrent by opening contacts in the motor windings.

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:             P528     (B1927)

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

A.  Thermal overload device

B.  Overcurrent trip relay

C.  Underfrequency relay

D.  Undervoltage device

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:             P1028   (B1526)

Which one of the following will result from prolonged operation of an ac motor with excessively high stator temperatures?

A.  Decreased electrical current demand due to reduced counter electromotive force

B.  Increased electrical current demand due to reduced counter electromotive force

C.  Decreased electrical resistance to ground due to breakdown of winding insulation

D.  Increased electrical resistance to ground due to breakdown of winding insulation

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:  K1.02   [2.8/2.9]
QID:             P1528   (B1126)

Continuous operation of a motor at rated load with a loss of required cooling to the motor windings will eventually result in...

A.  cavitation of the pumped fluid.

B.  failure of the motor overcurrent protection devices.

C.  breakdown of the motor insulation.

D.  phase current imbalance in the motor and overspeed trip actuation.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:  K1.02   [2.8/2.9]
QID:             P2644   (B2242)

Thermal overload devices will provide the first electrical protection for a pump motor in the event of...

A.  a locked rotor upon starting.

B.  an electrical short circuit.

C.  gradual motor bearing damage.

D.  a sheared shaft during operation.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:            P2927

Which one of the following breaker trip signals will trip the associated motor breaker if a motor bearing seizes while the motor is running?

A.  Undervoltage

B.  Underfrequency

C.  Time-delayed overcurrent

D.  Instantaneous overcurrent

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P115    (B120)

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

    100 MW
    0 MVAR
    2,900 amps
    20,000 VAC

If main generator excitation is <u>reduced</u> slightly, amps will _____ and MW will _____.

A.  increase; decrease

B.  decrease; decrease

C.  increase; remain the same

D.  decrease; remain the same

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P229

Excessive current will be drawn by an ac induction motor that is operating...

A.  completely unloaded.

B.  at full load.

C.  with open-circuited stator windings.

D.  with short-circuited stator windings.

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P529

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

    500 Mw
    300 MVAR (out)
    2,800 amps

If main generator excitation is reduced slightly, amps will _____ and Mw will _____.

A.  increase; decrease

B.  increase; remain the same

C.  decrease; decrease

D.  decrease; remain the same

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P928

A main generator is operating in parallel with an infinite power grid.  If the voltage supplied to the generator field is slowly and continuously decreased, the generator will experience high current due to... (Assume <u>no</u> generator protective actuations occur.)

A.  excessive generator MW.

B.  excessive generator MVAR (VARs out).

C.  excessive generator MVAR (VARs in).

D.  generator reverse power.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P1128   (B2228)

An ac generator is supplying an isolated electrical system with a power factor of 1.0.  If generator voltage is held constant while real load (KW) increases, the current supplied by the generator will increase in direct proportion to the _____ of the change in real load.  (Assume the generator power factor remains constant at 1.0.)

A.  cube

B.  square

C.  amount

D.  square root

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P1428   (B1830)

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

    600 MW
    100 MVAR (in)
    13,800 amps
    25,000 volts

If main generator excitation is increased slightly, amps will _____ and MW will _____.

A.  decrease; increase

B.  increase; increase

C.  decrease; remain the same

D.  increase; remain the same

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P1728   (B1729)

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

    600 MW
    100 MVAR (in)
    13,800 amps
    25,000 volts

If main generator excitation is decreased slightly, amps will _____ and MVAR will _____.

A.  decrease; increase

B.  increase; increase

C.  decrease; decrease

D.  increase; decrease

ANSWER:  B.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P1928   (B226)

A main generator is connected to an infinite power grid.  Which one of the following conditions will exist on the generator if it is operating underexcited?

A.  Negative MVAR (VARs in) and a leading power factor

B.  Positive MVAR (VARs out) and a leading power factor

C.  Positive MVAR (VARs out) and a lagging power factor

D.  Negative MVAR (VARs in) and a lagging power factor

ANSWER:  A.

TOPIC:           191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P2027   (B2028)

A diesel generator (D/G) is supplying both KW and kVAR to an electrical bus that is connected to an infinite power grid.  Assuming D/G and bus voltage do <u>not</u> change, if the D/G voltage regulator set point is increased slightly, then D/G KW will _____ and D/G amps will _____.

A.  remain the same; increase

B.  remain the same; remain the same

C.  increase; increase

D.  increase; remain the same

ANSWER:  A.

TOPIC:           191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P2228

A diesel generator (D/G) is supplying an electrical bus that is connected to an infinite power grid.  Assuming D/G terminal voltage and bus frequency do not change, if the D/G governor set point is increased from 60.0 Hz to 60.1 Hz, D/G kVAR load will _____ and D/G amps will _____.

A.  increase; increase

B.  increase; remain the same

C.  remain the same; increase

D.  remain the same; remain the same

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P2328   (B2330)

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

    600 MW
    100 MVAR (out)
    13,800 amps
    25,000 volts

If main generator excitation is decreased, amps will initially _____ and MVAR will initially _____.

A.  decrease; increase

B.  increase; increase

C.  decrease; decrease

D.  increase; decrease

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P2528   (B2530)

A diesel generator (D/G) is supplying both KW and KVAR to an electrical bus that is connected to an infinite power grid.  Assuming bus voltage does <u>not</u> change, if the D/G voltage regulator set point is decreased slightly, then D/G KW will _____ and D/G amps will _____.

A.  remain the same; decrease

B.  remain the same; remain the same

C.  decrease; decrease

D.  decrease; remain the same

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P2628   (B1532)

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

    100 MW
    0 MVAR
    2,900 amps
    20,000 volts

If main generator excitation is increased, amps will _____ and MW will _____.

A.  remain the same; increase

B.  increase; increase

C.  remain the same; remain the same

D.  increase; remain the same

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P2728   (B2729)

A main generator is operating in parallel with an infinite power grid.  If the voltage supplied to the generator field is slowly and continuously increased, the generator will experience high current due to: (Assume no generator protective actuations occur.)

A.  generator reverse power.

B.  excessive generator MW.

C.  excessive generator MVAR (VARs in).

D.  excessive generator MVAR (VARs out).

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P2838   (B3543)

Two identical 1,000 MW electrical generators are operating in parallel supplying the same isolated electrical bus.  The generator output breakers provide identical protection for the generators.  Generator A and B output indications are as follows:

| Generator A | Generator B |
| --- | --- |
| 22 KV | 22 KV |
| 60.2 Hertz | 60.2 Hertz |
| 800 MW | 800 MW |
| 50 MVAR (out) | 25 MVAR (in) |

A malfunction causes the voltage regulator for generator B to slowly and continuously increase the terminal voltage for generator B.  If no operator action is taken, generator B output current will...

A.  increase continuously until the output breaker for generator A trips on overcurrent.

B.  increase continuously until the output breaker for generator B trips on overcurrent.

C.  initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

D.  initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

ANSWER:  D.

TOPIC:         191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:           P3229   (B3227)

A cooling water system is being returned to service following maintenance on the two identical centrifugal cooling water pumps.  The two pumps (see figure below) take suction from a common suction header and discharge to a common discharge header.  Each pump is driven by a three-phase ac induction motor.

Pump A was started five minutes ago to initiate flow in the cooling water system. Pump B is about to be started.

When pump B is started, which one of the following would cause the ammeter for pump B to remain off-scale high for several seconds longer than usual before returning to normal running current indication?

A.  The pump packing was removed and <u>not</u> reinstalled.

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

C.  Two phases of the motor windings were electrically switched.

D.  The coupling between the motor and the pump was removed and <u>not</u> reinstalled.

ANSWER:  B.
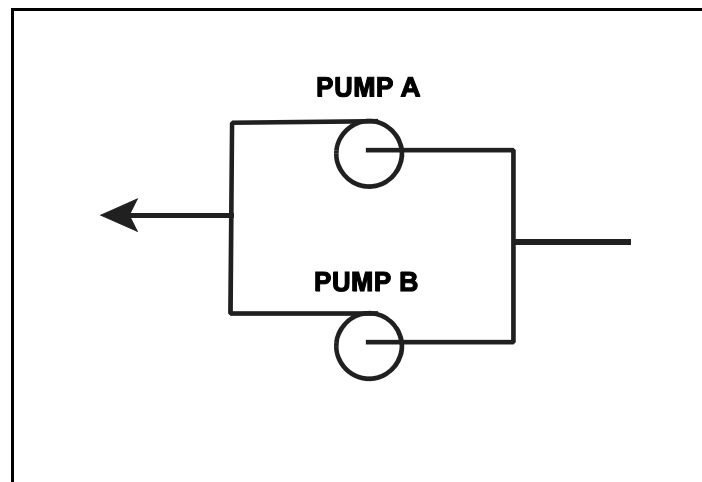
TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P3629   (B3629)

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

A.  excessive generator MW.

B.  excessive generator VARs (out).

C.  excessive generator VARs (in).

D.  generator reverse power.

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
KNOWLEDGE:   K1.09   [2.3/2.6]
QID:            P4115   (B4115)

A main generator is operating and connected to an infinite power grid.  Elevated main generator winding temperature requires a reduction in reactive load from 200 MVAR (out) to 150 MVAR (out).  To accomplish the reactive load reduction, the operator must _____ the generator field current; when generator reactive load equals 150 MVAR (out) the generator power factor will be _____than the initial power factor.

A.  increase; larger

B.  increase; smaller

C.  decrease; larger

D.  decrease; smaller

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P4315

A main generator is operating and connected to an infinite power grid with the following initial generator parameters:

| | |
|---|---|
| Terminal Voltage: | 22 KV |
| Frequency: | 60 Hertz |
| Load--Real: | 575 MW |
| Load--Reactive: | 100 MVAR (in) |
| Power Factor: | 0.985 |

Which one of the following contains a combination of manual adjustments to the main generator voltage regulator and speed control setpoints such that each adjustment will initially result in an increase in main generator amps?

| | VOLTAGE SETPOINT | SPEED SETPOINT |
|---|---|---|
| A. | Increase | Increase |
| B. | Increase | Decrease |
| C. | Decrease | Increase |
| D. | Decrease | Decrease |

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P4714   (B4714)

A nuclear power plant startup is in progress.  The main generator has just been connected to the power grid with the following generator indications:

    10 MW
    0 MVAR
    288 amps
    20,000 volts

The operator suspects that the main generator is operating under reverse power conditions and attempts to increase generator load (MW) normally.  If the main generator is operating under reverse power conditions when the operator attempts to increase generator load, generator MW will initially _____; and generator amps will initially _____.

A   decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P4814   (B4815)

A main generator is operating and is connected to an infinite power grid with the following initial generator parameters:

   Terminal Voltage:     22 KV
   Frequency:            60 Hertz
   Load--Real:           575 MW
   Load--Reactive:       100 MVAR (in)
   Power Factor:         0.985

Which one of the following contains a combination of manual adjustments to the main generator voltage regulator and speed control setpoints such that <u>each</u> adjustment will initially result in a decrease in main generator amps?

|     | VOLTAGE<br>SETPOINT | SPEED<br>SETPOINT |
|-----|---------------------|-------------------|
| A.  | Increase            | Increase          |
| B.  | Increase            | Decrease          |
| C.  | Decrease            | Increase          |
| D.  | Decrease            | Decrease          |

ANSWER:  B.

TOPIC:             191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:                P5014

A main generator is connected to an infinite power grid with the following initial generator parameters:

    Voltage:              22 KV
    Frequency:          60 Hertz
    Load--Real:         600 MW
    Load--Reactive:    100 MVAR (out)
    Power Factor:      0.986

Which one of the following contains a combination of manual adjustments to the main generator voltage regulator and speed control setpoints such that each adjustment will initially result in an increase in main generator amps?

|    | Voltage Setpoint | Speed Setpoint |
|----|------------------|----------------|
| A. | Increase | Increase |
| B. | Increase | Decrease |
| C. | Decrease | Increase |
| D. | Decrease | Decrease |

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P5414   (B5415)

A main generator is connected to an infinite power grid.  Which one of the following pairs of main generator output parameters places the generator in the closest proximity to slipping a pole.

A.  800 MW; 200 MVAR (in)

B.  800 MW; 600 MVAR (in)

C.  400 MW; 200 MVAR (out)

D.  400 MW; 600 MVAR (out)

ANSWER:  B.

TOPIC:          191005
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P5514

A main generator is connected to an infinite power grid with the following initial generator parameters:

| | |
|---|---|
| Voltage: | 22 KV |
| Frequency: | 60 Hertz |
| Load--Real: | 600 MW |
| Load--Reactive: | 100 MVAR (out) |
| Power Factor: | 0.986 |

Which one of the following contains a combination of manual adjustments to the main generator voltage regulator and speed control setpoints such that each adjustment will initially result in a decrease in main generator amps?

| | Voltage Setpoint | Speed Setpoint |
|---|---|---|
| A. | Increase | Increase |
| B. | Increase | Decrease |
| C. | Decrease | Increase |
| D. | Decrease | Decrease |

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P28

If the speed of a variable speed centrifugal pump is increased to cause pump flow rate to double, pump motor current will...

A.  remain constant.

B.  increase two-fold (double).

C.  increase four-fold.

D.  increase eight-fold.

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P120

A centrifugal pump is operating with the following parameters:

    Pump speed   = 1800 rpm
    Pump head    = 100 psid
    Motor current = 10 amps

What will be the new value of pump head if the speed is increased such that the current requirements are now 640 amps?

A.  400 psid

B.  800 psid

C.  1200 psid

D.  1600 psid

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P228   (B227)

A centrifugal pump has a flow rate of 3,000 gpm and a current requirement of 200 amps.  If the pump speed is reduced such that the flow rate is 2,000 gpm, what is the final <u>current</u> requirement at the new lower speed?  (Assume a constant motor voltage.)

A.  59 amps

B.  89 amps

C.  133 amps

D.  150 amps

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P328   (B326)

A centrifugal pump is operating with the following parameters:

    Speed             = 1,800 rpm
    Current           = 40 amps
    Pump head       = 20 psi
    Pump flow rate  = 400 gpm

Which one of the following will be the new value of pump head and current if the speed is increased to 2,000 rpm?

A.  22 psi, 49 amps

B.  22 psi, 55 amps

C.  25 psi, 49 amps

D.  25 psi, 55 amps

ANSWER:  D.

TOPIC:           191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:              P428

A centrifugal pump is operating at 600 rpm with the following parameters:

    Current          = 10 amps
    Pump head       = 50 psi
    Pump flow rate  = 200 gpm

What will be the new value of pump head if the flow is increased such that the current requirements are now 640 amps?

A.    400 psi

B.    600 psi

C.    800 psi

D.  1,200 psi

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:              P630

A motor-driven centrifugal pump is operating at a low flow condition in an open system.  The throttled discharge valve is then fully opened to increase system flow rate.

Which one of the following will increase?

A.  Pump discharge pressure

B.  Available net positive suction head

C.  Motor amps

D.  Pump speed

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:             P1329

A centrifugal pump is operating with the following parameters:

    Speed              = 3,600 rpm
    Current            = 100 amps
    Pump head        = 50 psi
    Pump flow rate   = 400 gpm

What will be the new value of pump head and current if the speed is decreased to 2,000 rpm?

A.  8.6 psi, 30.1 amps

B.  8.6 psi, 17.1 amps

C.  15.4 psi, 30.1 amps

D.  15.4 psi, 17.1 amps

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:             P1429

A two-speed centrifugal pump is driven by an ac motor with the following initial conditions:

    Pump speed    = 400 rpm
    Motor current = 40 amps
    Pump head      = 60 psid

If pump speed is increased to 1600 rpm what will be the new pump head?

A.  240 psid

B.  480 psid

C.  960 psid

D   3,840 psid

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:  K1.04   [2.7/2.8]
QID:             P1530   (B2126)

A centrifugal pump is operating with the following parameters:

    Speed          = 1,200 rpm
    Current        = 40 amps
    Pump head      = 20 psi
    Pump flow rate = 400 gpm

What will be the approximate value of pump head and current if pump speed is increased to 1,600 rpm?

A.  25 psi, 55 amps

B.  25 psi, 95 amps

C.  36 psi, 55 amps

D.  36 psi, 95 amps

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P1629

A centrifugal pump is operating with the following parameters:

    Speed           = 1,200 rpm
    Current         = 40 amps
    Pump head       = 20 psi
    Pump flow rate  = 400 gpm

What will be the approximate value of pump head and current if pump speed is increased to 1,800 rpm?

A.  36 psi, 95 amps

B.  36 psi, 135 amps

C.  45 psi, 95 amps

D.  45 psi, 135 amps

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P1729   (B1719)

A centrifugal pump is operating with the following parameters:

    Speed          = 1,800 rpm
    Current        = 40 amps
    Pump head      = 20 psi
    Pump flow rate = 400 gpm

What will be the approximate value of pump head and current if pump speed is decreased to 1,200 rpm?

A.  13 psi, 18 amps

B.  13 psi, 12 amps

C.  9 psi, 18 amps

D.  9 psi, 12 amps

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P1828   (B2627)

An ac motor-driven centrifugal pump is operating with a flow rate of 3,000 gpm and a motor current of 150 amps.  If the pump speed is reduced such that the flow rate is 2,000 gpm, what is the approximate final motor current at the new lower speed?  (Assume a constant motor voltage.)

A.  44 amps

B.  59 amps

C.  67 amps

D.  100 amps

ANSWER:  A.

TOPIC:              191005
KNOWLEDGE:  K1.04   [2.7/2.8]
QID:               P2130  (B2229)

A centrifugal pump is operating at 600 rpm with the following parameters:

     Motor current    = 100 amps
     Pump head        = 50 psid
     Pump flow rate  = 880 gpm

Which one of the following will be the approximate value of pump head if pump speed is increased to 1200 rpm?

A.  71 psid

B.  126 psid

C.  172 psid

D.  200 psid

ANSWER:  D.

TOPIC:              191005
KNOWLEDGE:  K1.04   [2.7/2.8]
QID:               P2329  (B2321)

A multi-speed centrifugal pump is operating at 3,600 rpm with a flow rate of 3,000 gpm.  Which one of the following approximates the new flow rate if the speed is decreased to 3,000 rpm?

A.  1,000 gpm

B.  1,500 gpm

C.  2,000 gpm

D.  2,500 gpm

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P2529   (B2527)

A multispeed centrifugal pump is operating with a flow rate of 1800 gpm at a speed of 3600 rpm. Which one of the following approximates the new flow rate if the pump speed is decreased to 2400 rpm?

A.  900 gpm

B.  1050 gpm

C.  1200 gpm

D.  1350 gpm

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P3129   (B1626)

A multi-speed  motor-driven centrifugal pump is operating with the following parameters:

    Motor current   =  27 amps
    Pump head        =  50 psi
    Pump flow rate  =  880 gpm

Which one of the following will be the approximate new value of pump head if pump speed is increased such that the motor current is now 64 amps?

A.  89 psi

B.  119 psi

C.  211 psi

D.  281 psi

ANSWER:  A.

TOPIC:           191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:              P3130   (B3127)

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

A.  Heat generation is directly proportional to the current.

B.  Heat generation is proportional to the cube of the current.

C.  Heat generation is proportional to the square of the current.

D.  Heat generation is proportional to the square root of the current.

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:              P3430   (B1228)

A centrifugal pump is operating at 600 rpm with the following parameters:

    Current          = 100 amps
    Pump head        = 50 psid
    Pump flow rate   = 880 gpm

What will be the approximate value of pump head if pump speed is increased such that the pump now draws 640 amps?

A.  93 psid

B.  126 psid

C.  173 psid

D.  320 psid

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:             P3730   (B3722)

A rotary positive displacement pump (PDP) is being used to supply water to a piping system.  The PDP is driven by an ac induction motor.  The initial parameters are:

    System pressure:        500 psig
    PDP flow rate:          50 gpm
    PDP motor current:    40 amps

After several hours, the PDP motor speed is increased such that the new PDP flow rate is 100 gpm.  If system pressure does <u>not</u> change, what is the approximate value of the PDP motor current at the 100 gpm flow rate?

A.  80 amps

B.  160 amps

C.  320 amps

D.  640 amps

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P4515   (B4515)

Refer to the pump performance curves for a centrifugal cooling water pump (see figure below).  The pump is being driven by a single-speed ac induction motor.   Pump flow rate is being controlled by a throttled discharge flow control valve.

The following initial pump conditions exist:

Pump motor current:        50 amps
Pump flow rate:            400 gpm
Pump suction temperature:  70°F

If the flow control valve is repositioned such that pump flow rate is now 800 gpm, what will be the approximate new pump motor current?

A.  Less than 100 amps

B.  200 amps

C.  400 amps

D.  More than 500 amps

ANSWER:  A.
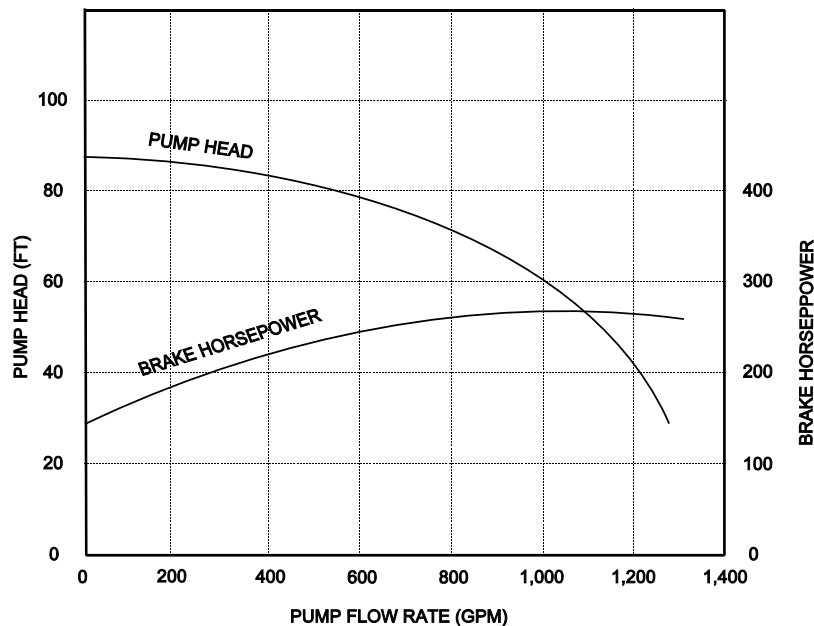
TOPIC:          191005
KNOWLEDGE:   K1.04   [2.7/2.8]
QID:            P4915   (B4914)

Consider two identical single-speed ac induction motors, one of which is connected to a radial-flow centrifugal pump and the other to a reciprocating-type positive displacement pump (PDP).  Both pumps are taking suction at the same elevation from a vented water storage tank.

Each pump has a maximum design backpressure of 800 psig, and each is operating with the following initial conditions:

   Flow rate:      200 gpm
   Backpressure:   400 psig
   Motor current:  100 amps

If the backpressure for each pump increases to 600 psig, the centrifugal pump will have a _____ flow rate than the PDP; and the centrifugal pump will have a _____ motor current than the PDP.

A.  lower; higher

B.  lower; lower

C.  higher; higher

D.  higher; lower

ANSWER:  B.

TOPIC:          191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P29     (B2127)

The starting current in a typical ac induction motor is significantly higher than the full-load running current because...

A.  starting torque is lower than running torque.

B.  starting torque is higher than running torque.

C.  rotor speed during start is too low to generate sufficient  counter electromotive force (CEMF) in the stator.

D.  rotor current during start is too low to generate sufficient CEMF in the stator.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P108    (B105)

The average starting current for an ac motor is approximately...

A.  the same as its normal running current.

B.  two to three times its normal running current.

C.  five to seven times its normal running current.

D.  ten to fifteen times its normal running current.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P230

Which one of the following describes the motor current indications that would be observed during the start of a large ac motor connected to a load?

A.  Amps slowly increase to the normal operating value over a period of five time constants.

B.  Amps immediately increase to the normal operating value and stabilize.

C.  Amps immediately increase to many times the normal operating value and then decrease to the normal operating value.

D.  Amps immediately increase to the full-scale value and then decrease rapidly to zero due to overload protection.

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P429

If the discharge valve of a large motor-driven centrifugal pump is kept closed during a normal pump start, the amps indication for the ac induction motor will rise to...

A.  several times the full-load current value and then decrease to the no-load current value.

B.  approximately the full-load current value and then decrease to the no-load current value.

C.  several times the full-load current value and then decrease to the full-load value.

D.  approximately the full-load current value and then stabilize at the full-load current value.

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:  K1.05   [2.8/2.7]
QID:            P930    (B2928)

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.

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:  K1.05   [2.8/2.7]
QID:            P1230

The starting current in an ac motor is significantly higher than the full-load running current because...

A.  little counter electromotive force is induced onto the rotor during motor start.

B.  motor torque production is highest during motor start.

C.  little counter electromotive force is induced onto the stator during motor start.

D.  work performed by the motor is highest during motor start.

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:              P1330

Starting current in an ac induction motor is typically _____ times full-load rated current.

A.  1/4 to ½

B.  2 to 3

C.  5 to 6

D.  10 to 12

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:              P1827   (B1327)

Which one of the following describes the motor current during the start of a typical ac motor-driven centrifugal pump with a closed discharge valve?  (Assume the pump does <u>not</u> trip.)

A.  Current immediately increases to the full-load value and then  gradually decreases to the no-load value.

B.  Current immediately increases to the full-load value and then stabilizes at the full-load value.

C.  Current immediately increases to many times the full-load value and then rapidly decreases to the no-load value after several seconds and then stabilizes.

D.  Current immediately increases to many times the full-load value and then rapidly decreases to the full-load value after several seconds and then stabilizes.

ANSWER:  C.

TOPIC:            191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P1929   (B1428)

Which one of the following describes the typical ammeter response during a normal start of a large ac motor-driven centrifugal pump with a closed discharge valve?

A.  Indication will approach full scale and then return to the full-load value.

B.  Indication will go off scale high and then return to the no-load value.

C.  Indication will approach full scale and then return to the no-load value.

D.  Indication will go off scale high and then return to the full-load value.

ANSWER:  B.

TOPIC:            191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:            P2229   (B28)

Which one of the following describes the motor current indications that would be observed during the start of a large ac motor-driven centrifugal pump with a closed discharge valve?

A.  Current immediately increases to the full-load value and then gradually decreases to the no-load value over several minutes.

B.  Current immediately increases to the no-load value and then stabilizes.

C.  Current immediately increases to many times the no-load value and then rapidly decreases to the no-load value after several seconds.

D.  Current immediately increases to many times the no-load value and then gradually decreases to the no-load value after several minutes.

ANSWER:  C.

TOPIC:           191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:              P2230   (B2227)

Two identical 4,160 VAC induction motors are connected to identical centrifugal pumps being used to provide cooling water flow in separate systems in a nuclear power plant.  Each motor is rated at 1000 hp.  The discharge valve for pump A is fully open and the discharge valve for pump B is fully shut.

If each motor is then started, the longest time period required to stabilize motor current will be experienced by motor _____ and the higher stable motor current will be experienced by motor _____.

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  A.

TOPIC:           191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:              P2430   (B2428)

Which one of the following describes when the highest stator current will be experienced by an ac induction motor?

A.  During motor operation at full load

B.  During motor operation at zero load

C.  Immediately after energizing the motor

D.  Immediately after deenergizing the motor

ANSWER:  C.

TOPIC:              191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:                    P2730  (B2727)

Two identical 4,160 VAC induction motors are connected to identical centrifugal pumps in identical but separate cooling water systems.  Each motor is rated at 200 hp.  The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

If each motor is then started, the longest time period required to stabilize motor current will be experienced by motor _____ and the higher stable motor current will be experienced by motor _____.

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  D.

TOPIC:              191005
KNOWLEDGE:   K1.05   [2.8/2.7]
QID:                    P2830  (B2828)

Two identical 4,160 VAC induction motors are connected to identical centrifugal pumps.  The pumps are used to provide flow in two separate but identical cooling water systems in a nuclear power plant.  Each motor is rated at 400 hp.  The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

If each motor is then started, the longer time period required to stabilize motor current will be experienced by motor _____ and the higher stable motor current will be experienced by motor _____.

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  D.

TOPIC: 191005
KNOWLEDGE: K1.05 [2.8/2.7]
QID: P2931 (B3529)

Two identical 4,160 VAC induction motors are connected to identical centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

When the motors are started under these conditions, the shorter time period required to reach a stable running current will be experienced by motor _____, and the higher stable running current will be experienced by motor _____.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: B.

TOPIC: 191005
KNOWLEDGE: K1.05 [2.8/2.7]
QID: P4615 (B4614)

Select the option that correctly fills in the blanks.

To minimize the adverse effects of starting current, an ac induction motor should be started _____ to _____ the stator counter electromotive force (CEMF).

A. unloaded; quickly establish

B. unloaded; delay

C. partially loaded; quickly establish

D. partially loaded; delay

ANSWER: A.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P30     (B1826)

What is the primary reason for limiting the number of starts for an electric motor in a given period of time?

A.  Prevent overheating of the windings due to high starting currents.

B.  Prevent overheating of the windings due to shorting within the stator.

C.  Prevent rotor damage due to excessive cyclic stresses on the shaft.

D.  Prevent rotor damage due to excessive axial displacement of the shaft.

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P231    (B328)

Which one of the following is the basis for restricting the number of starts that a large ac motor may be subjected to within a one-hour period?

A.  Prevent excessive torsional stresses on the motor shaft

B.  Prevent excessive arcing and degradation of motor breaker contacts

C.  Prevent excessive heat buildup within the motor windings

D.  Prevent excessive wear of motor thrust bearings

ANSWER:  C.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P1031

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

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P1131

The frequency of start/stop cycles for an electrical motor is limited to prevent...

A.  overheating the motor windings.

B.  overheating the motor supply bus.

C.  excessive shaft torsional stresses.

D.  excessive cycling of the motor breaker.

ANSWER:  A.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P1331   (B1128)

Frequent start/stop cycling of large ac motors is prohibited to prevent...

A.  excessive bearing wear.

B.  motor shaft imbalance.

C.  overloading electrical buswork.

D.  overheating motor windings.

ANSWER:  D.

TOPIC:          191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:            P2531   (B2528)

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

A.  low electrical resistance of the motor windings.

B.  an electrical short circuit between the rotor and stator.

C.  high counter electromotive force at low rotor speeds.

D.  windage losses between the rotor and stator.

ANSWER:  A.

TOPIC:         191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:           P2631   (B228)

Which one of the following is the primary reason for limiting the number of motor starts in a given time period?

A.  Minimizes pitting of contacts in the motor breaker.

B.  Prevents excessive torsional stresses on motor shaft.

C.  Prevents overheating of motor windings.

D.  Minimizes axial stresses on motor bearings.

ANSWER:  C.

TOPIC:         191005
KNOWLEDGE:   K1.06   [3.0/3.1]
QID:           P3331   (B3327)

A large centrifugal pump is driven by a 200 horsepower 4.16 kV ac motor.  The motor breaker control circuit contains the following protection devices: instantaneous overcurrent relay, motor thermal overload relay, control power fuses, and an anti-pumping device.

The pump had been manually started and stopped several times during a 5-minute period when the motor breaker unexpectedly tripped.  In this situation, which one of the following is the most likely cause of the breaker trip?

A.  Instantaneous overcurrent

B.  Motor thermal overload

C.  Blown control power fuse

D.  Anti-pumping device actuation

ANSWER:  B.

TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P104 (B231)

Refer to the drawing of an operating water cleanup system. All valves are identical and are initially 50% open (see figure below).

To <u>lower</u> the temperature at point 7, the operator should adjust valve _____ in the <u>open</u> direction.

A. A

B. B

C. C

D. D

ANSWER: D.

RETURN
TO
SYSTEM

FROM
SYSTEM

540°F • 2

1     A
450°F

HEAT
EXCHANGER

B   3
122°F

C

250°F • 4

5
90°F

COOLING
WATER

HEAT
EXCHANGER

D   6
110°F

122°F • 7

ION EXCHANGER

**WATER CLEANUP SYSTEM**
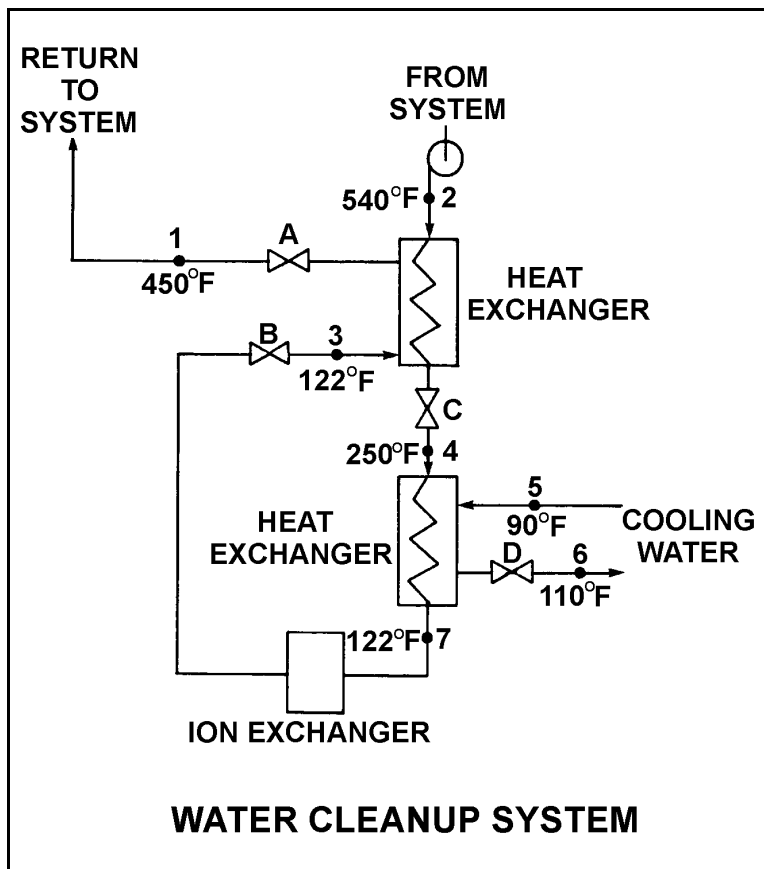
TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:            P534    (B331)

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

Increasing the oil flow rate through the heat exchanger will cause the oil outlet temperature to _____ and the cooling water outlet temperature to _____.  (Assume cooling water flow rate remains the same.)

A.  decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  D.

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:            P632    (B431)

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

Assume that the inlet lube oil and inlet cooling water temperatures are constant and cooling water flow rate remains the same.  Decreasing the oil flow rate through the heat exchanger will cause the oil outlet temperature to _____ and the cooling water outlet temperature to _____.

A.  increase, increase

B.  increase, decrease

C.  decrease, increase

D.  decrease, decrease

ANSWER:  D.
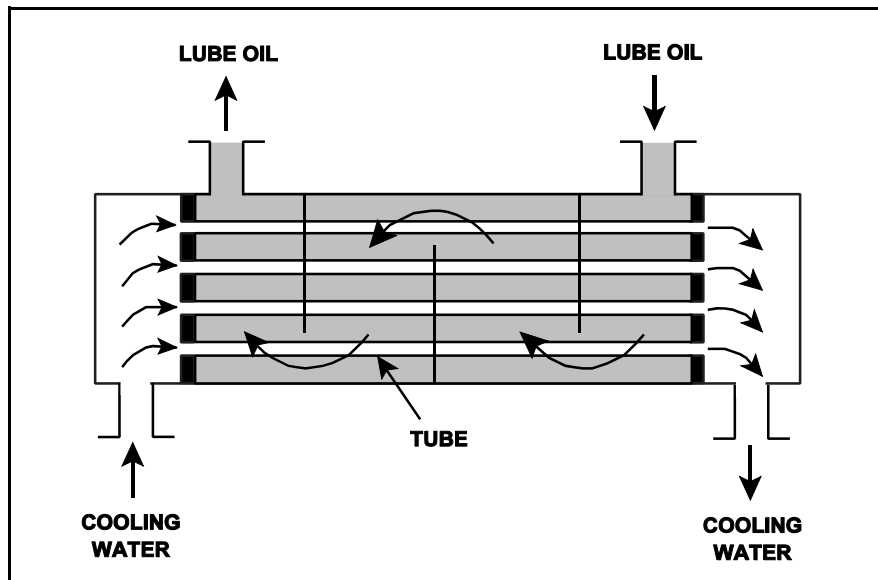
TOPIC:          191006
KNOWLEDGE:  K1.07    [2.4/2.6]
QID:             P732    (B1834)

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

Valves A, B, and C are fully open.  Valve D is 80% open.  All temperatures are as shown.  If valve D is then throttled to 50%, the temperature at point...

A.  3 will decrease.

B.  4 will increase.

C.  5 will increase.

D.  6 will decrease.

ANSWER:  B.
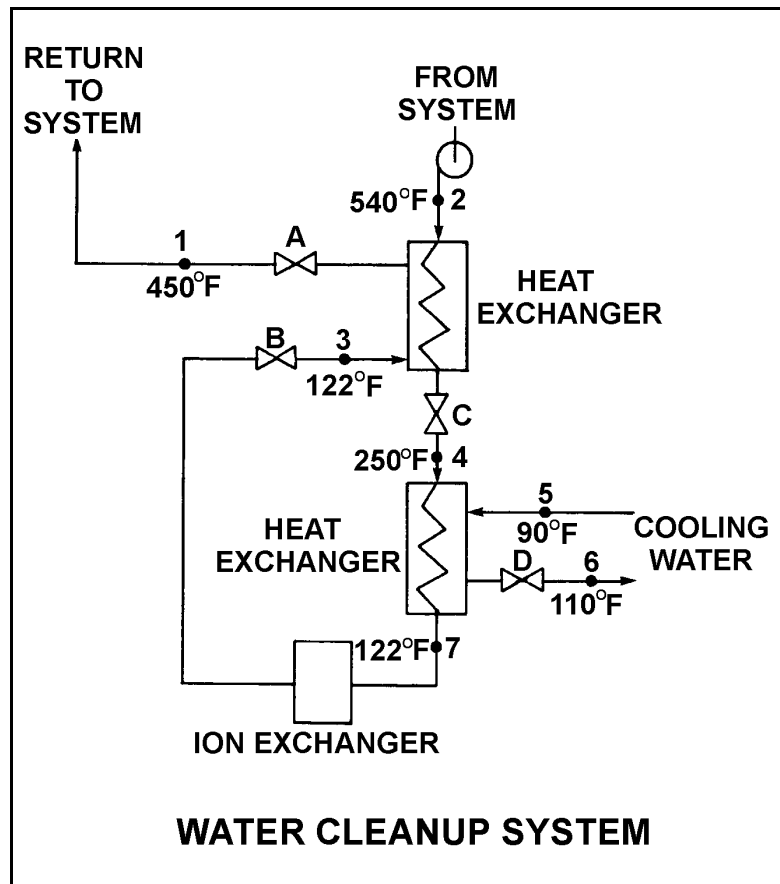
TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:             P1032   (B1031)

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

Valves A, B, and C are fully open.  Valve D is 20% open.  All temperatures are as shown.  Valve D is then quickly opened to 100%.

The temperature at point...

A.  3 will increase.

B.  4 will decrease.

C.  5 will decrease.

D.  7 will increase.

ANSWER:  B.



WATER CLEANUP SYSTEM

*Heat Exchangers and Condensers*
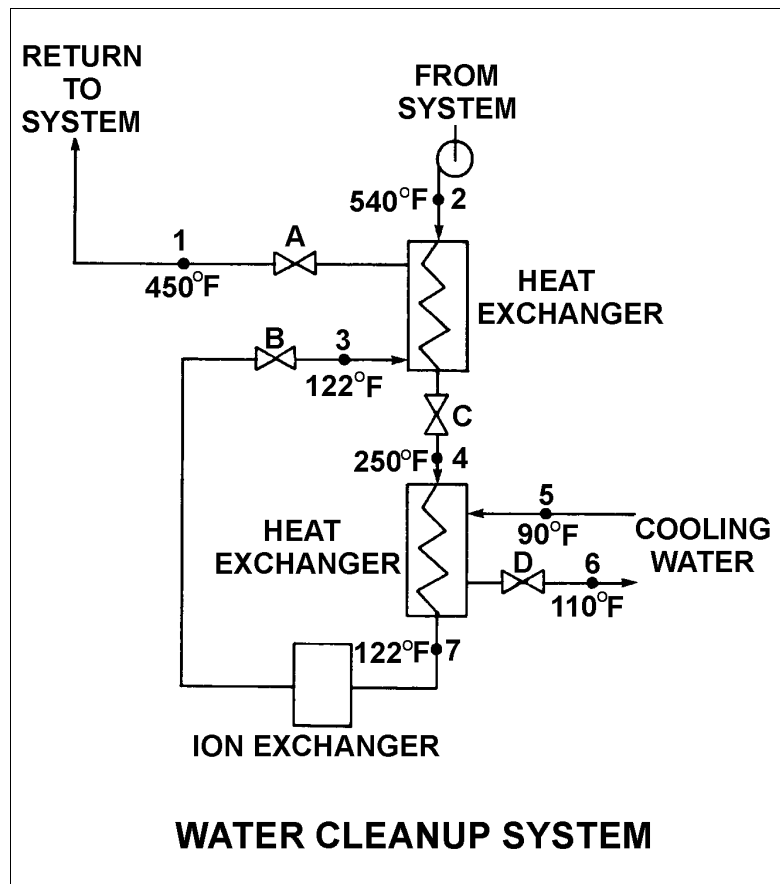
TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P1231   (B1231)

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

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

A.  A; open

B.  B; shut

C.  C; open

D.  D; shut

ANSWER:  B.

RETURN
TO
SYSTEM

FROM
SYSTEM

540°F  2

1            A
450°F

HEAT
EXCHANGER

B       3
122°F

C

250°F  4

5
90°F

COOLING
WATER

HEAT
EXCHANGER

D       6
110°F

122°F  7

ION EXCHANGER

**WATER CLEANUP SYSTEM**

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P1432   (B1432)

The rate of heat transfer between two liquids in a heat exchanger will be increased if the:  (Assume single-phase conditions and a constant specific heat.)

A.  temperature of the hotter liquid is decreased by 20°F.

B.  temperature of the colder liquid is increased by 20°F.

C.  flow rates of both liquids are decreased by 10%.

D.  flow rates of both liquids are increased by 10%.

ANSWER:  D.

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:            P1533   (B1531)

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

The heat exchanger is operating with the following parameters:

$T_{oil\,in}$      = 174°F
$T_{oil\,out}$     = 114°F
$c_{p\text{-}oil}$      = 1.1 Btu/lbm-°F
$\dot{m}_{oil}$        = 4.0 x 10$^4$ lbm/hr
$T_{water\,in}$    = 85°F
$T_{water\,out}$   = 115°F
$c_{p\text{-}water}$      = 1.0 Btu/lbm-°F
$\dot{m}_{water}$     = ?

What is the mass flow rate of the cooling water?

A.  8.8 x 10$^4$ lbm/hr

B.  7.3 x 10$^4$ lbm/hr

C.  2.2 x 10$^4$ lbm/hr

D.  1.8 x 10$^4$ lbm/hr

ANSWER:  A.
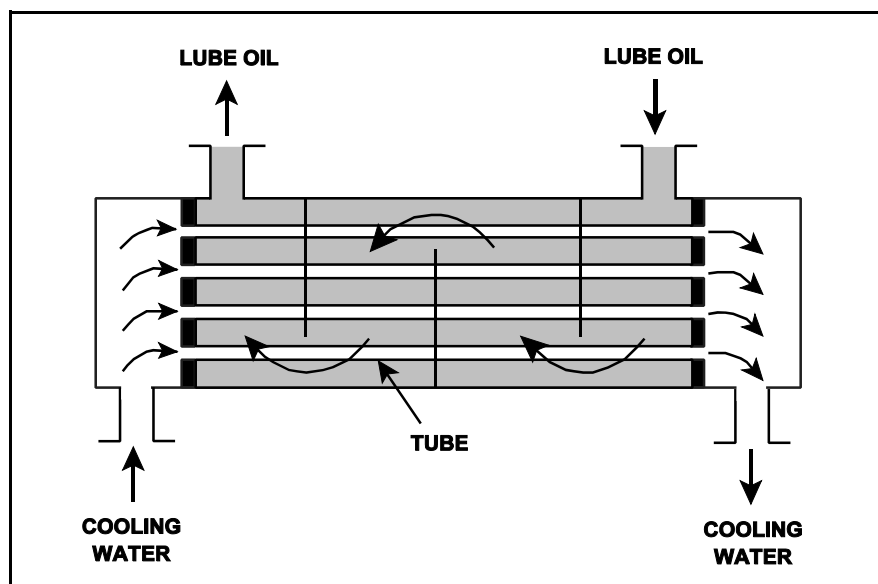
TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P1632   (B832)

A liquid-to-liquid counterflow heat exchanger is operating with single-phase conditions and a constant specific heat for each liquid.  Which one of the following will decrease the heat transfer between the two liquids?

A.  The temperature of both liquids is increased by 20°F.

B.  The temperature of both liquids is decreased by 20°F.

C.  The flow rate of the hotter liquid is increased by 10%.

D.  The flow rate of the colder liquid is decreased by 10%.

ANSWER:  D.

TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P1634 (B1631)

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

Given the following information, which one of the following is the temperature of the oil exiting the heat exchanger ($T_{oil-out}$)?

$\dot{m}_{oil}$ = 2.0 x $10^4$ lbm/hr
$\dot{m}_{water}$ = 3.0 x $10^4$ lbm/hr
$c_{p-oil}$ = 1.1 Btu/lbm-°F
$c_{p-water}$ = 1.0 Btu/lbm-°F
$T_{cw-in}$ = 92°F
$T_{cw-out}$ = 125°F
$T_{oil-in}$ = 180°F
$T_{oil-out}$ = ?

A.  135°F

B.  140°F

C.  145°F

D.  150°F

ANSWER:  A.
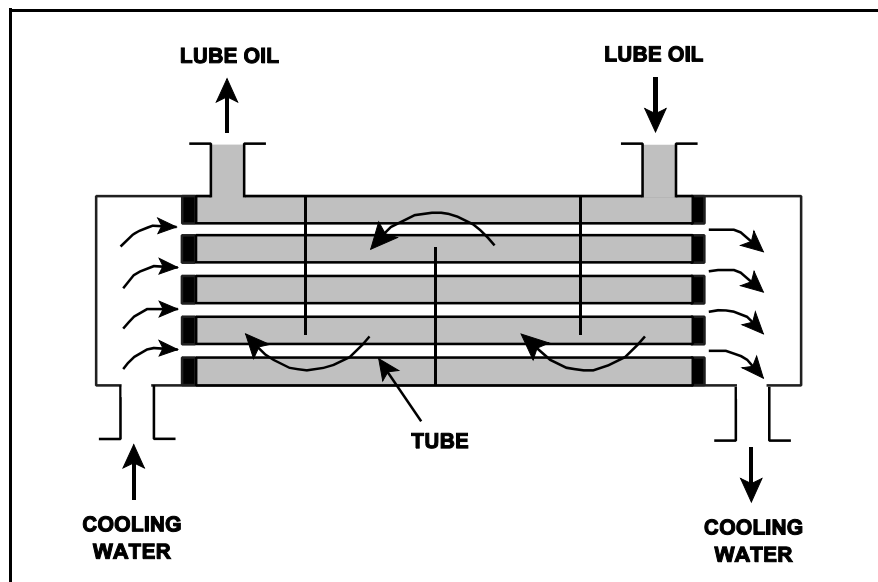
TOPIC:           191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:             P1732   (B1732)

Which one of the following will reduce the rate of heat transfer between two liquids in a heat exchanger? (Assume single-phase conditions and a constant specific heat for both liquids.)

A.  The inlet temperatures of both liquids are decreased by 20°F.

B.  The inlet temperatures of both liquids are increased by 20°F.

C.  The inlet temperature of the hotter liquid is increased by 20°F.

D.  The inlet temperature of the colder liquid is increased by 20°F.

ANSWER:  D.

TOPIC:           191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:             P1832   (B631)

The rate of heat transfer between two liquids in a heat exchanger will be <u>increased</u> if the:  (Assume single-phase conditions and a constant specific heat capacity.)

A.  temperature of both liquids is decreased by 20°F.

B.  temperature of both liquids is increased by 20°F.

C.  flow rate of the colder liquid is decreased by 10%.

D.  flow rate of the hotter liquid is increased by 10%.

ANSWER:  D.

TOPIC:              191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:                  P1934   (B1933)

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

Given the following information, which one of the following is the temperature of the oil exiting the heat exchanger ($T_{oil-out}$)?

$\dot{m}_{oil}$        = 1.5 x $10^4$ lbm/hr
$\dot{m}_{water}$    = 2.5 x $10^4$ lbm/hr
$c_{p-oil}$         = 1.1 Btu/lbm-°F
$c_{p-water}$      = 1.0 Btu/lbm-°F
$T_{cw-in}$         = 92°F
$T_{cw-out}$      = 125°F
$T_{oil-in}$        = 160°F
$T_{oil-out}$      = ?

A.  110°F

B.  127°F

C.  135°F

D.  147°F

ANSWER:  A.
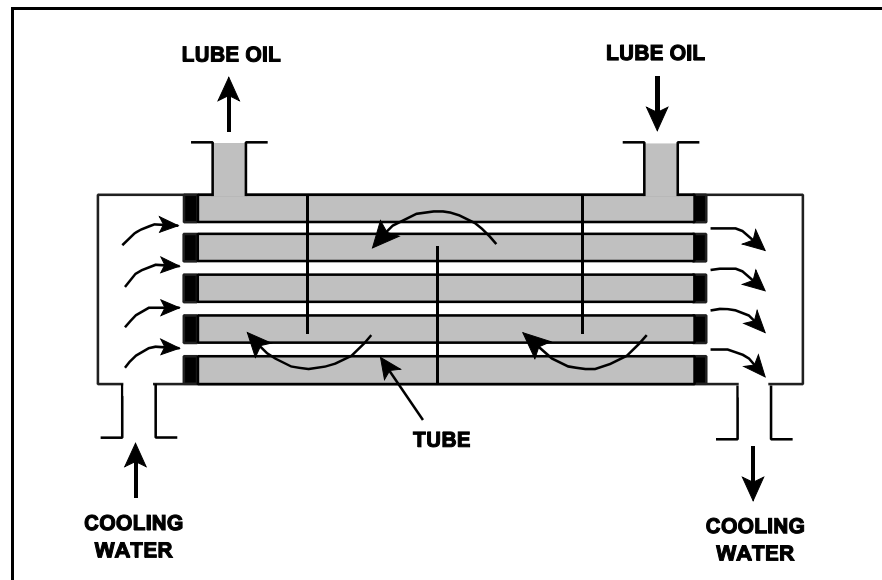
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P2034 (B834)

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

Given the following existing conditions:

$c_{p\text{-oil}}$ = 1.1 Btu/lbm-°F
$c_{p\text{-water}}$ = 1.0 Btu/lbm-°F
$\dot{m}_{oil}$ = 1.2 x $10^4$ lbm/hr
$\dot{m}_{water}$ = 1.61 x $10^4$ lbm/hr
$T_{oil\ in}$ = 170°F
$T_{oil\ out}$ = 120°F
$T_{water\ out}$ = 110°F
$T_{water\ in}$ = ?

Which one of the following is the approximate cooling water inlet temperature ($T_{water\ in}$) in this heat exchanger?

A. 65°F

B. 69°F

C. 73°F

D. 77°F

ANSWER: B.

TOPIC:            191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:               P2133   (B2132)

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

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

Lube oil inlet temperature:            120°F
Cooling water inlet temperature:      60°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is possible?  (Assume both fluids have the same $c_p$.)

|   | Lube Oil Outlet Temp | Cooling Water Outlet Temp |
|---|---|---|
| A. | 100°F | 100°F |
| B. | 90°F | 90°F |
| C. | 80°F | 80°F |
| D. | 80°F | 100°F |

ANSWER:  C.
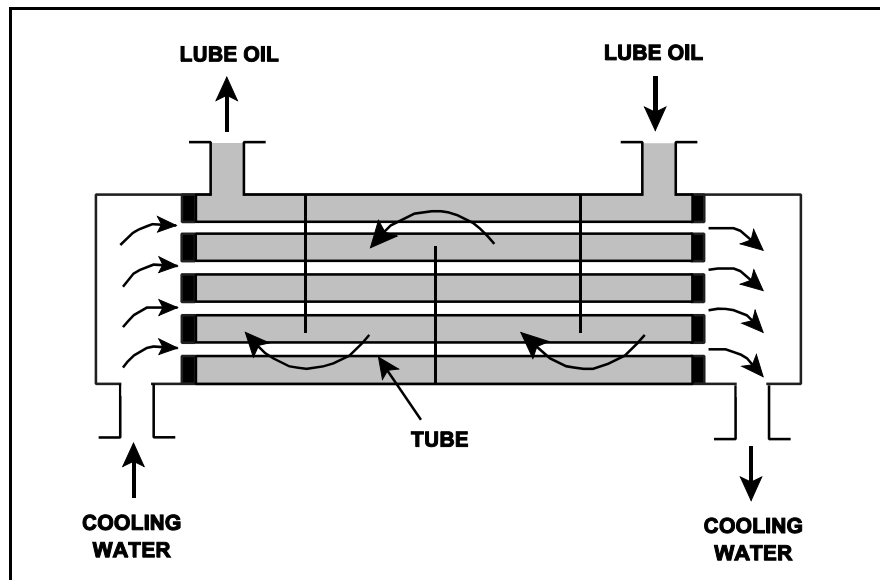
TOPIC:              191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:                 P2232   (B1435)

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

Given the following existing conditions:

$\dot{m}_{oil}$       = 1.8 x $10^4$ lbm/hr
$\dot{m}_{water}$     = 3.3 x $10^4$ lbm/hr
$c_{p\text{-oil}}$      = 1.1 Btu/lbm-°F
$c_{p\text{-water}}$    = 1.0 Btu/lbm-°F
$T_{cw\text{-in}}$      = 90°F
$T_{cw\text{-out}}$     = 120°F
$T_{oil\text{-in}}$     = 190°F
$T_{oil\text{-out}}$    = ?

Which one of the following is the temperature of the oil exiting the heat exchanger ($T_{oil\text{-out}}$)?

A.  110°F

B.  120°F

C.  130°F

D.  140°F

ANSWER:  D.

TOPIC:        191006
KNOWLEDGE:  K1.07  [2.4/2.6]
QID:           P2434  (B2233)

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

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

Lube oil inlet temperature:         130°F
Cooling water inlet temperature:    70°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is possible? (Neglect any difference between fluid specific heat.)

    Lube Oil     Cooling Water
    Outlet Temp  Outlet Temp

A.    90°F        100°F

B.    90°F        110°F
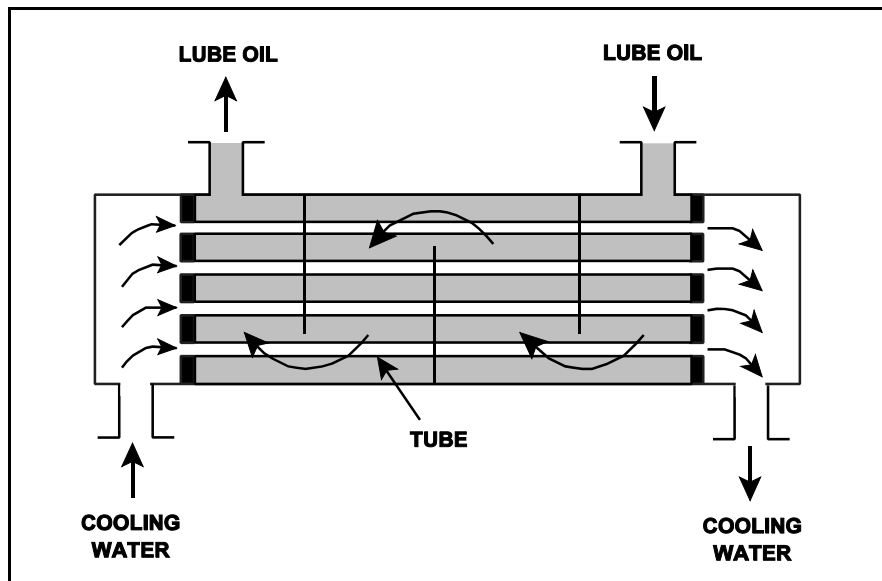
C.  100°F      100°F

D.  100°F      110°F

ANSWER: A.
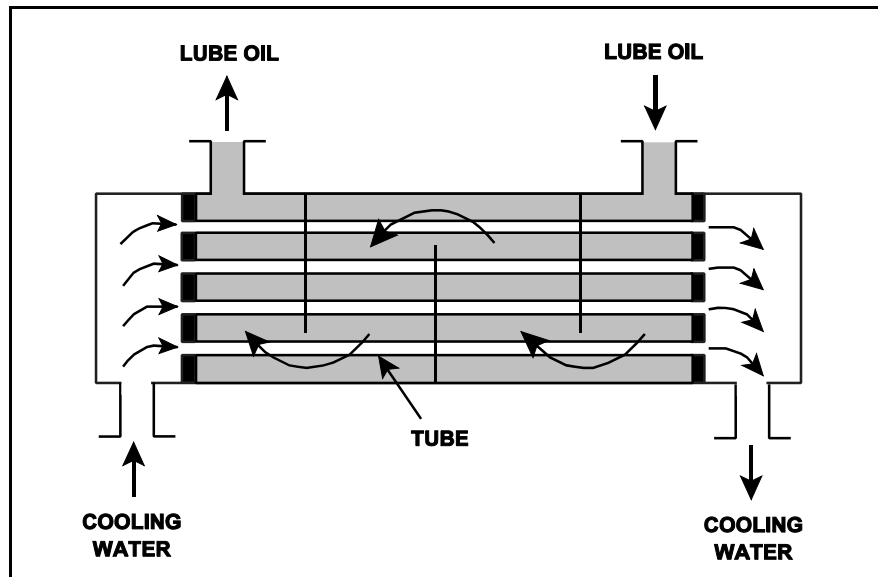
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P2532 (B2534)

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

Given the following information, which one of the following is the temperature of the cooling water exiting the heat exchanger ($T_{cw-out}$)?

$\dot{m}_{oil}$ = 1.5 x $10^4$ lbm/hr
$\dot{m}_{water}$ = 2.5 x $10^4$ lbm/hr
$c_{p-oil}$ = 1.1 Btu/lbm-°F
$c_{p-water}$ = 1.0 Btu/lbm-°F
$T_{oil-in}$ = 160°F
$T_{oil-out}$ = 110°F
$T_{cw-in}$ = 92°F
$T_{cw-out}$ = ?

A. 110°F

B. 115°F

C. 120°F

D. 125°F

ANSWER: D.



*Heat Exchangers and Condensers*

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P2632   (B2531)

The rate of heat transfer between two liquids in a heat exchanger will be decreased if the:  (Assume single-phase conditions and a constant specific heat for both liquids.)

A.  inlet temperature of the hotter liquid is increased by 20°F.

B.  inlet temperature of the colder liquid is decreased by 20°F.

C.  flow rates of both liquids are decreased by 10%.

D.  flow rates of both liquids are increased by 10%.

ANSWER:  C.

TOPIC:           191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P2633   (B2632)

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

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

    Lube oil inlet temperature:         110°F
    Cooling water inlet temperature:  75°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is possible?  (Neglect any difference between fluid specific heats.)

    Lube Oil        Cooling Water
    Outlet Temp    Outlet Temp

A.  100°F          100°F

B.  100°F           90°F

C.   90°F          100°F

D.   90°F           90°F

ANSWER:  D.

TOPIC:         191006
KNOWLEDGE:  K1.07  [2.4/2.6]
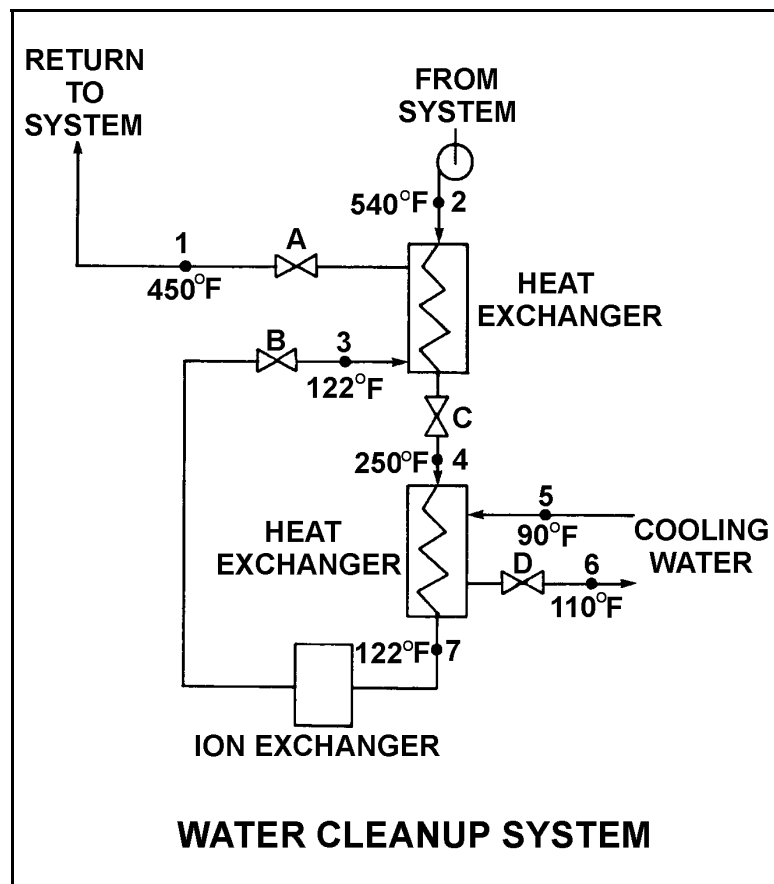QID:            P2732  (B2732)

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

ANSWER:  C.

RETURN
TO
SYSTEM

FROM
SYSTEM

540°F ● 2

1          A
●
450°F

HEAT
EXCHANGER

B      3
●
122°F

C

250°F ● 4

5
●
90°F

HEAT
EXCHANGER

COOLING
WATER

D      6
●
110°F

122°F ● 7

ION EXCHANGER

**WATER CLEANUP SYSTEM**
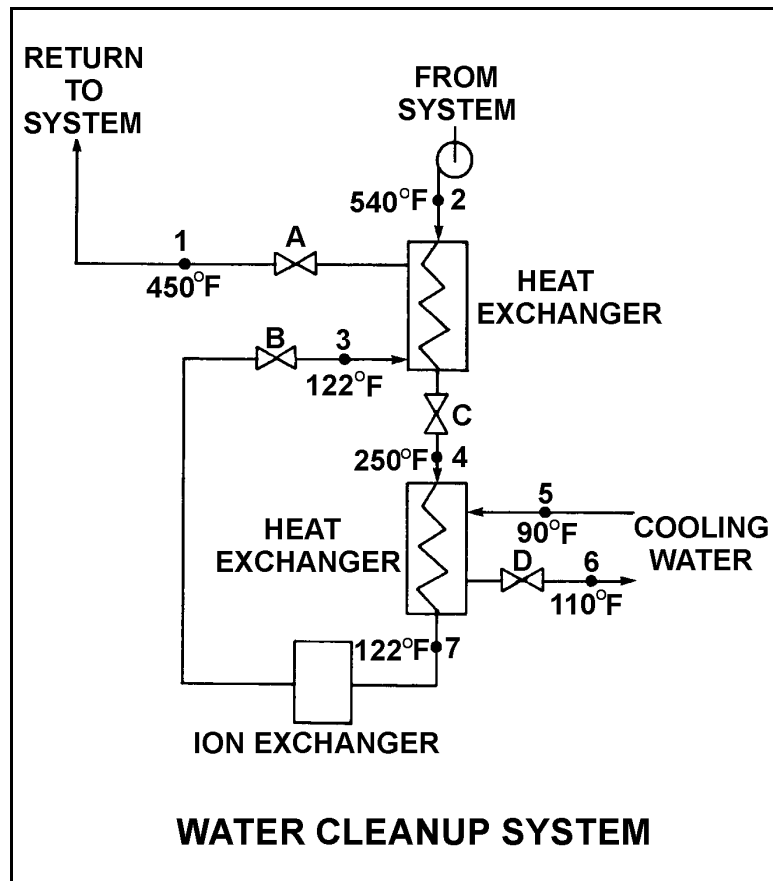
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P2733 (B2733)

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

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

    Lube oil inlet temperature:          130°F
    Cooling water inlet temperature:   70°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is not possible? (Assume both fluids have the same specific heat.)

|  | Lube Oil<br>Outlet Temp | Cooling Water<br>Outlet Temp |
|---|---|---|
| A. | 90°F | 86°F |
| B. | 100°F | 85°F |
| C. | 110°F | 84°F |
| D. | 120°F | 83°F |

ANSWER: D.



LUBE OIL        LUBE OIL

TUBE

COOLING        COOLING
WATER          WATER

TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P2934 (B2933)

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

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

Lube oil inlet temperature: 130°F
Cooling water inlet temperature: 70°F

Assuming that cooling water flow rate is significantly larger than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is possible? (Assume both fluids have the same specific heat.)

|  | Lube Oil Outlet Temp | Cooling Water Outlet Temp |
|---|---|---|
| A. | 100°F | 90°F |
| B. | 100°F | 100°F |
| C. | 110°F | 90°F |
| D. | 110°F | 100°F |

ANSWER: A.

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P3034   (B3082)

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

Given the following lube oil cooling system conditions:

The lube oil flow rate in the lube oil heat exchanger is 200 lbm/min.
The lube oil enters the heat exchanger at 140°F.
The lube oil leaves the heat exchanger at 100°F.
The specific heat of the lube oil is 0.8 Btu/lbm-°F.
The cooling water flow rate is 400 lbm/min.
The cooling water enters the lube oil heat exchanger at 60°F.
The specific heat of the cooling water is 1.0 Btu/lbm-°F.

What is the approximate temperature of the cooling water leaving the lube oil heat exchanger?

A.  76°F

B.  85°F

C.  92°F

D.  124°F

ANSWER:  A.
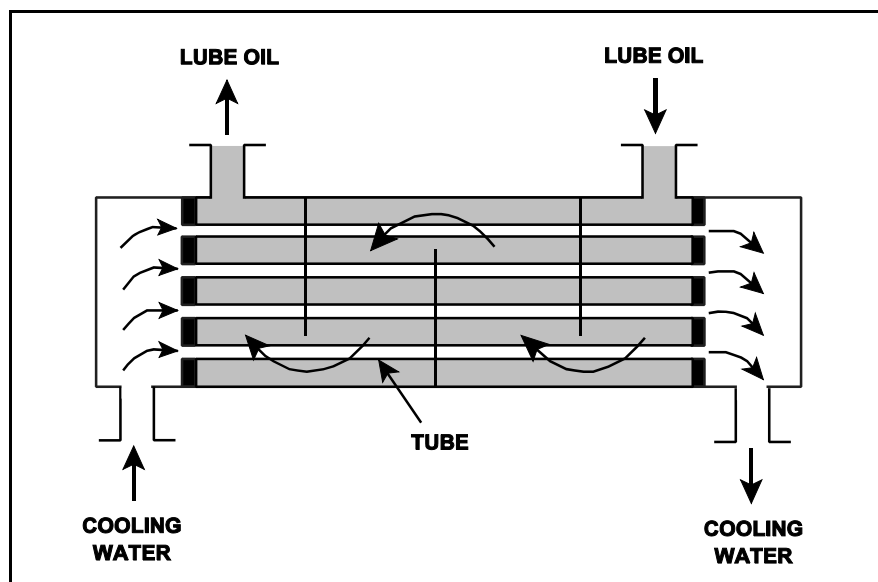
TOPIC:            191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:               P3132   (B934)

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

The heat exchanger is operating with the following parameters:

$\dot{Q}_{oil}$        = 1.0 x $10^7$ Btu/hr
$T_{oil\ in}$     = 170°F
$T_{oil\ out}$    = 134°F
$T_{water\ in}$   = 85°F
$T_{water\ out}$  = 112°F
$c_{p\text{-}oil}$     = 1.1 Btu/lbm-°F
$c_{p\text{-}water}$   = 1.0 Btu/lbm-°F
$\dot{m}_{water}$   = ?

Which one of the following is the mass flow rate of the cooling water?

A.  4.5 x $10^5$ lbm/hr

B.  3.7 x $10^5$ lbm/hr

C.  2.5 x $10^5$ lbm/hr

D.  1.2 x $10^5$ lbm/hr

ANSWER:  B.
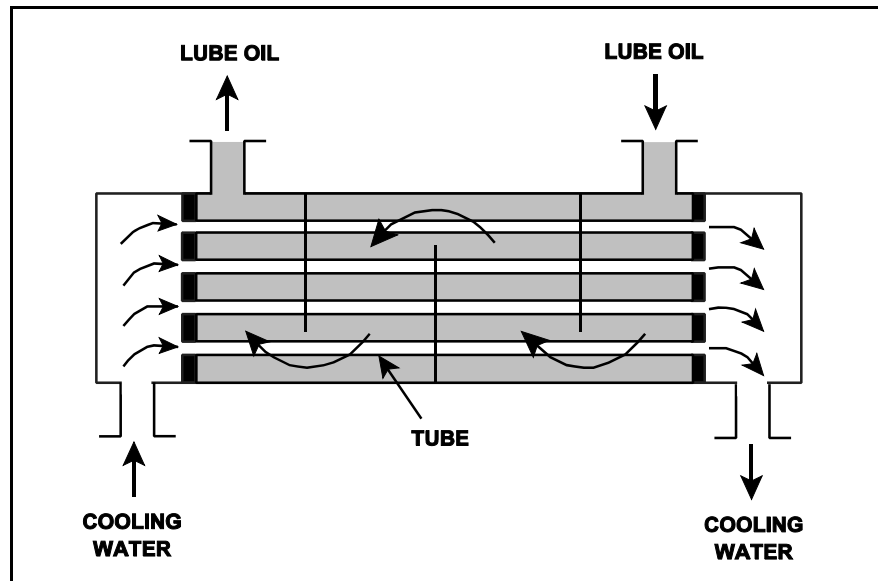
TOPIC:          191006
KNOWLEDGE:  K1.07   [2.4/2.6]
QID:               P3232   (B632)

Refer to the drawing of an operating water cleanup system (see figure below).  Valves A, B, and D are fully open and valve C is 50% open.

If valve C is opened to 100%, how will the temperatures at points 3 and 6 be affected?

    Point 3              Point 6

A.  Decrease          Decrease

B.  Decrease          Increase

C.  Increase            Decrease

D.  Increase            Increase

ANSWER:  D.



WATER CLEANUP SYSTEM

*Heat Exchangers and Condensers*
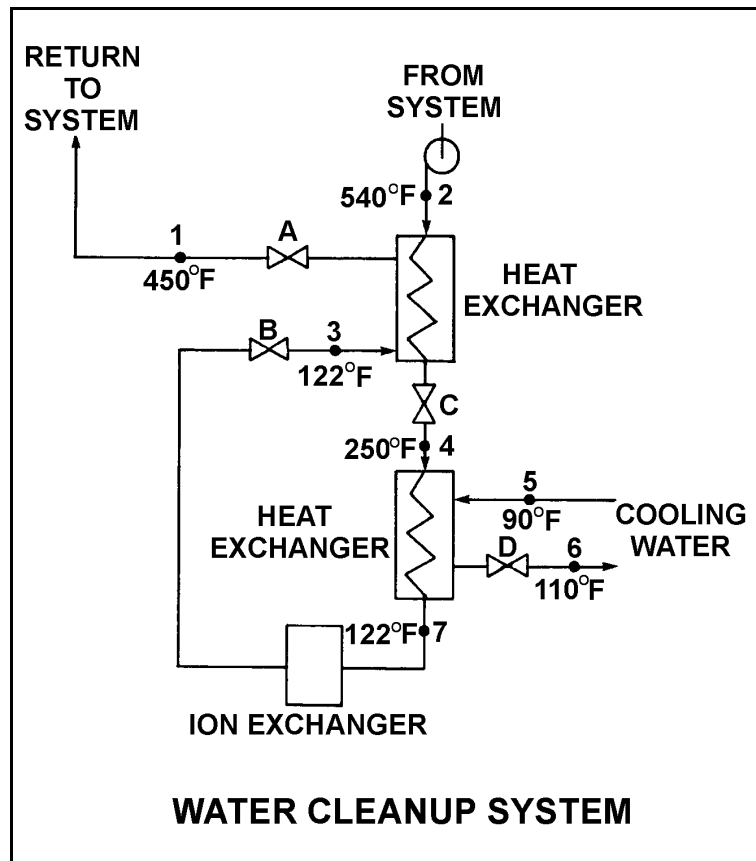
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P3332 (B1930)

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 7, the operator should adjust valve _____ in the <u>close</u> direction.

A.  A

B.  B

C.  C

D.  D

ANSWER:  D.
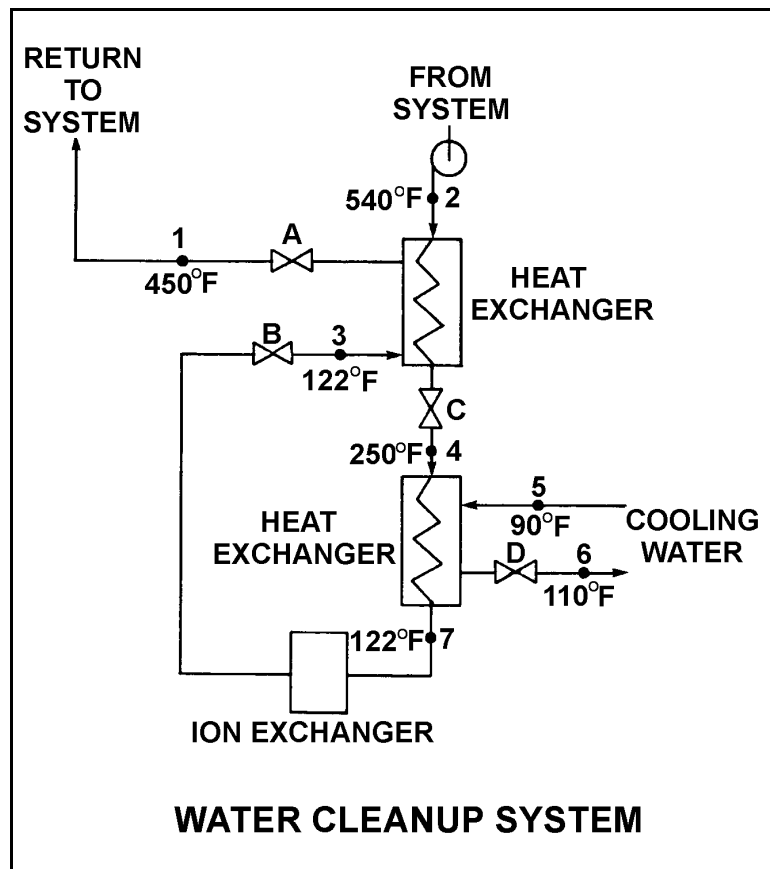
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: P3432 (B1435)

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

Given the following existing conditions:

$\dot{m}_{oil}$ = 1.8 x 10⁴ lbm/hr
$\dot{m}_{water}$ = 3.3 x 10⁴ lbm/hr
$c_{p\text{-}oil}$ = 1.1 Btu/lbm-°F
$c_{p\text{-}water}$ = 1.0 Btu/lbm-°F
$T_{cw\text{-}in}$ = 90°F
$T_{cw\text{-}out}$ = 120°F
$T_{oil\text{-}in}$ = 170°F
$T_{oil\text{-}out}$ = ?

What is the approximate temperature of the oil exiting the heat exchanger ($T_{oil\text{-}out}$)?

A. 110°F

B. 120°F

C. 130°F

D. 140°F

ANSWER: B.



*Heat Exchangers and Condensers*
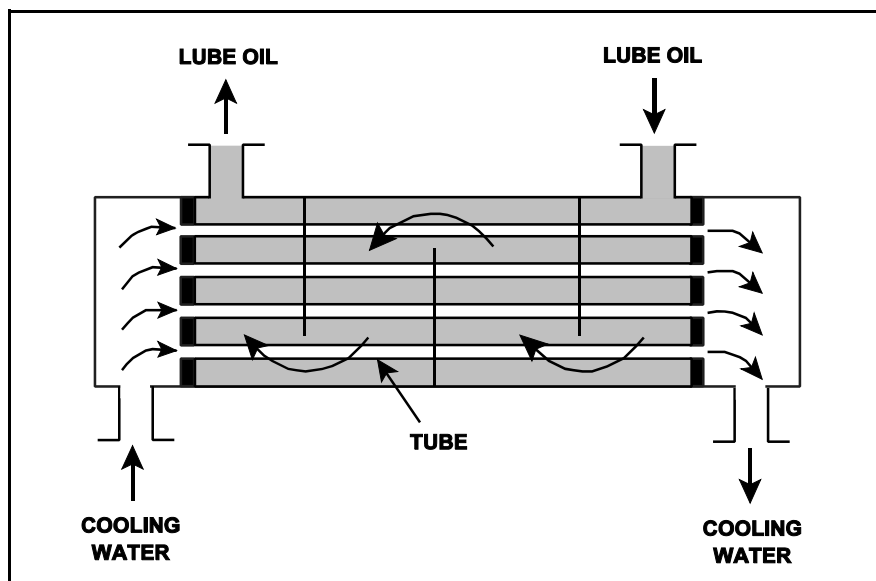
TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:             P3632   (B3631)

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

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

A.  $1.6 \times 10^5$ lbm/hr

B.  $3.2 \times 10^5$ lbm/hr

C.  $1.6 \times 10^6$ lbm/hr

D.  $3.2 \times 10^6$ lbm/hr

ANSWER:  A.
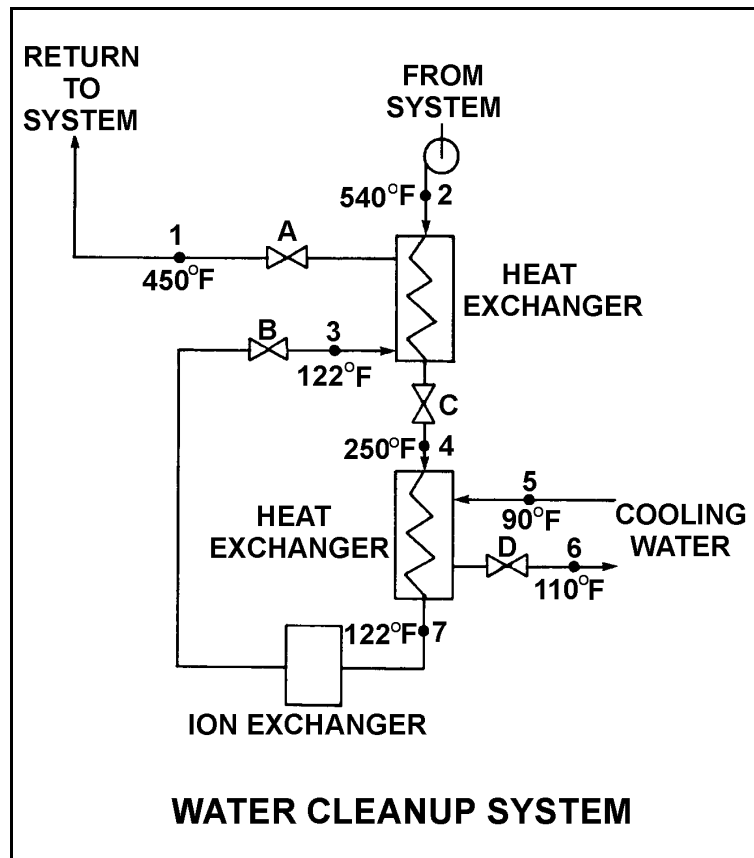
TOPIC:           191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:             P3732   (B3732)

Refer to the drawing of a lube oil heat exchanger (see figure below).
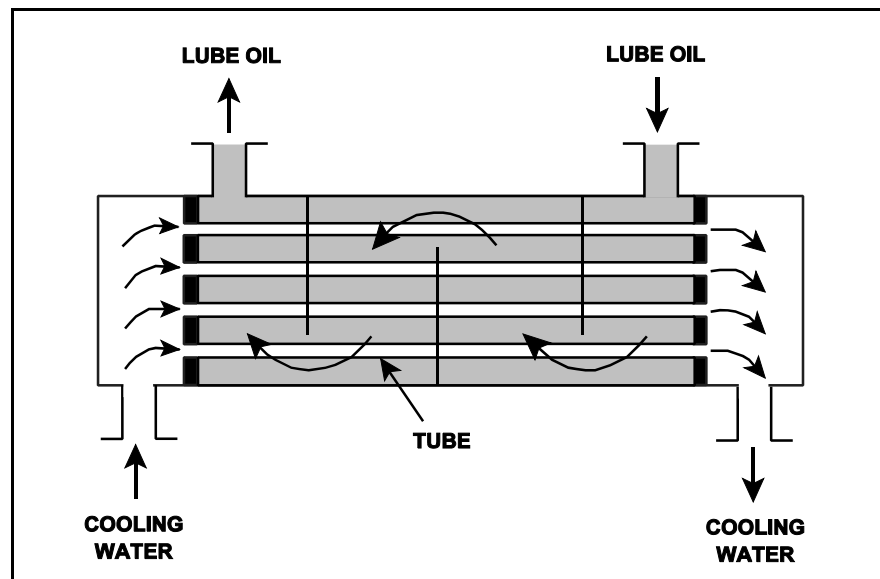
The lube oil heat exchanger is in service with the following inlet temperatures:

    Lube oil inlet temperature:          130°F
    Cooling water inlet temperature:  70°F

Assume that cooling water mass flow rate is less than lube oil mass flow rate, and that both fluids have the same specific heat.  Which one of the following pairs of heat exchanger outlet temperatures is not possible?

| Lube Oil Outlet Temp | Cooling Water Outlet Temp |
|---|---|
| A.   100°F | 105°F |
| B.   105°F | 105°F |
| C.   110°F | 90°F |
| D.   115°F | 90°F |

ANSWER:  C.
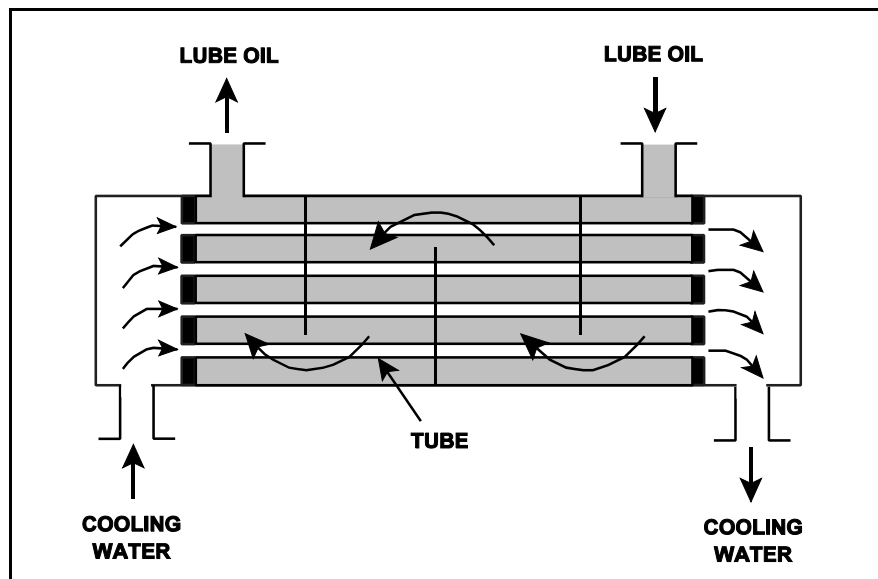
TOPIC:           191006
KNOWLEDGE:   K1.07   [2.5/2.7]
QID:             P3833   (B3832)

A main turbine-generator was operating at 80% load with the following <u>initial</u> steady-state lube oil and cooling water temperatures for the main turbine lube oil heat exchanger:

$T_{oil\ in}$      $= 174°F$
$T_{oil\ out}$     $= 114°F$
$T_{water\ in}$    $= 85°F$
$T_{water\ out}$   $= 115°F$

Six months later, the following <u>current</u> steady-state heat exchanger temperatures are observed:

$T_{oil\ in}$      $= 177°F$
$T_{oil\ out}$     $= 111°F$
$T_{water\ in}$    $= 85°F$
$T_{water\ out}$   $= 115°F$

Assume that the total heat exchanger heat transfer coefficient and the cooling water mass flow rate do <u>not</u> change, and that the specific heat values for the cooling water and lube oil do <u>not</u> change. Also, assume that the lube oil system is a closed system.

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

A.  The current main turbine-generator load is lower than the initial load.

B.  The current main turbine-generator load is higher than the initial load.

C.  The current main turbine lube oil mass flow rate is less than the initial flow rate.

D.  The current main turbine lube oil mass flow rate is greater than the initial flow rate.

ANSWER:  C.

TOPIC:           191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:              P4416   (B4416)

Refer to the drawing of a lube oil heat exchanger (see figure below).
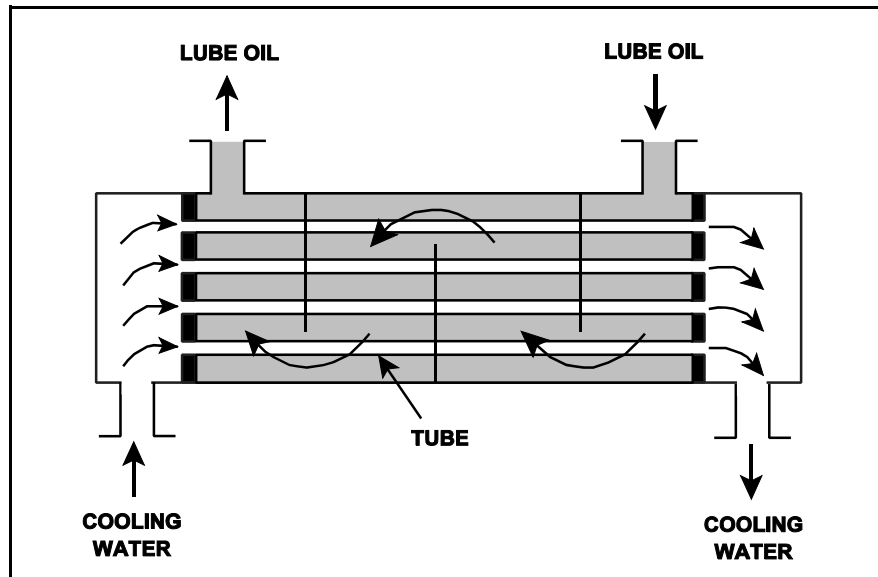
The lube oil heat exchanger is in service with the following inlet temperatures:

   Lube oil inlet temperature:          120°F
   Cooling water inlet temperature:  60°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following sets of heat exchanger outlet temperatures is possible?  (Neglect any difference between fluid specific heats.)

|   | Lube Oil Outlet Temp | Cooling Water Outlet Temp |
|---|---|---|
| A. | 90°F | 100°F |
| B. | 90°F | 85°F |
| C. | 95°F | 100°F |
| D. | 95°F | 85°F |

ANSWER:  B.
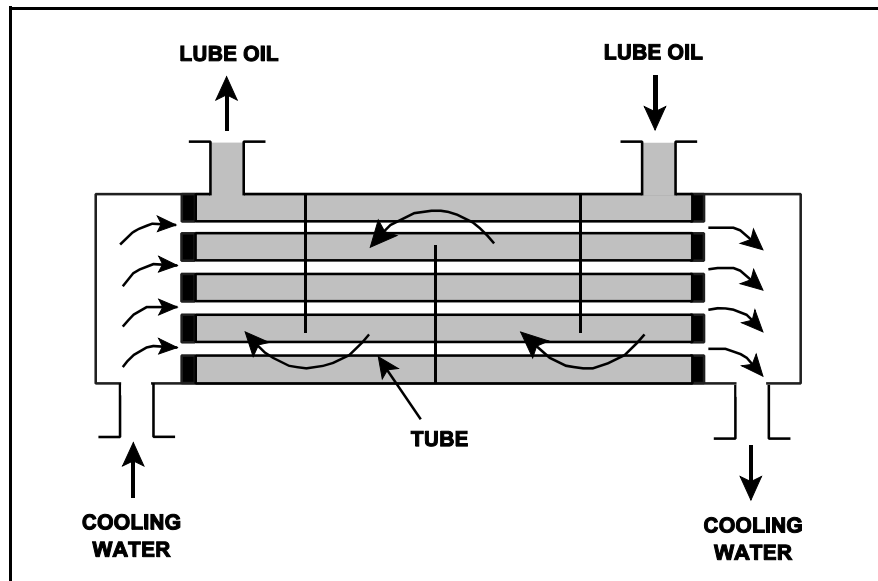
TOPIC:              191006
KNOWLEDGE:   K1.07   [2.5/2.7]
QID:                  P5316   (B5317)

A main turbine-generator was operating at 80% load with the following <u>initial</u> steady-state lube oil and cooling water temperatures for the main turbine lube oil heat exchanger:

$T_{oil\ in}$      = 174°F
$T_{oil\ out}$    = 114°F
$T_{water\ in}$    = 85°F
$T_{water\ out}$   = 115°F

Six months later, the <u>current</u> steady-state heat exchanger temperatures are:

$T_{oil\ in}$      = 174°F
$T_{oil\ out}$    = 120°F
$T_{water\ in}$    = 85°F
$T_{water\ out}$   = 120°F

Assume that the lube oil mass flow rate does <u>not</u> change, and that the specific heat values for the cooling water and lube oil do <u>not</u> change.  Also, assume that the main turbine lube oil system is a closed system.

The differences between the initial and current steady-state heat exchanger temperatures could be caused by the current main turbine-generator load being _____ with the current heat exchanger cooling water mass flow rate being _____.

A.  higher; lower

B.  higher; higher

C.  lower; lower

D.  lower; higher

ANSWER:  C.

TOPIC:              191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:                   P5516   (B5517)

Refer to the drawing of a lube oil heat exchanger (see figure below).
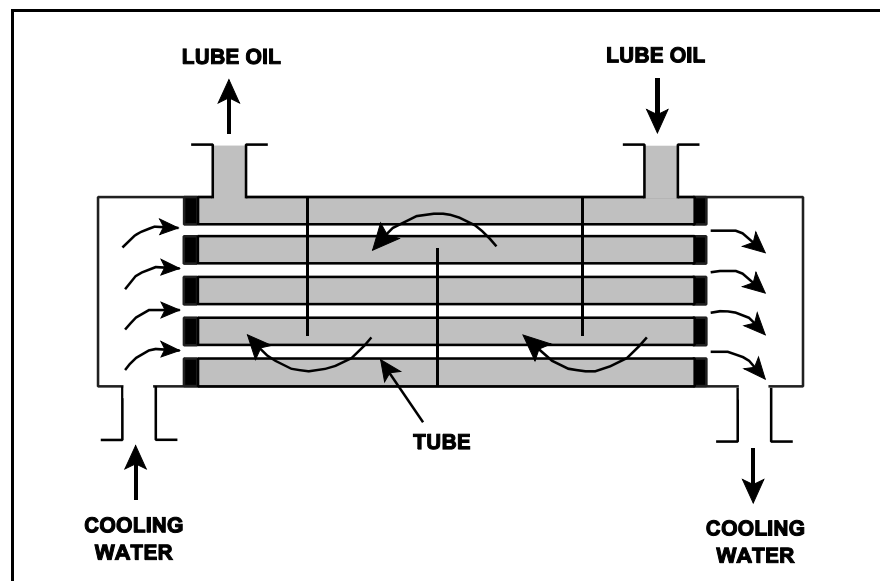
The lube oil heat exchanger is in service with the following inlet temperatures:

    Lube oil inlet temperature:          130°F
    Cooling water inlet temperature:  70°F

Given that cooling water mass flow rate is greater than lube oil mass flow rate, which one of the following pairs of heat exchanger outlet temperatures is <u>not</u> possible?  (Neglect any difference between the fluid specific heat capacities.)

    Lube Oil         Cooling Water
    <u>Outlet Temp</u>    <u>Outlet Temp</u>

A.     90°F              105°F

B.     90°F              100°F

C.   110°F              95°F

D.   110°F              85°F

ANSWER:  C.

TOPIC:          191006
KNOWLEDGE:   K1.07   [2.4/2.6]
QID:               P5616   (B5617)

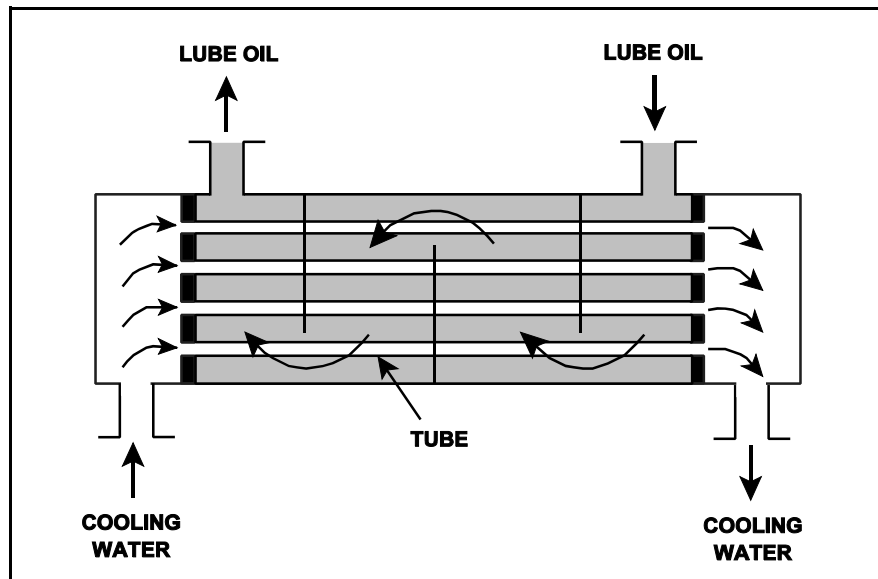Refer to the drawing of an operating lube oil heat exchanger (see figure below).

Assume that the inlet lube oil and inlet cooling water temperatures are constant and the lube oil flow rate remains the same.  If the cooling water flow rate increases, the lube oil outlet temperature will _____ and the cooling water outlet temperature will _____.

A.  increase, increase

B.  increase, decrease

C.  decrease, increase

D.  decrease, decrease

ANSWER:  D.
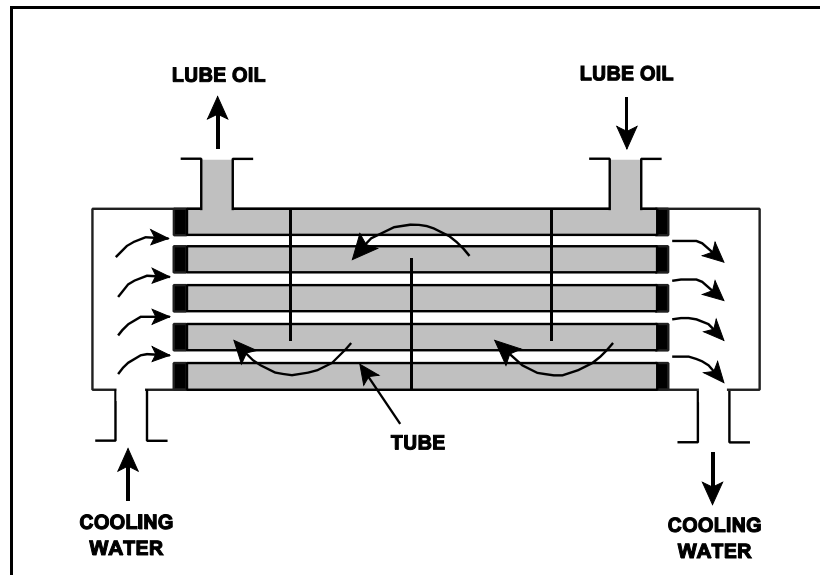
TOPIC:          191006
KNOWLEDGE:   K1.09   [2.8/2.8]
QID:             P31

Severe stress in a mechanical component, induced by a sudden, unequally distributed temperature reduction is a description of...

A.  fracture stress.

B.  brittle fracture.

C.  thermal shock.

D.  pressurized thermal shock.

ANSWER:  C.

TOPIC:          191006
KNOWLEDGE:   K1.09   [2.8/2.8]
QID:             P233

The <u>major</u> thermodynamic concern resulting from <u>rapidly</u> cooling a reactor vessel is...

A.  thermal shock.

B.  stress corrosion.

C.  loss of shutdown margin.

D.  loss of subcooling margin.

ANSWER:  A.

TOPIC:          191006
KNOWLEDGE:   K1.09   [2.8/2.8]
QID:             P2832   (B633)

Steam has been admitted to a main condenser for 25 minutes with no cooling water.  Initiating full cooling water flow rate at this time will...

A.  reduce the stress on the condenser shell by rapidly cooling the shell.

B.  reduce the stress on the condenser tubes by rapidly cooling the tubes.

C.  induce large thermal stresses on the condenser shell.

D.  induce large thermal stresses on the junctions between the condenser tubes and the tubesheet.

ANSWER:  D.

TOPIC:          191006
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P32     (B1234)

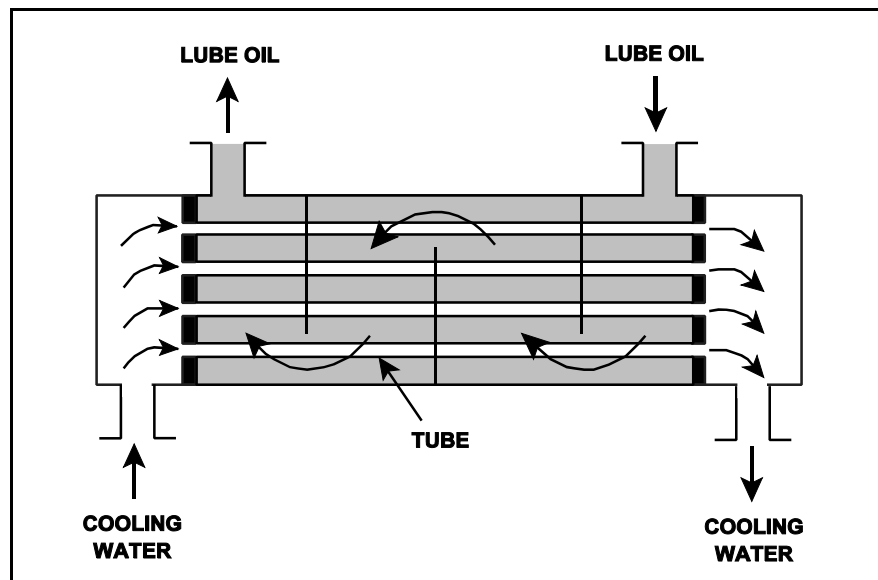Refer to the drawing of an operating lube oil heat exchanger (see figure below).

If scaling occurs inside the cooling water tubes, cooling water outlet temperature will _____ and lube oil outlet temperature will _____.  (Assume oil and cooling water flow rates remain the same.)

A.  decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  B.

TOPIC:            191006
KNOWLEDGE:    K1.12    [2.5/2.7]
QID:              P105

Which one of the following will occur to reduce the heat transfer rate in a parallel-flow heat exchanger as scaling increases on the exterior surface of the tubes?  (Assume no operator actions.)

A.  Flow through the heat exchanger tubes will decrease.

B.  Surface area of the tubes will decrease.

C.  Thermal conductivity of the tubes will decrease.

D.  Delta-T across the tubes will decrease.

ANSWER:  C.

TOPIC:            191006
KNOWLEDGE:    K1.12    [2.5/2.7]
QID:              P331    (B332)

A nuclear power plant is operating at steady-state conditions with the main generator supplying 1,000 MW to the power grid.  Assume main generator load remains constant.

If 1% of the tubes in the main condenser become plugged, condenser absolute pressure will _____; and condenser hotwell temperature will _____.

A.  increase; increase

B.  decrease; increase

C.  increase; decrease

D.  decrease; decrease

ANSWER:  A.

TOPIC:          191006
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:             P2233   (B1833)

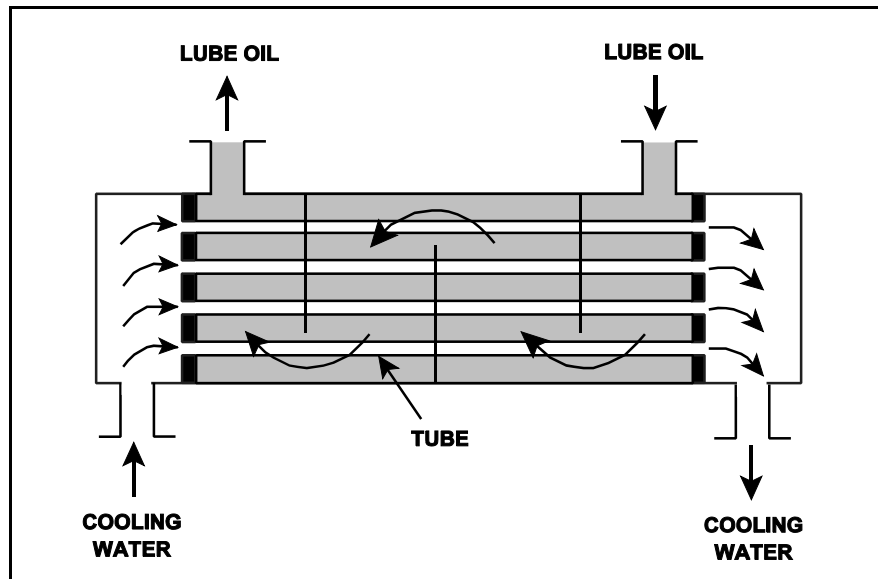Refer to the drawing of an operating lube oil heat exchanger (see figure below).

If deposits accumulate on the outside of the cooling water tubes, cooling water outlet temperature will _____ and oil outlet temperature will _____.  (Assume oil and cooling water inlet temperatures and flow rates remain the same.)

A.  increase; decrease

B.  increase; increase

C.  decrease; decrease

D.  decrease; increase

ANSWER:  D.
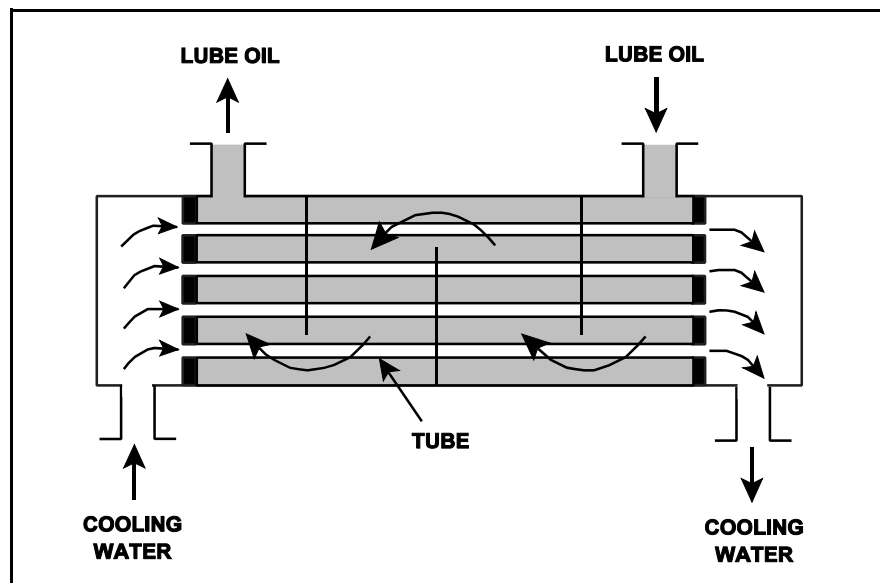
TOPIC:                191006
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:                   P3633   (B3635)

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

$T_{oil\ in}$       = 174°F
$T_{oil\ out}$     = 114°F
$T_{water\ in}$    = 85°F
$T_{water\ out}$   = 115°F

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

$T_{oil\ in}$       = 179°F
$T_{oil\ out}$     = 119°F
$T_{water\ in}$    = 85°F
$T_{water\ out}$   = 115°F

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

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

A.  The heat exchanger tubes have become fouled with scale.

B.  The temperature of the cooling water source has increased.

C.  The final main turbine-generator load is higher than the initial load.

D.  The final main turbine-generator load is lower than the initial load.

ANSWER:  A.

TOPIC:          191006
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P4617   (B4616)

Refer to the drawing of two system curves for a typical main condenser cooling water system (see figure below).

Which one of the following will cause the system curve to shift from the solid curve toward the dashed curve?

A.  The main condenser tubes are cleaned.

B.  The main condenser tubes become increasingly fouled.

C.  Cooling water flow rate is increased by 25% by starting an additional cooling water pump.

D.  Cooling water flow rate is decreased by 25% by stopping one of the operating cooling water pumps.

ANSWER:  A.
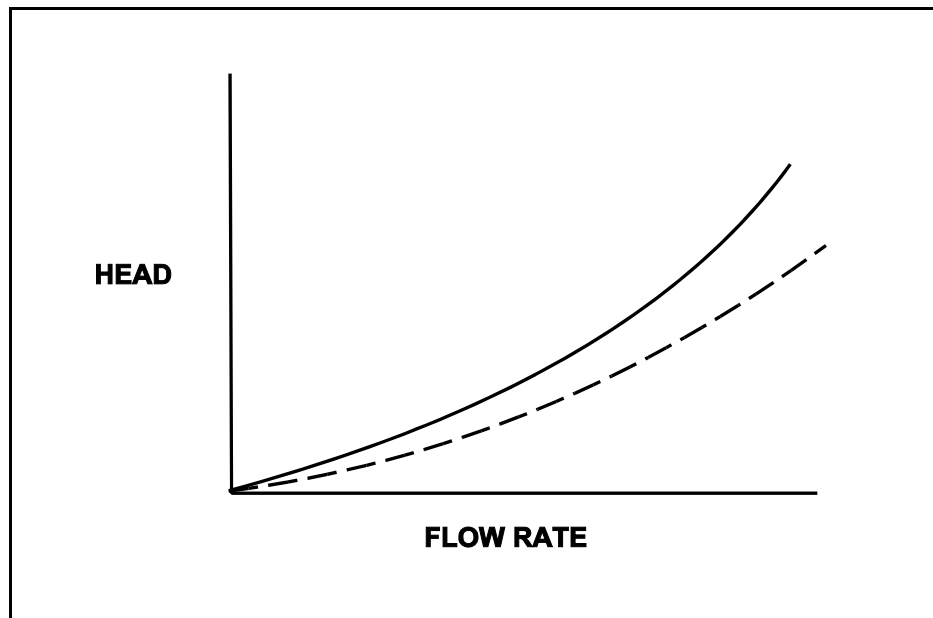
TOPIC:          191006
KNOWLEDGE:   K1.12   [2.5/2.7]
QID:            P5116   (B5117)

Refer to the drawing of two system curves for a typical main condenser cooling water system (see figure below).

Which one of the following will result in the system curve shifting from the solid curve toward the dashed curve?

A.  The main condenser tubes are cleaned.

B.  The main condenser tubes become increasingly fouled.

C.  Cooling water system flow rate is increased by 25% by starting an additional cooling water pump.

D.  Cooling water system flow rate is decreased by 25% by stopping one of the operating cooling water pumps.

ANSWER:  B.
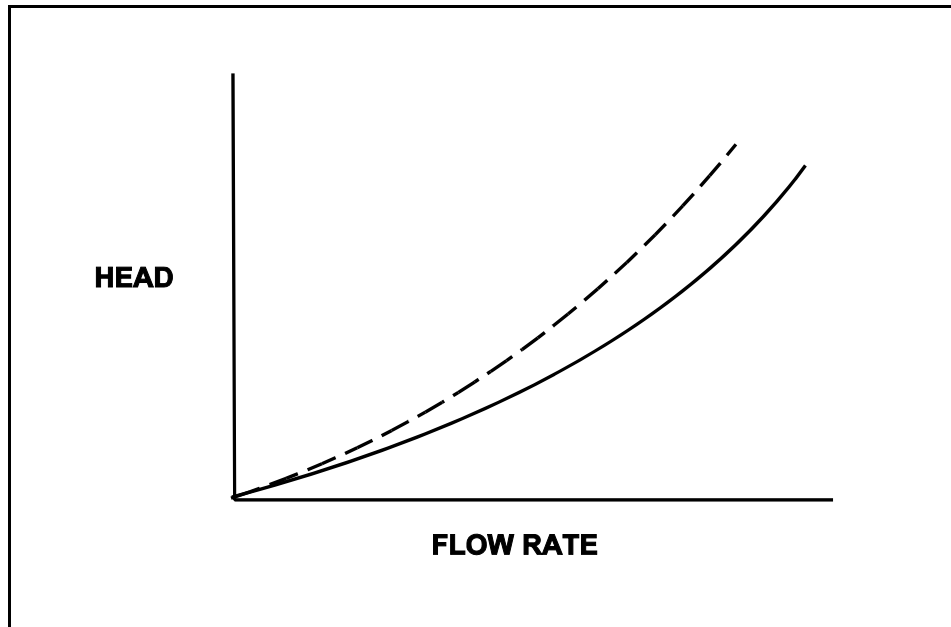
TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P33

Borated water is flowing through the tubes of a heat exchanger being cooled by fresh water.  The shell side pressure is less than tube side pressure.  What will occur as a result of a tube failure?

A.  Shell side pressure will increase and the borated water system will be diluted.

B.  Shell side pressure will decrease and the borated water inventory will be depleted.

C.  Shell side pressure will increase and the borated water inventory will be depleted.

D.  Shell side pressure will decrease and the borated water system will be diluted.

ANSWER:  C.

TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P234    (B3535)

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

Which one of the following effects would occur as a result of the failed tube in the heat exchanger?

A.  Level in the surge tank increases.

B.  Flow in the low pressure system reverses.

C.  Pressure in the low pressure system decreases.

D.  Low pressure fluid heat exchanger outlet temperature decreases.

ANSWER:  D.
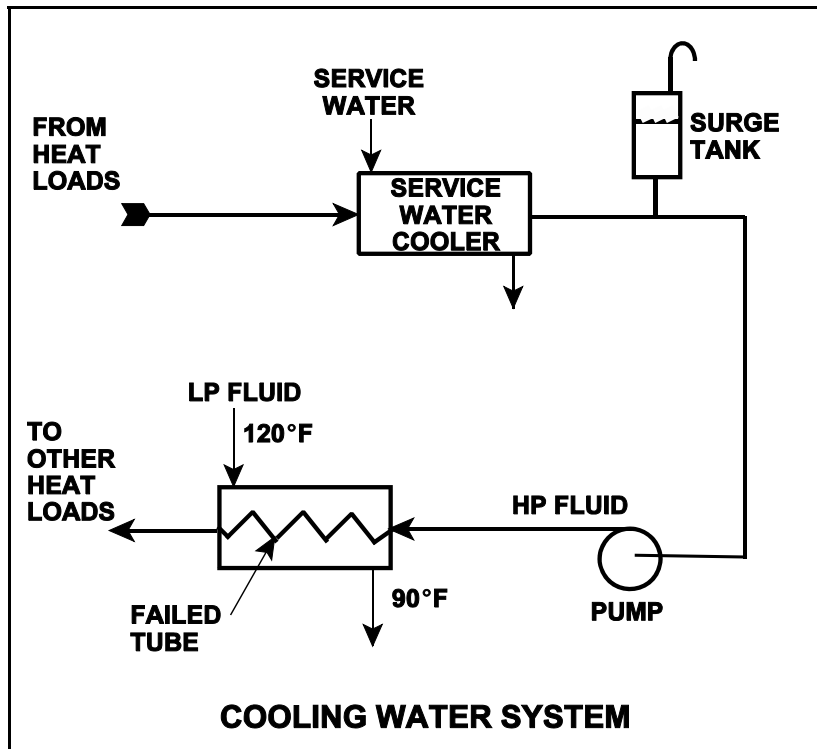
TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P333    (B333)

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

A.  Increased condenser vacuum

B.  Increased conductivity of the condensate

C.  Decreased condensate pump net positive suction head

D.  Decreased condensate pump flow rate

ANSWER:  B.

TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P1134   (B1931)

Which one of the following effects will occur as a result of multiple tube failures (leaks) in the main condenser of a nuclear power plant at 50% power?

A.  Condensate depression will decrease.

B.  Condensate conductivity will increase.

C.  Condensate oxygen concentration will decrease.

D.  Condenser inlet cooling water flow rate will decrease.

ANSWER:  B.

TOPIC:             191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:                  P1234   (B1535)

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.

ANSWER:  D.



COOLING WATER SYSTEM
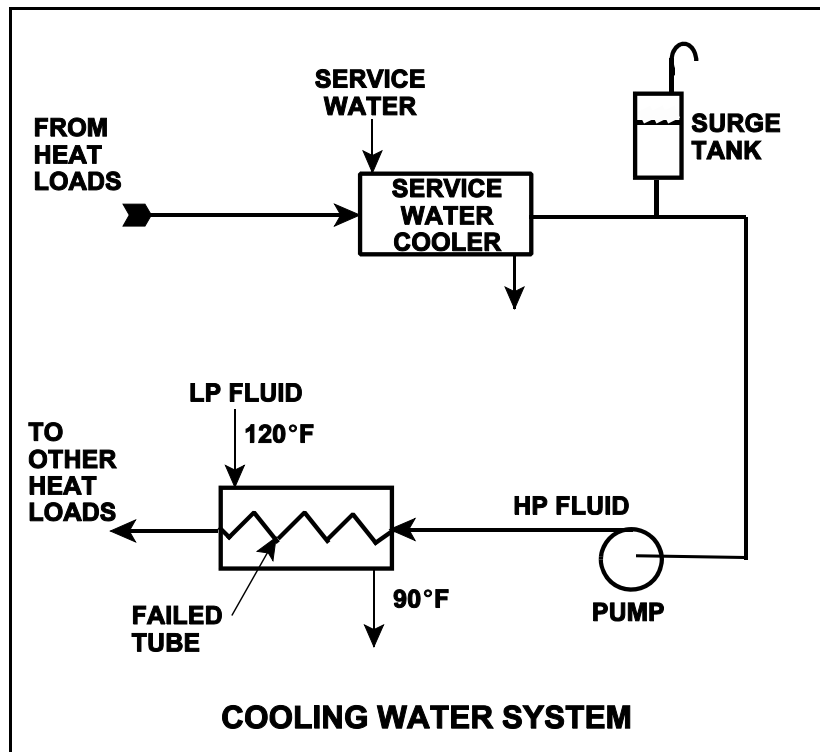
TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P2984   (B2084)

The following 100% rated power conditions existed <u>before</u> a nuclear power plant outage:

    Main condenser pressure:            1.20 psia
    Cooling water inlet temperature:   60°F
    Cooling water outlet temperature:  92°F

During the outage, 6% of the main condenser tubes were plugged.  <u>After </u>the outage, the following 100% rated power conditions exist:

    Main condenser pressure:            1.31 psia
    Cooling water inlet temperature:   60°F
    Cooling water outlet temperature:  ?

Which one of the following is the approximate cooling water outlet temperature <u>after </u>the outage?

A.  92°F

B.  94°F

C.  96°F

D.  98°F

ANSWER:  B.

TOPIC:          191006
KNOWLEDGE:   K1.13   [2.8/2.9]
QID:            P4917   (B4918)

A nuclear power plant was initially operating at steady-state 50% thermal power with 50 gpm of main condenser cooling water  inleakage through a cooling water tube rupture.  Thermal power was then increased and is currently stable at 60%.

Assume that the size of the cooling water tube rupture does not change, and that the main condenser cooling water inlet pressure and inlet temperature do not change.

When compared to the flow rate of main condenser cooling water inleakage at 50% power, the flow rate of main condenser cooling water inleakage at 60% power is _____ because the main condenser pressure at 60% power is _____.

A.  lower; lower

B.  lower; higher

C.  higher; lower

D.  higher; higher

ANSWER:  B.

TOPIC:          191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P1834   (B111)

During normal nuclear power plant operation, a main condenser develops an air leak which decreases vacuum at a rate of 1 inch Hg/min.  Which one of the following will <u>increase</u> because of this condition?

A.  Extraction steam flow rate

B.  Condenser hotwell temperature

C.  Low pressure turbine exhaust steam moisture content

D.  Steam cycle efficiency

ANSWER:  B.

TOPIC:              191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:                P1912   (B936)

During normal nuclear power plant operation, why does air entry into the main condenser reduce the thermodynamic efficiency of the steam cycle?

A.  The rate of steam flow through the main turbine increases.

B.  The condensate subcooling in the main condenser increases.

C.  The enthalpy of the low pressure turbine exhaust increases.

D.  The air mixes with the steam and enters the condensate.

ANSWER:  C.

TOPIC:              191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:                P2634   (B2633)

A nuclear power plant is operating at steady-state 100% power.  Assuming that condenser cooling water inlet temperature and flow rate do <u>not</u> change, if condenser vacuum decreases, condensate temperature will...

A.  increase because condensate subcooling has decreased.

B.  increase because condenser saturation pressure has increased.

C.  decrease because condensate subcooling has increased.

D.  decrease because condenser saturation pressure has decreased.

ANSWER:  B.

TOPIC:          191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P3534   (B2736)

A nuclear power plant is operating at steady-state 100% power when air inleakage causes main condenser vacuum to decrease from 28 inches Hg to 27 inches Hg.  Assume the steam inlet quality and mass flow rate of steam through the main turbine remain unchanged, and that condenser cooling water inlet temperature and flow rate do not change.

When the plant stabilizes, turbine exhaust quality will be_____ and turbine exhaust temperature will be _____.

A.  higher; higher

B.  higher; lower

C.  lower; higher

D.  lower; lower

ANSWER:  A.

TOPIC:          191006
KNOWLEDGE:  K1.14   [2.4/2.6]
QID:             P3734  (B3777)

A nuclear power plant is operating near rated power with the following initial conditions:

    Main steam pressure:         900 psia
    Main steam quality:          100%, saturated vapor
    Main condenser pressure:   1.0 psia

Air leakage into the main condenser results in the main condenser pressure increasing and stabilizing at 2.0 psia.  Assume that all main steam parameters (e.g., pressure, quality, and mass flow rate) remain the same and that the main turbine efficiency remains at 100%.

Which one of the following is the approximate percent by which the main generator output will decrease as a result of the main condenser pressure increase?

A.  5.0%

B.  6.3%

C.  7.5%

D.  8.8%

ANSWER:  C.

TOPIC:　　　　191006
KNOWLEDGE:　K1.14　[2.4/2.6]
QID:　　　　　P4016　(B4018)

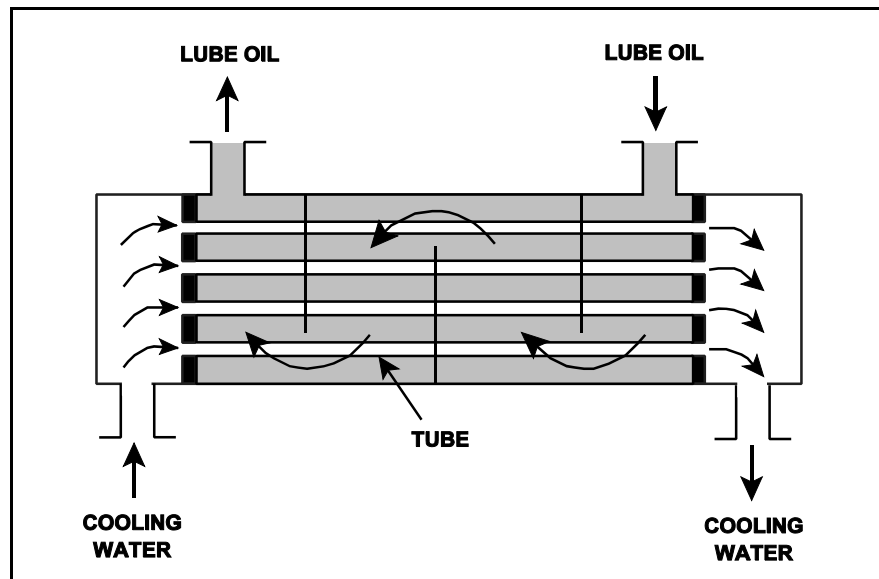Refer to the drawing of an operating lube oil heat exchanger (see figure below).

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 resulting temperature of the oil exiting the heat exchanger ($T_{oil-out}$)?

A.  126°F

B.  130°F

C.  134°F

D.  138°F

ANSWER:  A.

LUBE OIL　　　　　LUBE OIL

TUBE

COOLING
WATER
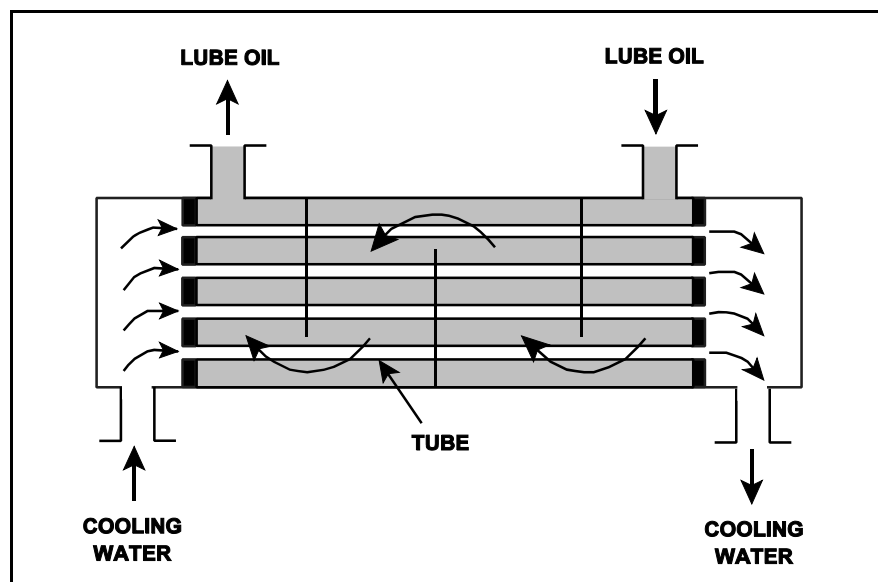
COOLING
WATER

TOPIC:          191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:             P4517   (B2832)

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

Given the following initial parameters:

   Cooling water inlet temperature ($T_{cw\text{-}in}$)    $= 75°F$
   Cooling water outlet temperature ($T_{cw\text{-}out}$) $= 105°F$
   Oil inlet temperature ($T_{oil\text{-}in}$)          $= 140°F$
   Oil outlet temperature ($T_{oil\text{-}out}$)         $= 100°F$

Air introduction to the heat exchanger results in some of the heat exchanger tubes becoming uncovered.  As a result, $T_{cw\text{-}out}$ decreases to 99°F.   Assume that the mass flow rate and specific heat of both fluids remain the same, and that Toil-in does not change.  Which one of the following will be the approximate temperature of the oil exiting the heat exchanger ($T_{oil\text{-}out}$)?

A.  99°F

B.  108°F

C.  116°F

D.  122°F

ANSWER:  B.
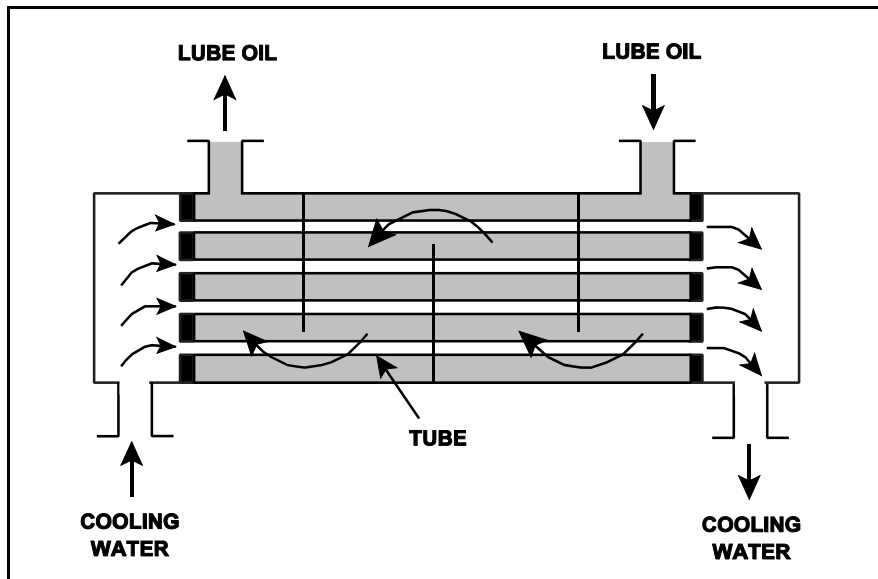
TOPIC:          191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P4816   (B4817)

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 ($T_{oil-out}$)            = 110°F

Air leakage into the heat exchanger causes some of the heat exchanger tubes to become uncovered. As a result, $T_{cw-out}$ decreases to 89°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.  116°F

B.  122°F

C.  130°F

D.  138°F

ANSWER:  B.
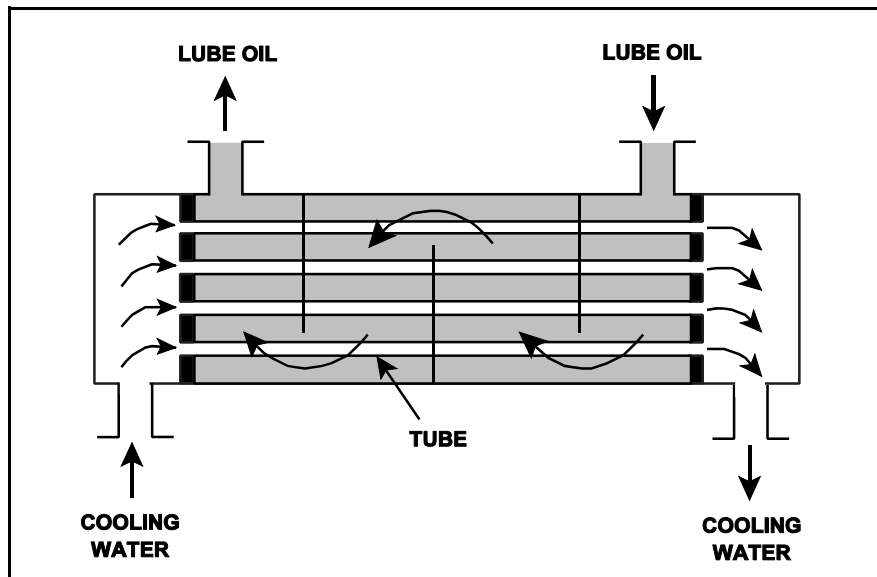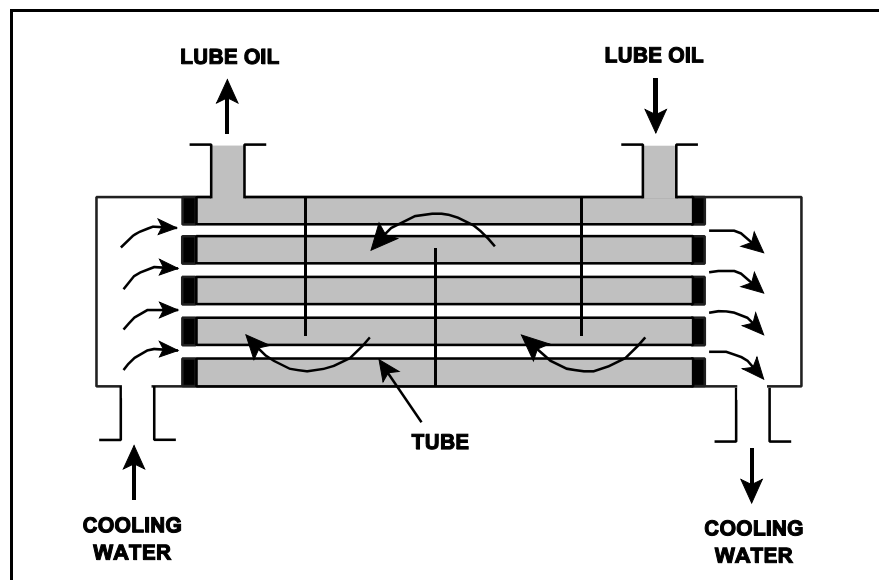
TOPIC:          191006
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P5417   (B5418)

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

The heat exchanger was operating with the following initial parameters:

Cooling water inlet temperature ($T_{cw\text{-}in}$)     $= 71°F$
Cooling water outlet temperature ($T_{cw\text{-}out}$) $= 91°F$
Oil inlet temperature ($T_{oil\text{-}in}$)             $= 175°F$
Oil outlet temperature ($T_{oil\text{-}out}$)           $= 125°F$

The heat exchanger was vented, resulting in the following current parameters:

Cooling water inlet temperature ($T_{cw\text{-}in}$)     $= 71°F$
Cooling water outlet temperature ($T_{cw\text{-}out}$) $= 95°F$
Oil inlet temperature ($T_{oil\text{-}in}$)             $= 175°F$
Oil outlet temperature ($T_{oil\text{-}out}$)           $=$  ?

Assume that the mass flow rates and specific heats of both fluids were unchanged.

Which one of the following is the current lube oil outlet temperature ($T_{oil\text{-}out}$)?

A.  115°F

B.  120°F

C.  130°F

D.  135°F

ANSWER:  A.
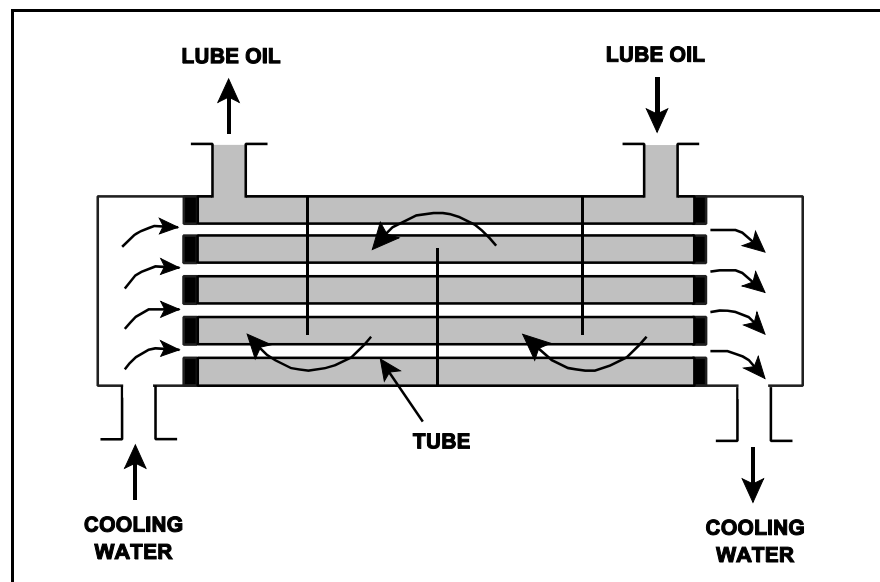
TOPIC:        191007
KNOWLEDGE:   K1.01   [2.3/2.5]
QID:          P935    (B737)

A demineralizer is being used in a water purification system.  How will accumulation of suspended solids in the demineralizer affect performance of the demineralizer?

A.  The rate of resin depletion will increase.

B.  The flow rate of water through the demineralizer will increase.

C.  The differential pressure across the demineralizer will decrease.

D.  The rate of unwanted ion removal from the system will decrease.

ANSWER:  D.

TOPIC:        191007
KNOWLEDGE:   K1.01   [2.3/2.5]
QID:          P1035

A sudden increase in conductivity of water at the outlet of a demineralizer will result from...

A.  increased demineralizer flow rate

B.  reduced demineralizer inlet temperature

C.  reduced demineralizer inlet conductivity

D.  increased demineralizer effluent pressure

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:  K1.01   [2.3/2.5]
QID:              P1535   (B1138)

A condensate demineralizer differential pressure (D/P) gauge indicates 4.0 psid at 50% flow rate. Over the next two days plant power changes have caused condensate flow rate to vary between 25% and 100%.

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

|     | Condensate Flow Rate | Demineralizer D/P (psid) |
| --- | --- | --- |
| A.  | 100% | 15.0 |
| B.  | 75%  | 9.0  |
| C.  | 60%  | 5.0  |
| D.  | 25%  | 2.0  |

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.01   [2.3/2.5]
QID:             P1736   (B1736)

A condensate demineralizer differential pressure (D/P) gauge indicates 6.0 psid at 50% flow rate. Which one of the following combinations of condensate flow rate and demineralizer D/P observed at various power levels over the next few days indicates an <u>increase</u> in the accumulation of insoluble corrosion products in the demineralizer?

|    | Condensate Flow Rate | Demineralizer D/P (psid) |
|----|----------------------|--------------------------|
| A. | 100%                 | 23.5                     |
| B. | 75%                  | 16.5                     |
| C. | 60%                  | 8.5                      |
| D. | 25%                  | 1.5                      |

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.01   [2.3/2.5]
QID:             P2035   (B2039)

Which one of the following conditions will lead to channeling in a demineralizer?

A.  Suspended solids and insoluble particles forming a mat on the surface of the resin bed.

B.  A sudden 10°F decrease in the temperature of the influent to the demineralizer.

C.  Exhaustion of the resin bed due to high conductivity of the demineralizer influent.

D.  Operation of the demineralizer with influent flow rate at 10% below design flow rate.

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:   K1.01   [2.3/2.5]
QID:             P2135   (B637)

High differential pressure in a demineralizer could be caused by all of the following <u>except</u>...

A.  resin exhaustion.

B.  resin overheating.

C.  crud buildup.

D.  high flow rate.

ANSWER:  A.

TOPIC: 191007
KNOWLEDGE: K1.01 [2.3/2.5]
QID: P2235 (B2638)

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 over the next few days indicates an <u>increase</u> in the accumulation of insoluble corrosion products in the demineralizer?

|  | Condensate Flow Rate | Demineralizer D/P (psid) |
|---|---|---|
| A. | 25% | 0.9 |
| B. | 60% | 6.3 |
| C. | 75% | 8.7 |
| D. | 100% | 15.6 |

ANSWER: B.

TOPIC:           191007
KNOWLEDGE:  K1.01   [2.3/2.5]
QID:             P2335   (B2338)

A condensate demineralizer differential pressure (D/P) gauge indicates 4.0 psid at 50% flow rate. Over the next two days plant power changes have caused condensate flow rate to vary between 25% and 100%.

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

|    | Condensate Flow Rate | Demineralizer D/P (psid) |
|----|----------------------|--------------------------|
| A. | 100%                 | 15.0                     |
| B. | 75%                  | 9.0                      |
| C. | 40%                  | 3.0                      |
| D. | 25%                  | 1.0                      |

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:             P535    (B39)

Which one of the following is an indication of resin exhaustion in a demineralizer:

A.  An increase in suspended solids in the effluent

B.  A decrease in the flow rate through the demineralizer

C.  An increase in the conductivity of the effluent

D.  An increase in the differential pressure across the demineralizer

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:             P835    (B839)

The demineralization factor of a demineralizer can be expressed as...

A.  Inlet Conductivity minus Outlet Conductivity.

B.  Outlet Conductivity minus Inlet Conductivity.

C.  Inlet Conductivity divided by Outlet Conductivity.

D.  Outlet Conductivity divided by Inlet Conductivity.

ANSWER:  C.

TOPIC:              191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:                P936

The ion exchange efficiency of a condensate demineralizer is determined by performing a calculation using the...

A.  change in conductivity at the outlet of the demineralizer over a period of time.

B.  change in pH at the outlet of the demineralizer over a period of time.

C.  demineralizer inlet and outlet conductivity.

D.  demineralizer inlet and outlet pH.

ANSWER:  C.

TOPIC:              191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:                P1735

Which one of the following will be caused by exhausted demineralizer resin?

A.  Decreased demineralizer process water flow rate

B.  Decreased demineralizer influent conductivity

C.  Decreased demineralizer differential pressure

D.  Decreased demineralizer decontamination factor

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:  K1.03   [2.2/2.5]
QID:             P1835

The ion exchange efficiency of a condensate demineralizer can be calculated using the values for demineralizer inlet and outlet...

A.  conductivity.

B.  pH.

C.  N-16 radioactivity.

D.  pressure.

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:  K1.03   [2.2/2.5]
QID:             P2236   (B1437)

To determine the demineralization factor for a demineralizer, the parameters that must be monitored are inlet and outlet:

A.  pH

B.  conductivity

C.  suspended solids

D.  pressure

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:          P2735   (B2737)

What percentage of impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 25?

A.  99%

B.  96%

C.  88%

D.  75%

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:          P3235   (B3238)

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 50?

A.  98%

B.  96%

C.  75%

D.  50%

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:            P3435  (B3437)

The decontamination factor (also called the demineralization factor) of a condensate demineralizer has just been determined to be 50, based on conductivity measurements.

If condensate having a conductivity of 20 µmho/cm is flowing <u>into</u> this demineralizer, which one of the following is the conductivity of the condensate at the <u>outlet</u> of the demineralizer?

A.  0.4 µmho/cm

B.  1.0 µmho/cm

C.  4.0 µmho/cm

D.  10.0 µmho/cm

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:            P3636  (B3637)

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

If condensate having a conductivity of 20 µmho/cm is flowing <u>into</u> this demineralizer, which one of the following is the conductivity of the condensate at the <u>outlet</u> of the demineralizer?

A.  0.5 µmho/cm

B.  2.0 µmho/cm

C.  5.0 µmho/cm

D.  10.0 µmho/cm

ANSWER:  B.

TOPIC:            191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:            P4219   (B4219)

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 µmho/cm is flowing <u>into</u> this demineralizer, which one of the following is the conductivity of the condensate at the <u>outlet</u> of the demineralizer?

A.  0.4 µmho/cm

B.  4.0 µmho/cm

C.  10.0 µmho/cm

D.  100.0 µmho/cm

ANSWER:  B.

TOPIC:            191007
KNOWLEDGE:   K1.03   [2.2/2.5]
QID:            P4718   (B4719)

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%

B.  99%

C.  1%

D.  0%

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.03   [2.2/2.5]
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:            P5418

Two indications of channeling through an operating demineralizer are a _____-than-normal demineralizer differential pressure and a _____ -than-normal demineralization factor

A.  higher; lower

B.  higher; higher

C.  lower; lower

D.  lower; higher

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:            P635    (B2237)

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

A.  Low differential pressure indicates flow blockage in the demineralizer.

B.  Low differential pressure indicates that the demineralizer resin bed is exhausted.

C.  High differential pressure indicates flow blockage in the demineralizer.

D.  High differential pressure indicates that the demineralizer resin bed is exhausted.

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:            P836    (B539)

A lower than expected differential pressure across a demineralizer is an indication of...

A.  depletion of the cation exchange resin.

B.  channeling through the resin bed.

C.  improper resin regeneration.

D.  excessive accumulation of suspended solids.

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:            P1036   (B639)

As the operating time of a demineralizer resin bed increases, the differential pressure across the bed...

A.  increases due to depletion of resin sites.

B.  increases due to trapping of suspended solids.

C.  decreases due to gradual resin breakdown.

D.  decreases due to erosion of the resin sites.

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:            P1136

Which one of the following will cause a large pressure drop across a demineralizer that is in operation?

A.  Channeling of flow through the demineralizer

B.  Depletion and resultant swelling of resin beads

C.  Accumulation of suspended solids filtered by the resin beads

D.  Improper demineralizer venting after resin fill

ANSWER:  C.

TOPIC:           191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:             P1236

An indication that a demineralizer resin bed is clogged is a...

A.  large pressure drop across the bed.

B.  high flow rate through the bed.

C.  temperature rise in the effluent.

D.  large conductivity increase across the bed.

ANSWER:  A.

TOPIC:           191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:             P1537   (B1539)

A higher- than-expected differential pressure across an operating mixed-resin demineralizer can be caused by...

A.  exhaustion of the cation exchange resin.

B.  channeling through the resin bed.

C.  insufficient resin backwash.

D.  decreased demineralizer inlet conductivity.

ANSWER:  C.

TOPIC:              191007
KNOWLEDGE:   K1.06   [2.1/2.5]
QID:                  P1836   (B337)

A demineralizer that is continuously exposed to flowing water with high concentrations of suspended solids will <u>first</u> develop an increase in the...

A.  conductivity at the demineralizer outlet.

B.  decontamination factor of the demineralizer.

C.  differential pressure across the demineralizer.

D.  pH at the demineralizer outlet.

ANSWER:  C.

TOPIC:              191007
KNOWLEDGE:   K1.08   [3.0/3.1]
QID:                  P1636   (B838)

Which one of the following, if processed through a demineralizer, will rapidly reduce the effectiveness of the demineralizer?

A.  Condensate

B.  Oily water

C.  Radioactive water

D.  Makeup water

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.08   [3.0/3.1]
QID:            P2037

A nuclear power plant has been operating normally at 100% 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 cause a reduction in reactor coolant boron concentration in the demineralizer effluent?

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

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

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

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

ANSWER:  B.

TOPIC:          191007
KNOWLEDGE:   K1.08   [3.0/3.1]
QID:            P2837

A PWR nuclear power plant has two identical mixed resin reactor coolant ion exchangers, A and B, which operated in parallel service continuously for two weeks of power operation immediately after a refueling outage.  Then, ion exchanger A was removed from service while ion exchanger B remained in service.  After 10 months of continuous operation at full power, it is necessary to place ion exchanger A in service and remove ion exchanger B from service.

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

A.  To avoid an undesired increase in reactor coolant pH.

B.  To avoid an undesired decrease in reactor coolant pH.

C.  To avoid an undesired increase in reactor coolant boron concentration.

D.  To avoid an undesired decrease in reactor coolant boron concentration.

ANSWER:  C.

TOPIC:            191007
KNOWLEDGE:   K1.08   [3.0/3.1]
QID:              P2937

A nuclear power plant has been operating normally at 100% 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 an in-service reactor coolant letdown demineralizer will cause an increase in reactor coolant boron concentration in the demineralizer effluent?

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

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

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

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

ANSWER:  A.

TOPIC:            191007
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:              P34

What is the reason for bypassing a demineralizer due to high temperature?

A. Resins expand and restrict flow through the demineralizer.

B. Resins decompose and restrict flow through the demineralizer.

C. Resins decompose and create preferential flowpaths through the demineralizer.

D. Resins decompose and contaminate the system.

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:            P235    (B1838)

When a mixed-bed demineralizer resin is exhausted, the resin should be replaced or regenerated because...

A.  ions previously removed by the resin will be released into solution.

B.  the resin will fracture and possibly escape through the retention screens.

C.  particles previously filtered out of solution will be released.

D.  the resin will physically bond together, thereby causing a flow blockage.

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:            P236

A demineralizer that has been exposed to _____ should be bypassed because the resin beads may release unwanted ions.

A.  high flow

B.  low flow

C.  high temperature

D.  low temperature

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:            P2637   (B239)

A result of proper demineralizer operation on water with ionic impurities is that the exiting water will always have a...

A.  higher pH.

B.  lower pH.

C.  higher conductivity.

D.  lower conductivity.

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.11   [2.5/2.8]
QID:            P336

Prior to a scheduled nuclear power plant shutdown, the reactor coolant system was chemically shocked to induce a crud burst.  What effect will this have on the letdown purification demineralizers?

A.  Decreased radiation levels around the demineralizers

B.  Increased flow rate through the demineralizers

C.  Decreased demineralizer outlet conductivity

D.  Increased pressure drop across the demineralizers

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.11   [2.5/2.8]
QID:              P1436

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 demineralizer outlet conductivity

B.  Decreased pressure drop across the demineralizers

C.  Increased flow rate through the demineralizers

D.  Increased radiation levels around the demineralizers

ANSWER:  D.

TOPIC:          191007
KNOWLEDGE:   K1.11   [2.5/2.8]
QID:              P2736

A nuclear power plant was operating at steady-state 100% power when the reactor coolant system experienced a large crud burst.  After ten minutes, the operators began to record parameters for the in-service reactor coolant purification ion exchanger.

Assuming no additional operator actions, what trend will the recorded parameters show during the next few hours?

A.  Increasing flow rate through the ion exchanger

B.  Increasing pressure drop across the ion exchanger

C.  Increasing ion exchanger inlet water conductivity

D.  Increasing ion exchanger outlet water conductivity

ANSWER:  B.

TOPIC:           191007
KNOWLEDGE:   K1.11   [2.5/2.8]
QID:             P3537

After 12 months of operation at 100% power, a nuclear reactor is shutdown with a plant cooldown in progress.  An operator reports that the general area radiation levels around the operating shutdown cooling pumps have increased significantly since the cooldown started several hours ago.

Which one of the following is a typical cause of these indications, resulting from the cooldown?

A.  Increased radioactive tritium in the reactor coolant.

B.  Increased radioactive oxygen-16 dissolved in the reactor coolant.

C.  Increased radioactive nitrogen-16 dissolved in the reactor coolant.

D.  Increased radioactive corrosion products suspended in the reactor coolant.

ANSWER:  D.

TOPIC:           191007
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:             P337

A nuclear power plant is operating at 70% steady-state power level when the temperature of the reactor coolant letdown passing through a boron-saturated mixed bed ion exchanger is decreased by 20°F.

As a result, the boron concentration in the effluent of the ion exchanger will _____ because the affinity of the ion exchanger for boron atoms has _____.

A.  decrease; increased

B.  decrease; decreased

C.  increase; increased

D.  increase; decreased

ANSWER:  A.

TOPIC:          191007
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P1335

A nuclear power plant is operating at a stable 70% power level when the temperature of the reactor coolant letdown passing through a boron-saturated mixed bed ion exchanger increases by 20°F.

As a result, the boron concentration in the effluent of the ion exchanger will _____ because the affinity of the ion exchanger for boron atoms has _____.

A.  decrease; decreased

B.  decrease; increased

C.  increase; decreased

D.  increase; increased

ANSWER:  C.

TOPIC:          191007
KNOWLEDGE:   K1.14   [2.4/2.6]
QID:            P3337

Which one of the following underline indicates that a demineralizer receiving 75 gpm of reactor coolant is boron-saturated?

A.  The decontamination factor of the demineralizer is less than 1.0.

B.  The decontamination factor of the demineralizer is greater than 1.0.

C.  Following a reactor coolant temperature increase, demineralizer effluent boron concentration exceeds influent boron concentration.

D.  Following a reactor coolant temperature increase, demineralizer influent boron concentration exceeds effluent boron concentration.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.01   [2.6/2.8]
QID:            P37

To completely deenergize an electrical component and its associated control and indication circuits, the component breaker should be...

A.  open with the control switch in Pull-To-Lock.

B.  open with the control switch tagged in the open position.

C.  racked out and tagged in racked-out position.

D.  racked out with control power fuses removed.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:            P838    (B1841)

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.

ANSWER:  B.

TOPIC:            191008
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:              P4120   (B4121)

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

    All phase overcurrent trip flags are reset.
    The control power fuses indicate blown.
    The line-side voltmeter indicates 4,160 VAC.
    The load-side voltmeter indicates 0 volts.

Assuming <u>no</u> 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 tripped the breaker manually at the breaker cabinet.

D.  An operator tripped the breaker manually from a remote location.

ANSWER:  C.

TOPIC:            191008
KNOWLEDGE:   K1.02   [2.8/2.9]
QID:              P5020   (B1141)

Which one of the following describes the local overcurrent trip flag indicators for a breaker?

A.  They actuate prior to breaker tripping to warn of imminent protective action.

B.  When actuated, they indicate that the breaker overcurrent trip relay has been reset.

C.  They indicate breaker overcurrent trip actuation during and after breaker trip actuation.

D.  When actuated, they indicate that the associated breaker has failed to trip open.

ANSWER:  C.

TOPIC:             191008
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:                P40      (B1943)

Loss of breaker control power will cause...

A.  inability to operate the breaker locally and remotely.

B.  breaker line voltage to indicate zero regardless of actual breaker position.

C.  the remote breaker position to indicate open regardless of actual breaker position.

D.  failure of the closing spring to charge following local closing of the breaker.

ANSWER:  D.

TOPIC:             191008
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:                P118

Which one of the following results from a loss of control power to a breaker supplying a motor?

A.  Motor ammeter indication will be zero regardless of actual breaker position.

B.  Breaker position will remotely indicate closed regardless of actual position.

C.  Breaker will trip open due to the actuation of its protective trip device.

D.  Charging motor will <u>not</u> recharge the closing spring after the breaker closes.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:            P240

Which one of the following would cause a loss of ability to remotely trip a circuit breaker <u>and</u> a loss of remote breaker position indication?

A.  Failure of the breaker control switch

B.  Racking the breaker to the "test" position

C.  Mechanical binding of the breaker tripping bar

D.  Loss of control power for the breaker

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:            P338    (B40)

Which one of the following will cause a loss of indication from the remote breaker position indicating lights associated with a typical 480 VAC load supply breaker?

A.  Loss of breaker line voltage

B.  Locally opening the breaker

C.  Burnout of the local breaker position indicating lights

D.  Removing the breaker control power fuses

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:            P639

How is typical breaker operation affected when the associated breaker control power transfer switch is placed in the "Local" position?

A.  Control power will be available to provide protective trips, and the breaker can be electrically operated only from the control room.

B.  Control power will be removed from both the open and close circuits, and the breaker can be electrically operated only from the control room.

C.  Control power will be available to provide protective trips, and the breaker can be electrically operated only from the breaker cabinet.

D.  Control power will be removed from both the open and close circuits, and the breaker can be electrically operated only from the breaker cabinet.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:            P840    (B840)

A typical 120 VAC manual circuit breaker has tripped due to overload.  To <u>close</u> this circuit breaker the breaker handle must be moved from the...

A.  OFF position directly to the ON position; trip latch reset is not required.

B.  OFF position to the midposition to reset the trip latch, and then to the ON position.

C.  midposition directly to the ON position; trip latch reset is not required.

D.  midposition to the OFF position to reset the trip latch, and then to the ON position.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:            P2041   (B3344)

Two identical 1,000 MW electrical generators are operating in parallel, supplying the same isolated electrical bus.  The generator output breakers also provide identical protection for the generators.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 22.5 KV | 22.5 KV |
| 60.2 Hertz | 60.2 Hertz |
| 750 MW | 750 MW |
| 25 MVAR (out) | 50 MVAR (out) |

A malfunction causes the voltage regulator for generator B to slowly and continuously increase the terminal voltage for generator B.  If no operator action is taken, which one of the following describes the electrical current indications for generator A?

A.  Current will decrease continuously until the output breaker for generator A trips on reverse power.

B.  Current will decrease continuously until the output breaker for generator B trips on reverse power.

C.  Current will initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

D.  Current will initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:              P2439   (B2444)

Two identical 1,000 MW ac electrical generators are operating in parallel, supplying all the loads on a common electrical bus.  The generator output breakers provide identical protection for the generators.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 28 KV | 28 KV |
| 60 Hertz | 60 Hertz |
| 150 MW | 100 MW |
| 25 MVAR (out) | 50 MVAR (out) |

A malfunction causes the voltage regulator set point for generator B to slowly and continuously decrease.  If no operator action is taken, the electrical current indication for generator B will...

A.  initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

B.  initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

C.  decrease continuously until the output breaker for generator A trips on overcurrent.

D.  decrease continuously until the output breaker for generator B trips on reverse power.

ANSWER:  A.

TOPIC:             191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:                P2540   (B2543)

Two identical 1,000 MW electrical generators are operating in parallel supplying the same isolated electrical bus.  The generator output breakers also provide identical protection for the generators. Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 22 KV | 22 KV |
| 60.2 Hertz | 60.2 Hertz |
| 200 MW | 200 MW |
| 25 MVAR (out) | 50 MVAR (out) |

A malfunction causes the voltage regulator setpoint for generator A to slowly increase continuously toward a maximum of 25 KV.  If no operator action is taken, generator B output current will...

A.  initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

B.  initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

C.  increase continuously until the output breaker for generator A trips on overcurrent.

D.  increase continuously until the output breaker for generator B trips on overcurrent.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:            P2639

Two identical 1,000 MW electrical generators are operating in parallel supplying the same isolated electrical bus.  The generator output breakers also provide identical protection for the generators.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 22 KV | 22 KV |
| 60.2 Hertz | 60.2 Hertz |
| 200 MW | 200 MW |
| 25 MVAR (out) | 50 MVAR (out) |

A malfunction causes the voltage regulator setpoint for generator A to slowly and continuously decrease.  If no operator action is taken, generator B output current will increase until...

A.  the output breaker for generator A trips on overcurrent.

B.  the output breaker for generator B trips on overcurrent.

C.  the output breaker for generator A trips on reverse power.

D.  the output breaker for generator B trips on reverse power.

ANSWER:  B.

TOPIC:            191008
KNOWLEDGE:   K1.04   [2.9/3.0]
QID:              P4620   (B4615)

Two identical 1,000 MW electrical generators are operating in parallel supplying the same isolated electrical bus.  The generator output breakers provide identical protection for the generators.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 22 KV | 22 KV |
| 60.2 Hertz | 60.2 Hertz |
| 200 MW | 200 MW |
| 25 MVAR (out) | 50 MVAR (out) |

A malfunction causes the voltage regulator setpoint for generator B to slowly increase continuously toward a maximum of 25 KV.  If no operator action is taken, generator A output current will...

A.  increase continuously until the output breaker for generator A trips on overcurrent.

B.  decrease continuously until the output breaker for generator B trips on overcurrent.

C.  initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

D.  initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:              P540     (B541)

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

What is the purpose of depressing the S1 pushbutton?

A.  To deenergize the K3 relay after the initiating condition has cleared.

B.  To prevent energizing the K3 relay when the initiating condition occurs.

C.  To manually energize the K3 relay in the absence of the initiating condition.

D.  To maintain the K3 relay energized after the initiating condition has cleared.

ANSWER:  A.



**TYPICAL VALVE CONTROL CIRCUIT**
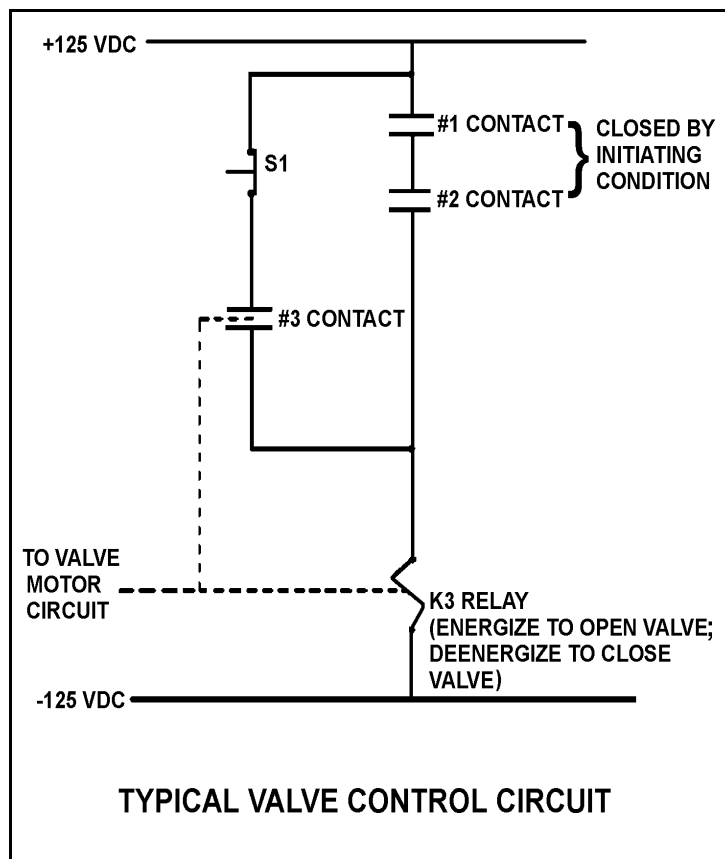
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P640    (B116)

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

One purpose of the K3 relay is to...

A.  hold the valve open after one or both of the initiating conditions have cleared, even if the reset pushbutton (S1) is depressed.

B.  hold the valve open even if one or both of the initiating conditions have cleared.

C.  close the valve as soon as either initiating condition has cleared.

D.  close the valve as soon as both initiating conditions have cleared.

ANSWER:  B.



**TYPICAL VALVE CONTROL CIRCUIT**
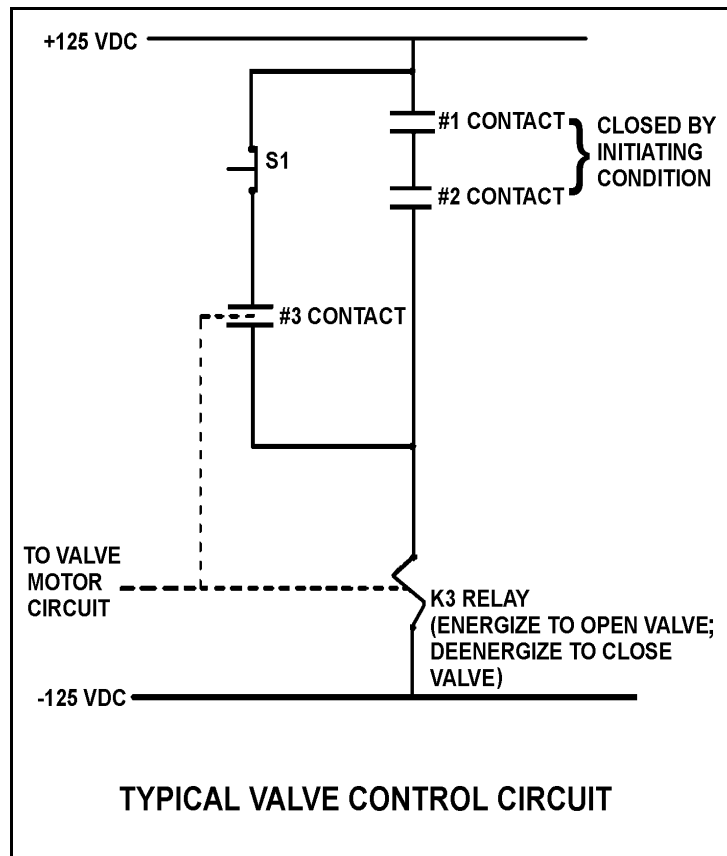
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P742    (B742)

Refer to the drawing of a typical valve control circuit for a 480 VAC motor-operated valve (see figure below).

The valve is currently open with the contact configuration as shown.  If the S1 pushbutton is depressed, the valve will _____ and when the S1 pushbutton is subsequently released, the valve will _____.

A.  remain open; remain open

B.  close; remain closed

C.  remain open; close

D.  close; open

ANSWER:  B.



**TYPICAL VALVE CONTROL CIRCUIT**

*Breakers, Relays, and Disconnects*
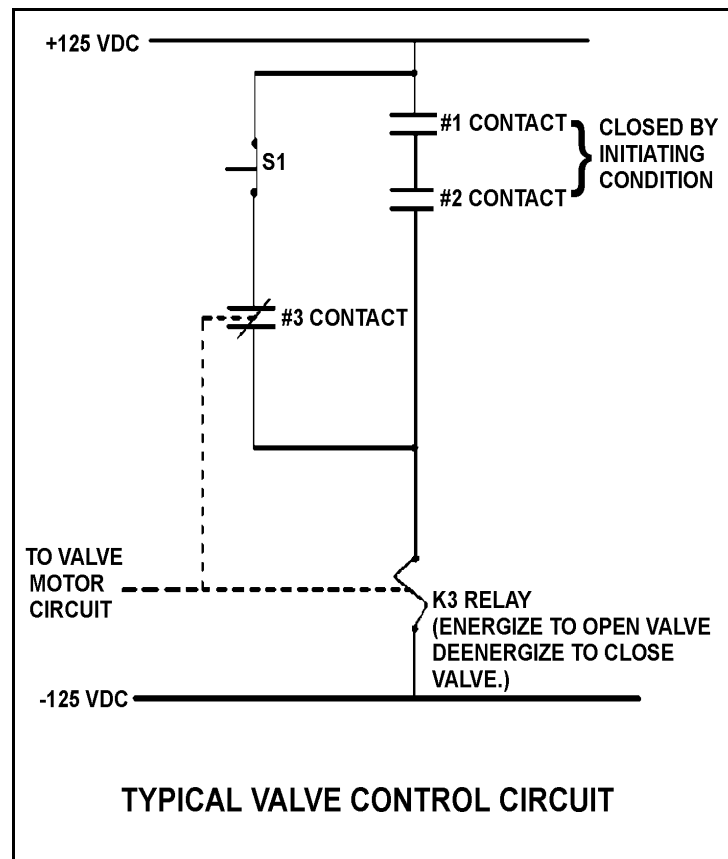
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P941    (B942)

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

Which one of the following describes the function of the #3 contact?

A.  To keep the K-3 relay energized after the initiating condition clears

B.  To provide a method for manually energizing the K-3 relay

C.  To increase circuit reliability because any one of three contacts can energize the K-3 relay

D.  To ensure the K-3 relay can always be deenergized even with the initiating condition present

ANSWER:  A.



TYPICAL VALVE CONTROL CIRCUIT

TOPIC:            191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:                P1040   (B1042)

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

The initiating condition occurs and closes the #1 and #2 contacts to energize the K-3 relay and open the valve.  Which one of the following will close the valve?

A.  Loss of 125 VDC

B.  Both #1 and #2 contacts open

C.  Either #1 or #2 contact opens

D.  Depressing the S1 pushbutton with the initiating condition present

ANSWER:  A.



TYPICAL VALVE CONTROL CIRCUIT
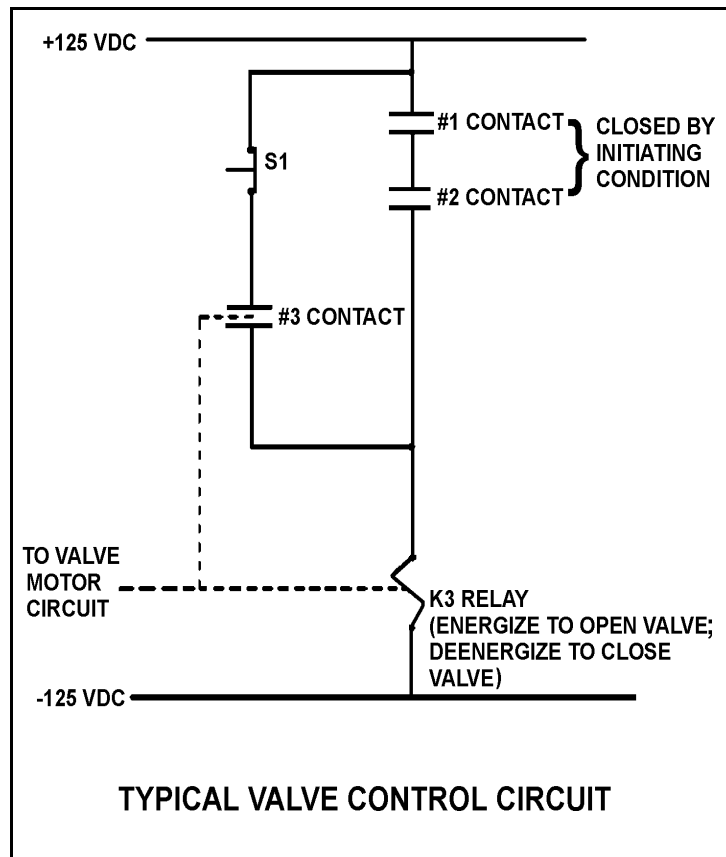
TOPIC:              191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:                 P1239   (B5022)

Refer to the drawing of a valve 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.

If the valve is presently closed, when will the alarm actuate?

A.  As soon as PB2 is pushed.

B.  Ten seconds after PB2 is pushed if the valve is still closed.

C.  Immediately upon pushing PB2 and for the next 10 seconds if the valve remains closed.

D.  Ten seconds after PB2 is pushed if the valve is still stroking open.

ANSWER:  B.



VALVE CONTROL CIRCUIT
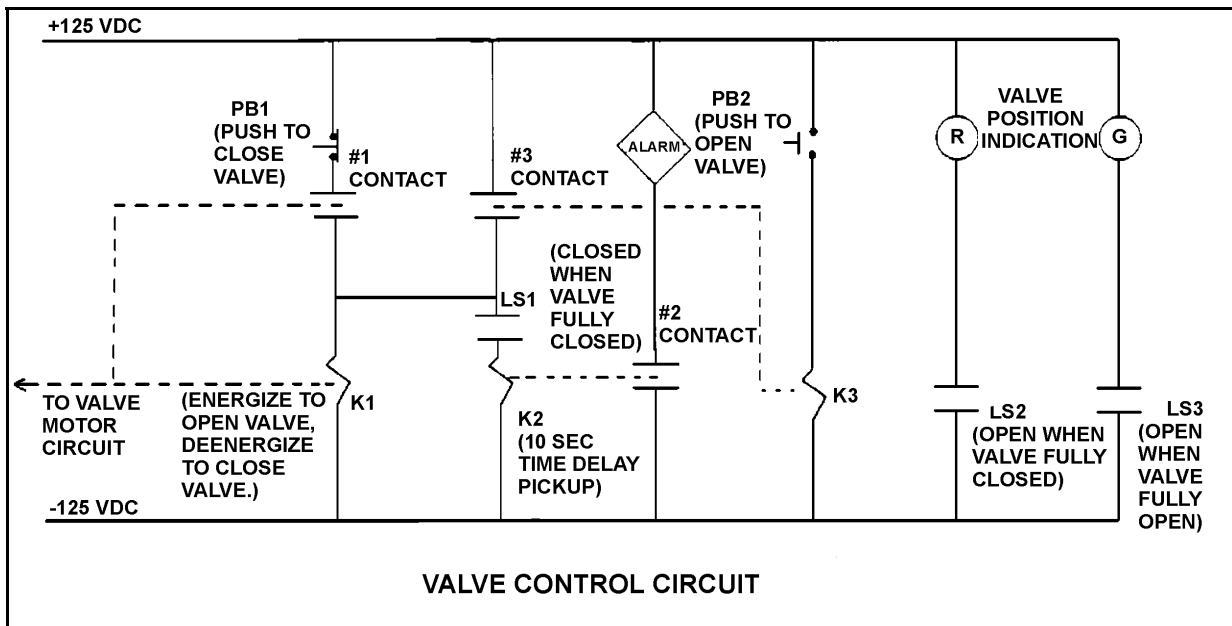
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:              P1340   (B1341)

Refer to the drawing of a valve control circuit for a valve that is initially fully closed (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.

Which one of the following describes when the motor-operated valve will begin to stroke open?

A.  At the same time the alarm actuates

B.  10 seconds after PB2 is depressed

C.  Immediately after PB2 is depressed

D.  Immediately after PB1 is depressed if contact #1 is closed

ANSWER:  C.



VALVE CONTROL CIRCUIT
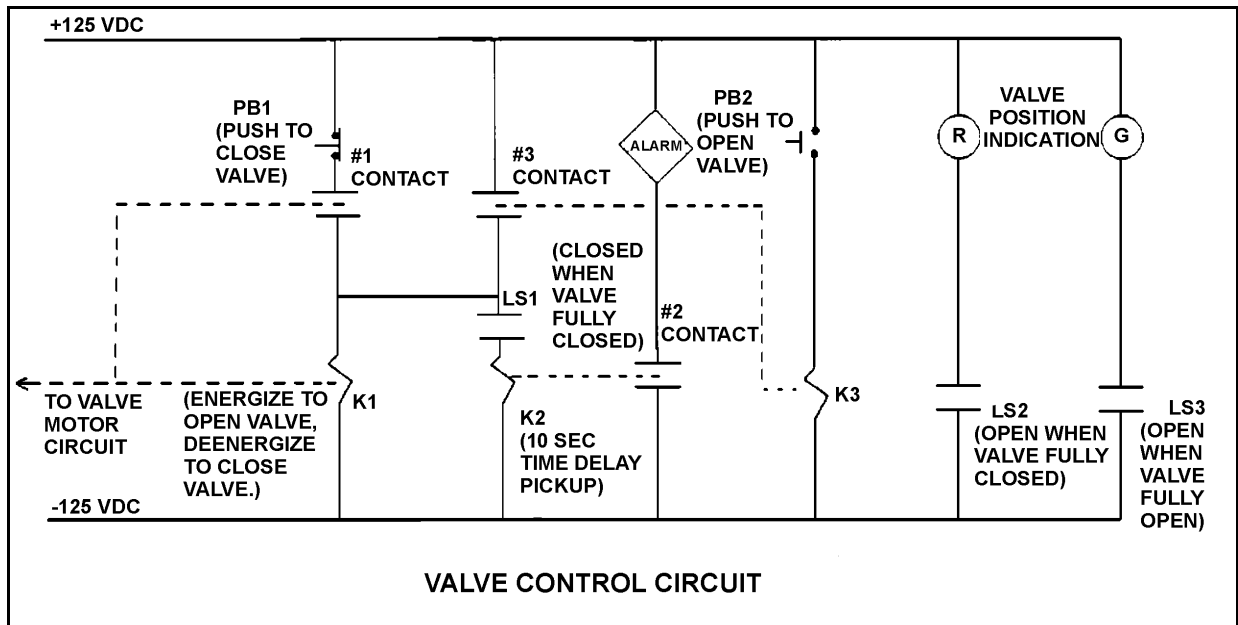
TOPIC: 191008
KNOWLEDGE: K1.06 [2.3/2.6]
QID: P1440 (B1441)

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

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

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

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

A. The valve is closed and the valve motor circuit has just been energized to open the valve.

B. The valve is closed and an open demand signal has existed for at least 10 seconds.

C. The valve is partially open and the valve motor circuit is deenergized as PB2 was prematurely released.

D. The valve is partially open and an open demand signal has existed for at least 10 seconds.

ANSWER: B.



VALVE CONTROL CIRCUIT

*Breakers, Relays, and Disconnects*

TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P1540   (B1542)

Refer to the drawing of a valve 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.

Which one of the following describes the purpose of the alarm?

A.  Alert the operator when the valve motor circuit has been energized for 10 seconds after pushbutton PB2 is depressed

B.  Alert the operator when the valve has not moved off its closed seat within 10 seconds of depressing pushbutton PB2

C.  Alert the operator that the valve is opening by sounding the alarm for 10 seconds after PB2 is depressed

D.  Alert the operator if the valve has not reached full open within 10 seconds of depressing pushbutton PB2

ANSWER:  B.



VALVE CONTROL CIRCUIT

TOPIC:              191008
KNOWLEDGE:    K1.06    [2.3/2.6]
QID:                  P1640    (B1644)

Refer to the drawing of a valve 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.

The valve is half open and moving to the open position.  Which one of the following describes the current condition of the valve position indicating lights?

A.  Red light on, green light off

B.  Red light off, green light on

C.  Red light off, green light off

D.  Red light on, green light on

ANSWER:  D.



VALVE CONTROL CIRCUIT
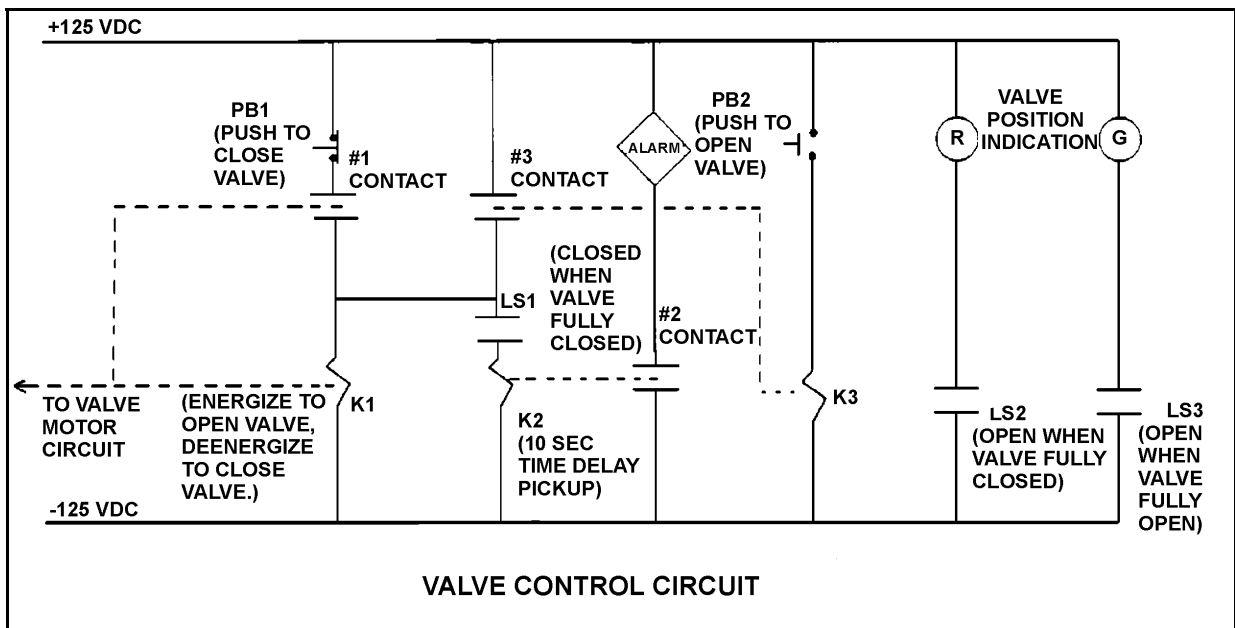
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P1739   (B1742)

Refer to the drawing of a valve 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 open; #3 open

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

ANSWER:  A.



VALVE CONTROL CIRCUIT

*Breakers, Relays, and Disconnects*
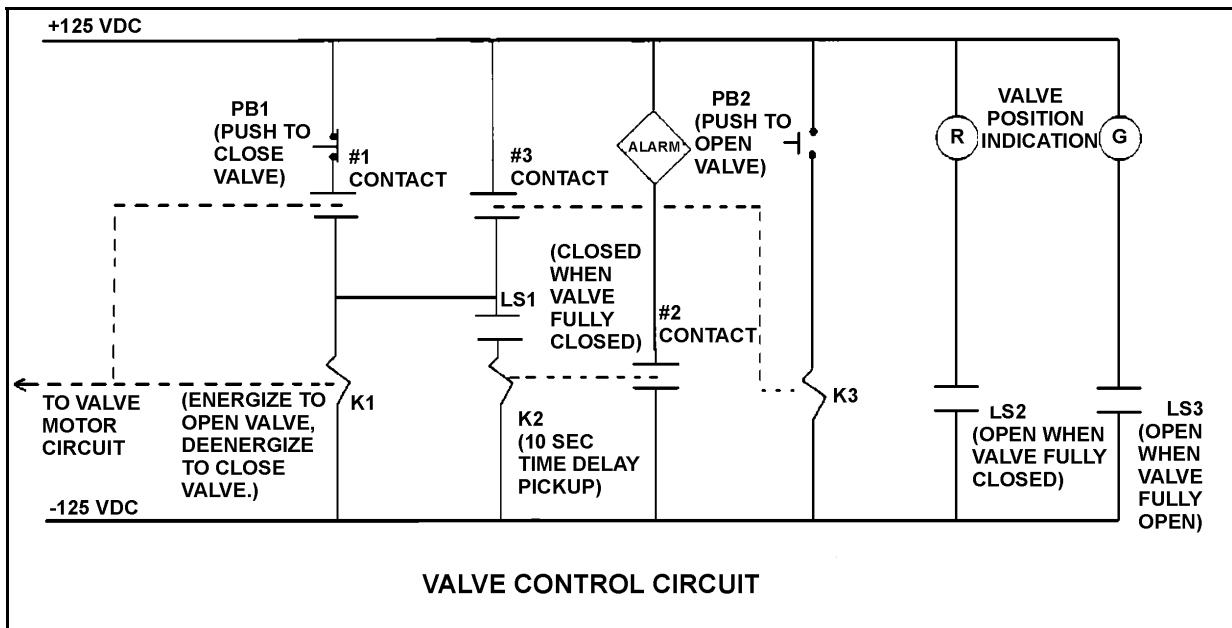
TOPIC:          191008
KNOWLEDGE:  K1.06  [2.3/2.6]
QID:            P2239  (B2341)

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.

**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 two seconds and then released?

A.  The valve will not 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.

ANSWER:  C.



VALVE MOTOR CONTROL CIRCUIT
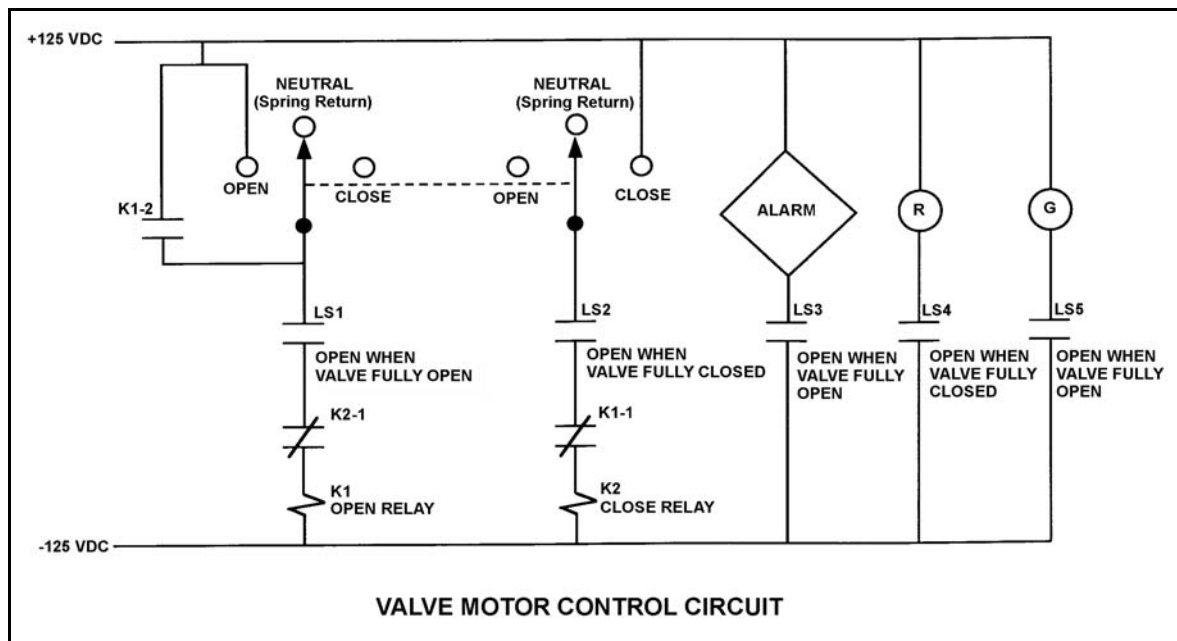
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P2341   (B2442)

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

**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 "Open" position for two seconds and then released?

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

B.  The valve will open fully.

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

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

ANSWER:  B.



**VALVE MOTOR CONTROL CIRCUIT**
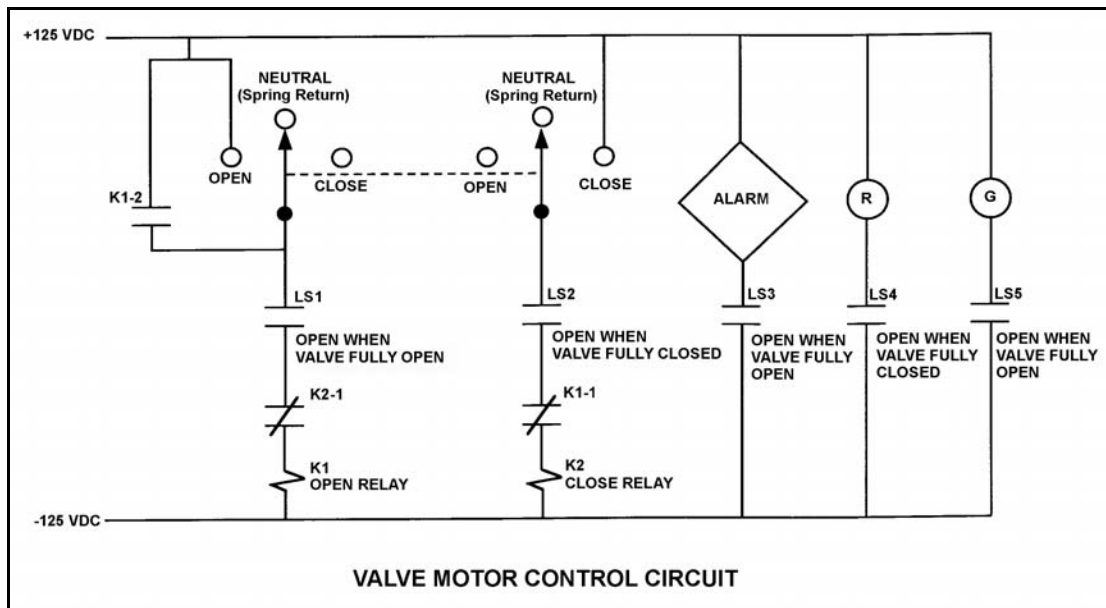
TOPIC:              191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:                P2539   (B2542)

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 not 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.

ANSWER:  A.



VALVE MOTOR CONTROL CIRCUIT
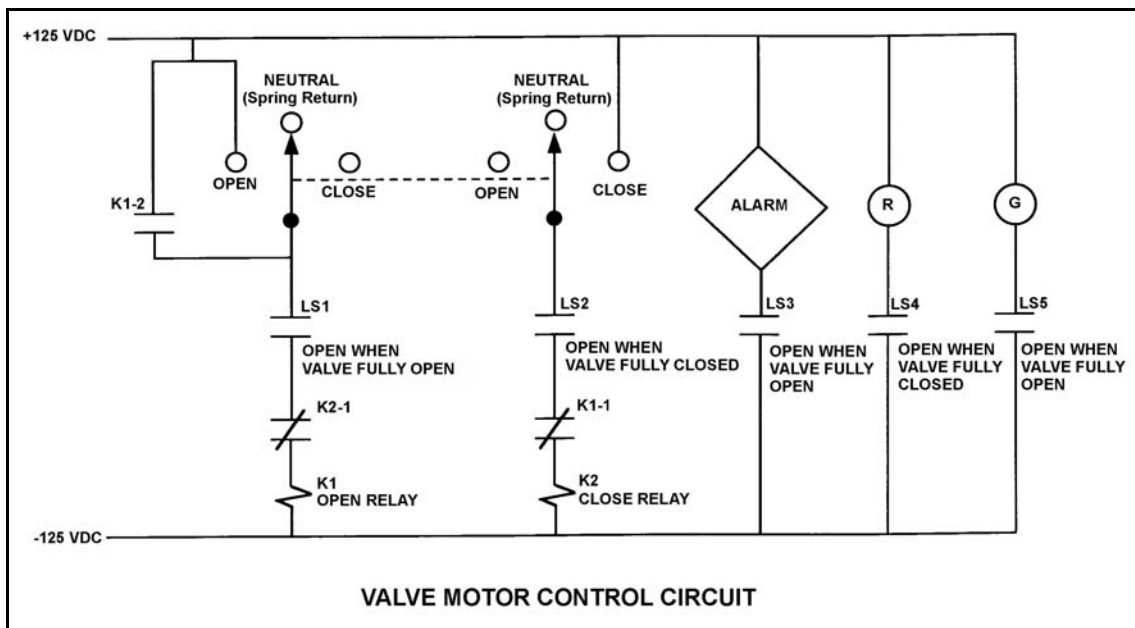
TOPIC: 191008
KNOWLEDGE: K1.06 [2.3/2.6]
QID: P2640 (B2841)

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

**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.

The operator takes the control switch to "Open" momentarily and the valve begins to open. Five seconds later, the operator takes the switch to "Close" momentarily and then releases the switch. Which one of the following describes the valve response after the switch is released?

A. The valve will stop opening and remain partially open.

B. The valve will stop opening and then go fully closed.

C. The valve will open fully and remain fully open.

D. The valve will open fully and then go fully closed.

ANSWER: C.



VALVE MOTOR CONTROL CIRCUIT
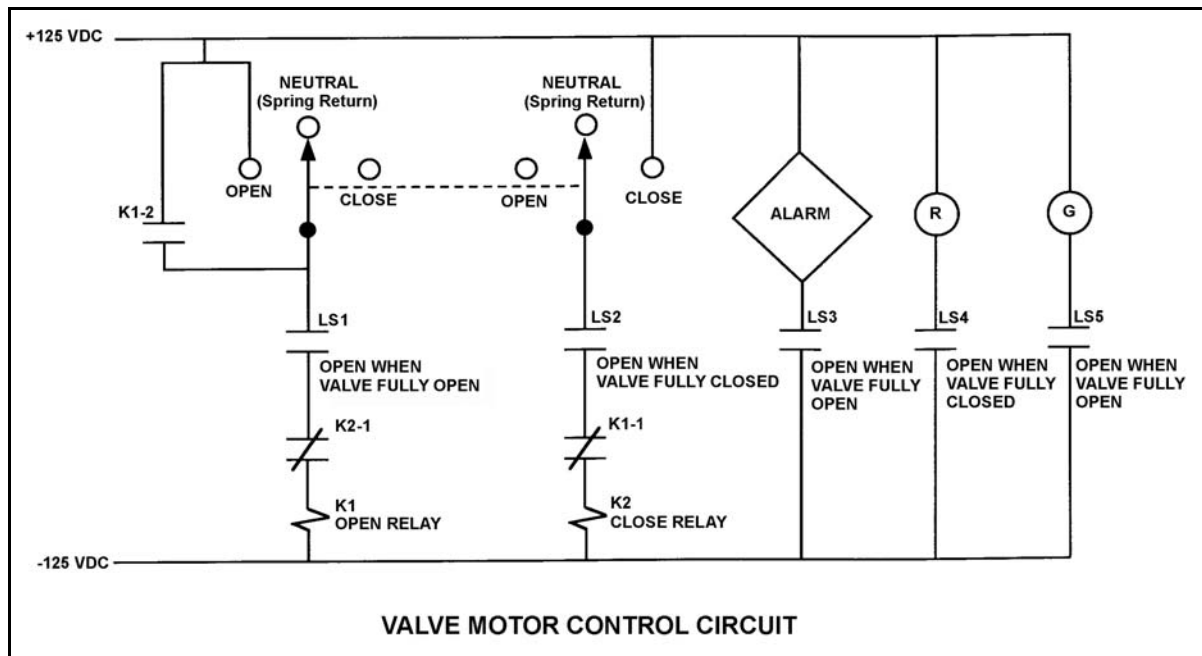
TOPIC:             191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:                  P2739   (B2741)

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

**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.

An operator takes the control switch to "Open" momentarily and the valve begins to open.  Five seconds later, the operator places and holds the switch in the "Close" position.  Which one of the following describes the valve response with the switch held in the "Close" position?

A.  The valve will stop opening and remain partially open.

B.  The valve will stop opening and then go fully closed.

C.  The valve will open fully and remain fully open.

D.  The valve will open fully and then go fully closed.

ANSWER:  D.



VALVE MOTOR CONTROL CIRCUIT
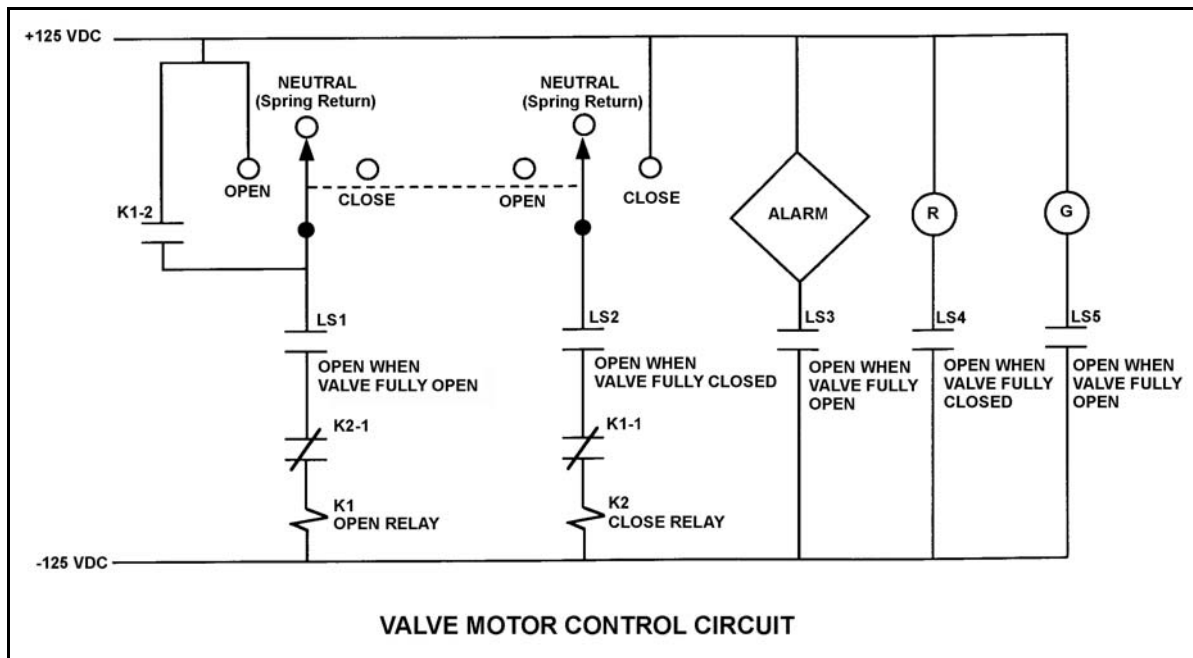
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P2839

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

**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.

The operator takes the control switch to "Open".  Two seconds later, after verifying the valve is opening, the operator releases the control switch.  Which one of the following describes the valve motor control circuit alarm response after the switch is released?

A.  The alarm will continue to actuate for approximately 8 seconds.

B.  The alarm will continue to actuate until additional operator action is taken.

C.  The alarm will actuate after approximately 8 seconds.

D.  The alarm will <u>not</u> actuate until additional operator action is taken.

ANSWER:  A.



VALVE MOTOR CONTROL CIRCUIT
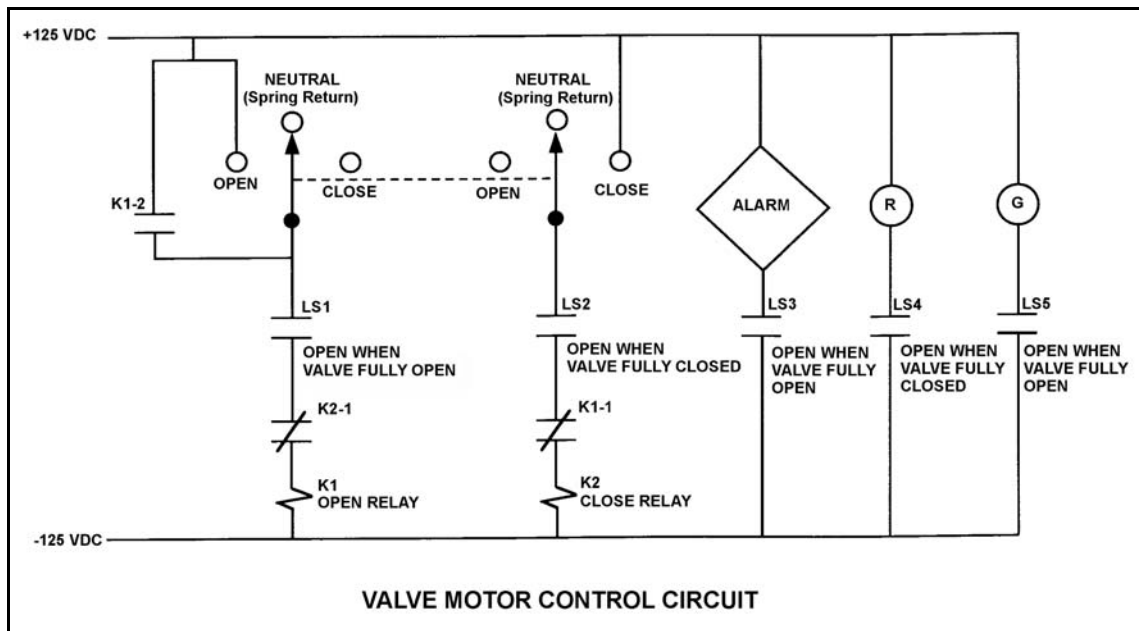
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:              P2942   (B2940)

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

**Note:** Relay contacts are shown open/closed according to the standard convention for control circuit drawings.

What is the purpose of the Time Delay Coil (TD) in the motor controller circuit?

A.  Ensures the motor cannot be started until the overload relays are reset.

B.  Ensures the motor cannot be started until the accelerating coil is energized.

C.  Allows the motor to come up to speed before bypassing the starting resistors.

D.  Allows the motor to come up to speed before placing the starting resistors in the circuit.

ANSWER:  C.
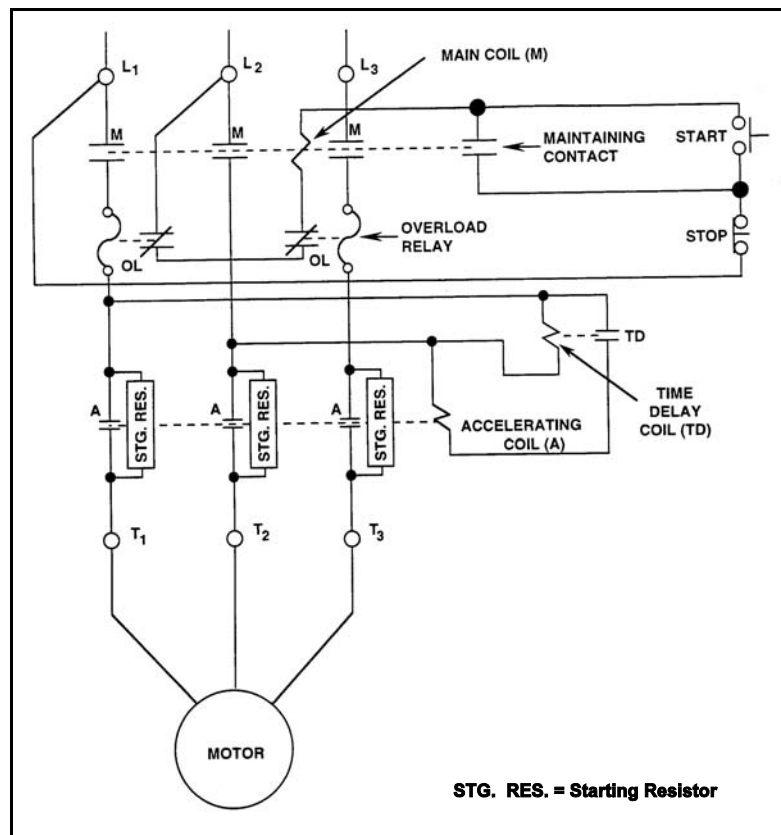
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:               P3640   (B3641)

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

**Note:**  Relay contacts are shown open/closed according to the standard convention for control circuit drawings.

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

A.  two; one

B.  two; two

C.  three; one

D.  three; two

ANSWER:  A.
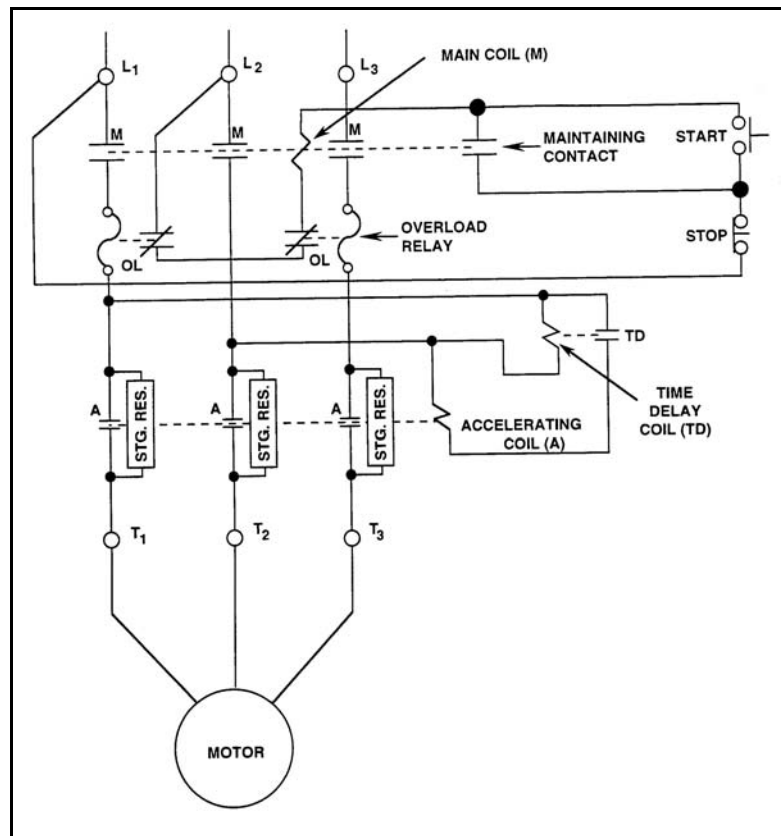
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:            P3921   (B3921)

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

**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.

The operator takes the control switch to "Open" for 5 seconds and then releases the switch. After one minute the operator takes the control switch to "Close" for 5 seconds and then releases the switch. Which one of the following describes the valve position immediately after the control switch is released the second time?

A.  Approximately fully open.

B.  Approximately fully closed.

C.  Approximately 50% open.

D.  Cannot be determined without additional information.

ANSWER:  B.



VALVE MOTOR CONTROL CIRCUIT
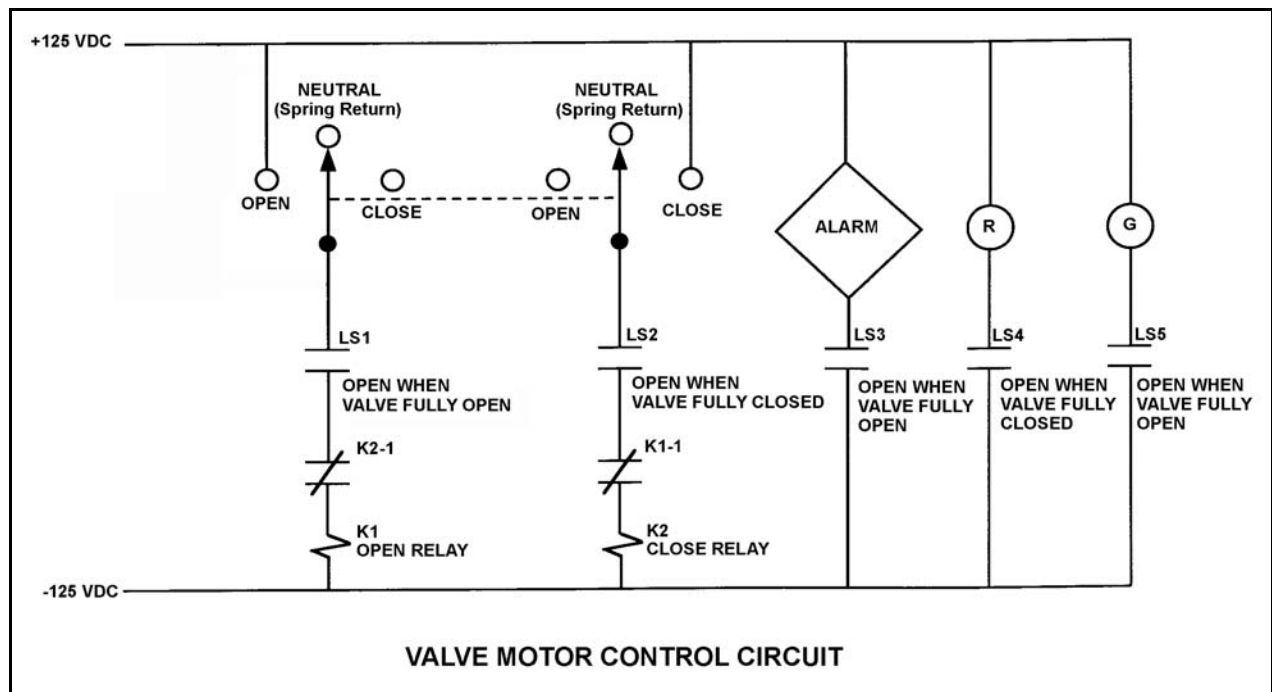
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:              P4221   (B4221)

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

**Note:** Relay contacts are shown open/closed according to 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.
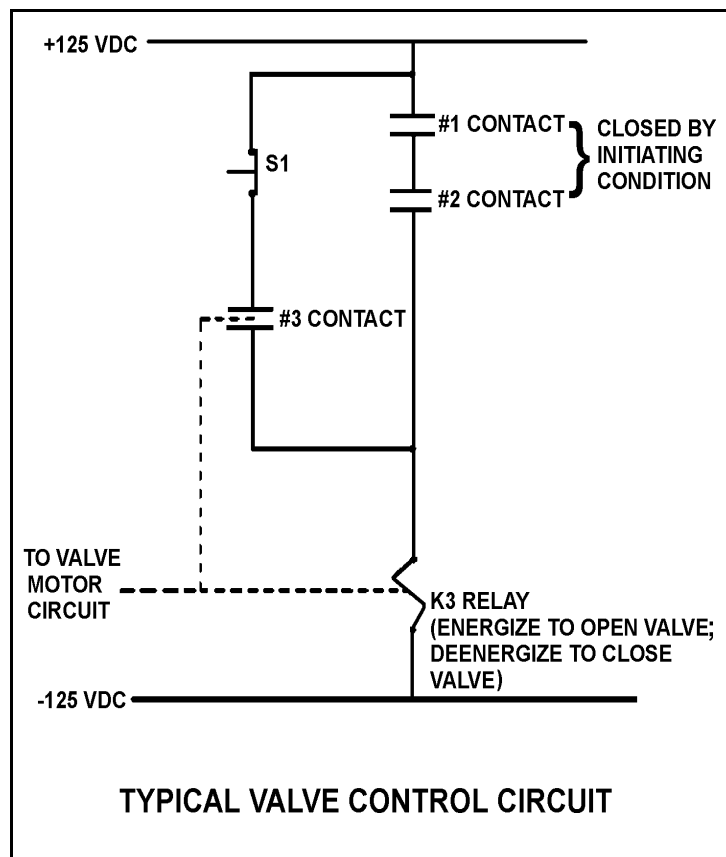
ANSWER:  A.

TOPIC:           191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:                 P4421   (B4421)

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

**Note:**  Relay contacts are shown open/closed according to the standard convention for control circuit drawings.

The motor has been operating for several hours when it is decided to stop the motor.  What is the status of the starting resistors before and after the motor STOP pushbutton is depressed?

A.  Initially inserted in the motor circuit; bypassed immediately after the STOP pushbutton is depressed.

B.  Initially inserted in the motor circuit; bypassed following a preset time delay after the STOP pushbutton is depressed.

C.  Initially bypassed; bypass is removed immediately after the STOP pushbutton is depressed.

D.  Initially bypassed; bypass is removed following a preset time delay after the STOP pushbutton is depressed.

ANSWER:  C.

TOPIC: 191008
KNOWLEDGE: K1.06 [2.3/2.6]
QID: P4521 (B4521)

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

**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 "Open" position for two seconds and then released?

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

B. The valve will open fully.

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

D. The valve will begin to open and then stop moving.

ANSWER: D.



VALVE MOTOR CONTROL CIRCUIT
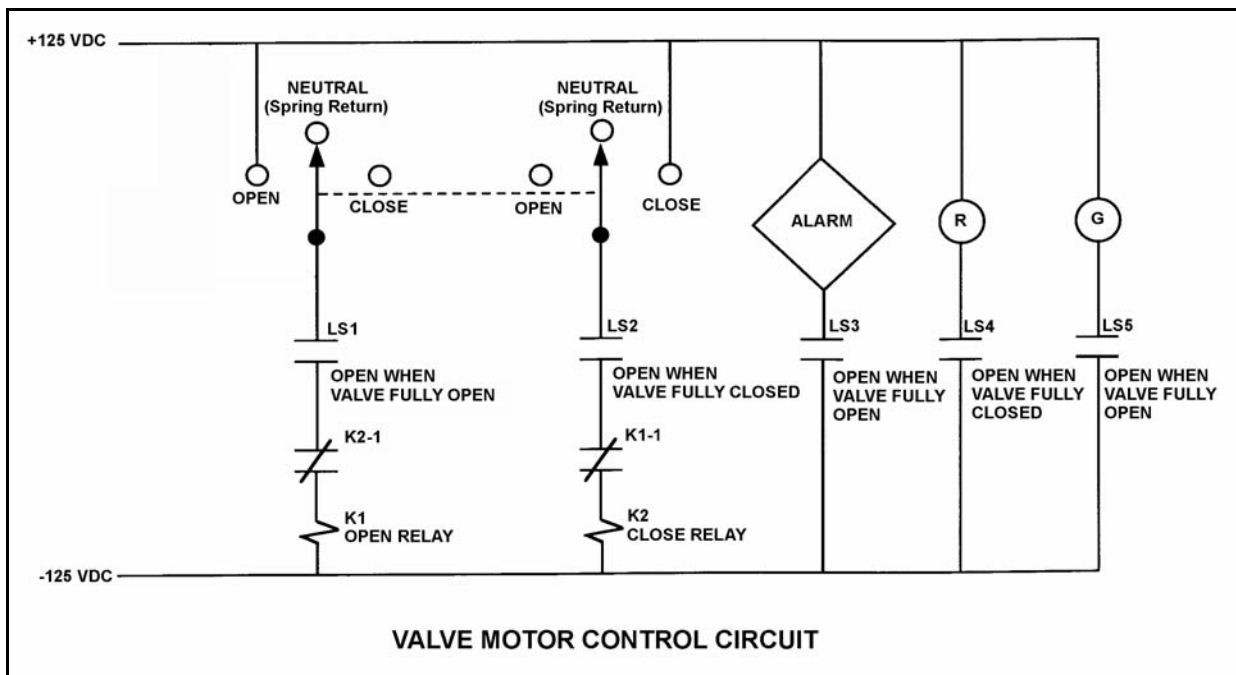
TOPIC:          191008
KNOWLEDGE:   K1.06   [2.3/2.6]
QID:             P5120   (B5121)

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

**Note:** Relay contacts are shown open/closed according to the standard convention for control circuit drawings.

The motor has been idle for several days when it is decided to start the motor.  What is the status of the starting resistors before and after the motor START pushbutton is depressed?

A.  Initially bypassed; bypass is removed immediately after the START pushbutton is depressed.

B.  Initially bypassed; bypass is removed following a preset time delay after the START pushbutton is depressed.

C.  Initially inserted in the motor circuit; bypassed immediately after the START pushbutton is depressed.

D.  Initially inserted in the motor circuit; bypassed following a preset time delay after the START pushbutton is depressed.

ANSWER:  D.
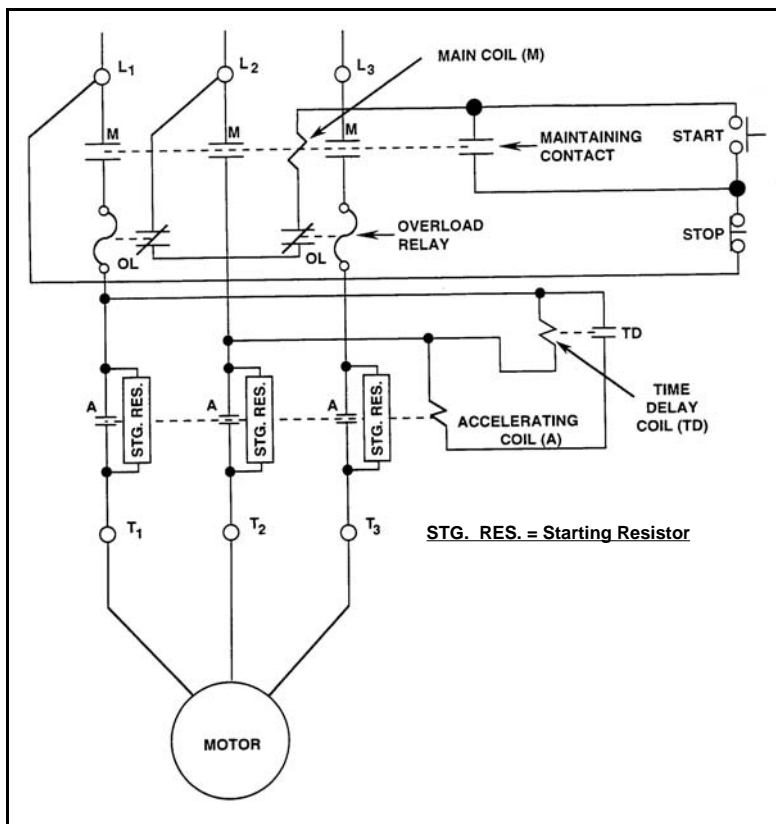
TOPIC:                  191008
KNOWLEDGE:    K1.06    [2.3/2.6]
QID:                    P5221    (B5222)

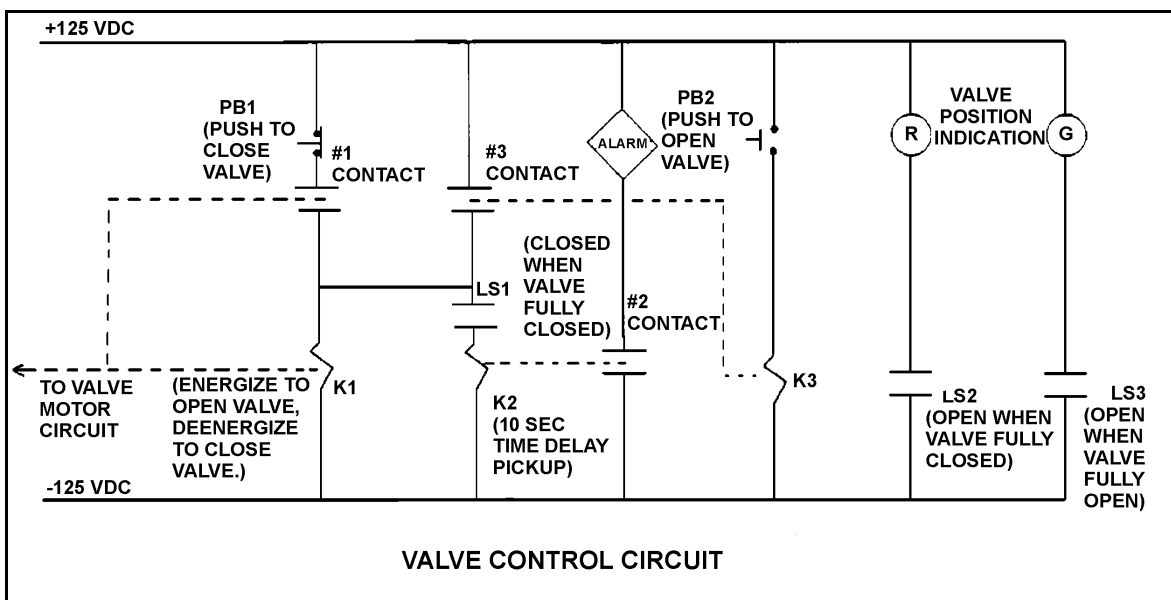Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully open and has a 10-second stroke time.

**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.

The operator takes the control switch to "Close".  Two seconds later, after verifying the valve is closing, the operator releases the control switch.  Which one of the following describes the valve motor control circuit alarm response after the switch is released?

A.  The alarm will continue to actuate for approximately 8 seconds.

B.  The alarm will continue to actuate until additional operator action is taken.

C.  The alarm will actuate after approximately 8 seconds.

D.  The alarm will not actuate until additional operator action is taken.

ANSWER:  B.



**VALVE MOTOR CONTROL CIRCUIT**
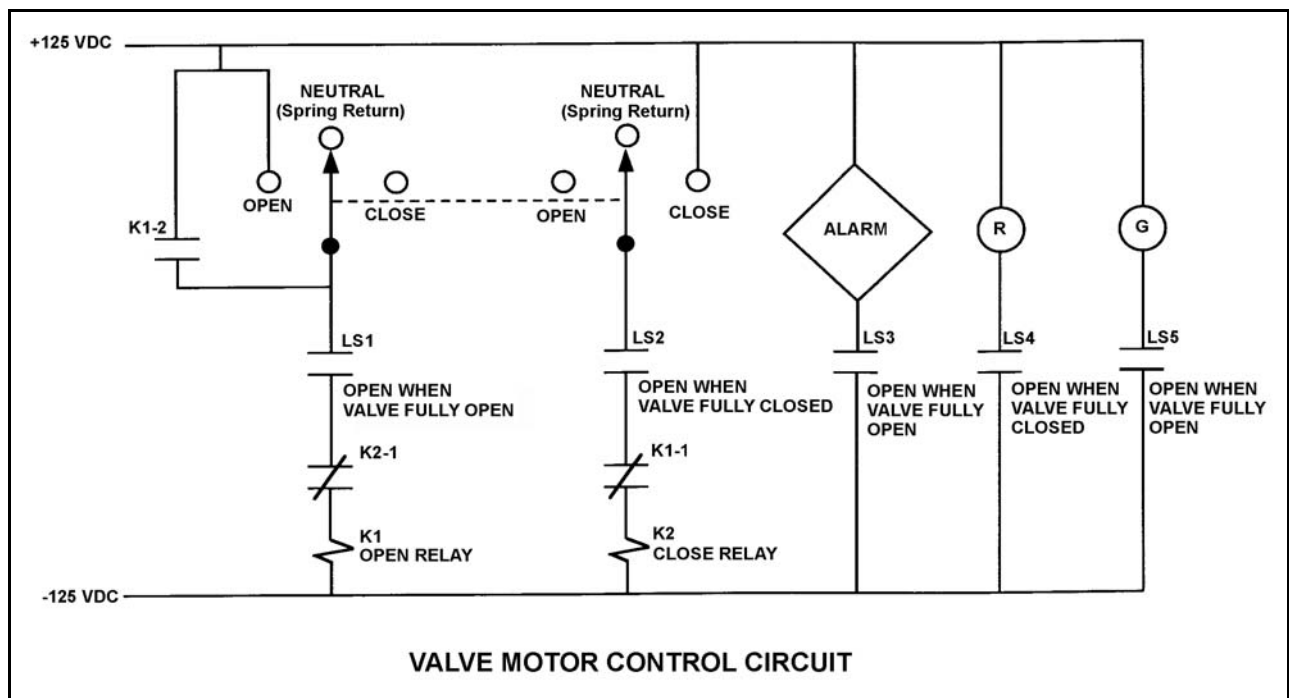
TOPIC:         191008
KNOWLEDGE:   K1.06   [2.3/2.6]
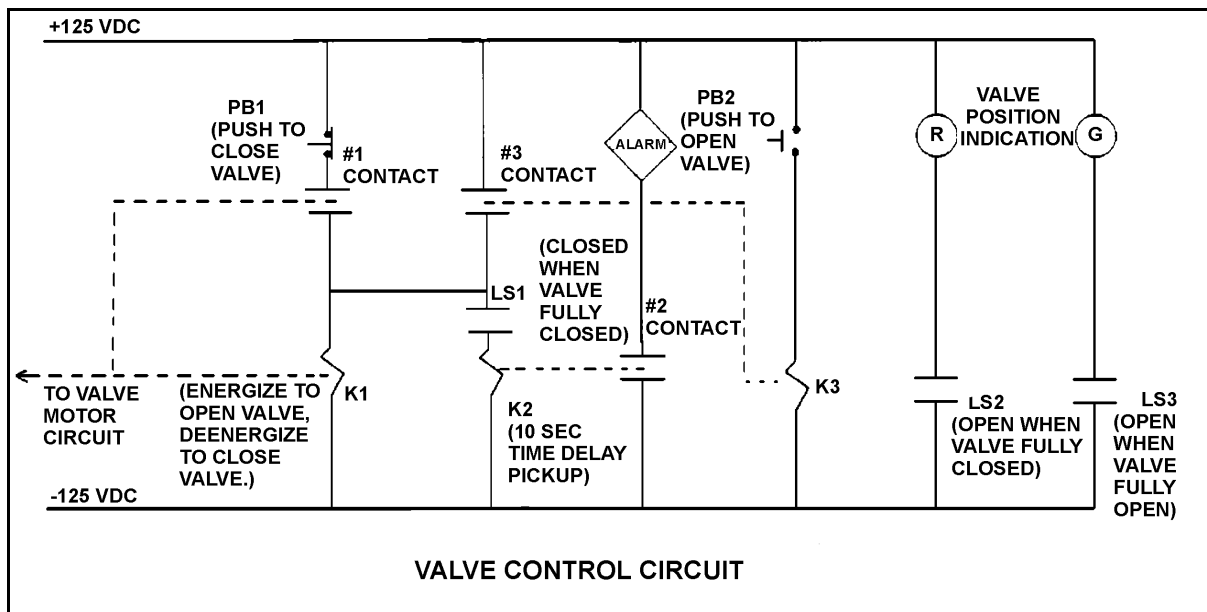QID:           P5421   (B5421)

Refer to the drawing of a valve 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.

Which one of the following conditions will actuate the alarm?

A.  The valve is partially closed with the control switch in the CLOSE position.

B.  The valve is fully open with the control switch in the CLOSE position.

C.  The valve is partially closed with the control switch in the OPEN position.

D.  The valve is fully open with the control switch in the OPEN position.

ANSWER:  C.
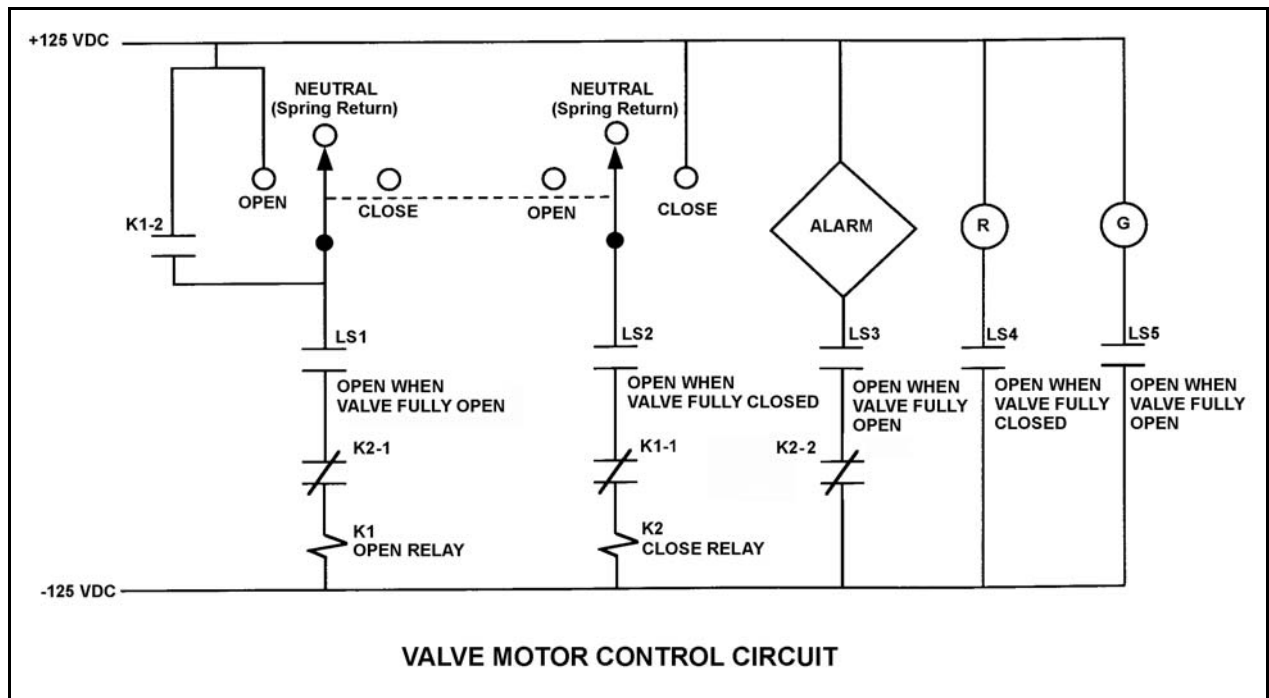
TOPIC:            191008
KNOWLEDGE:   K1.07   [3.0/3.3]
QID:             P1141   (B1142)

Which one of the following is an <u>unsafe</u> practice if performed when working on or near energized electrical equipment?

A.  Cover exposed energized circuits with insulating material to prevent inadvertent contact.

B.  Have a person standing by to deenergize the equipment in the event of an emergency.

C.  Use two hands for balance and to prevent dropping tools onto energized equipment.

D.  Stand on insulating rubber material to prevent yourself from being grounded.

ANSWER:  C.

TOPIC:            191008
KNOWLEDGE:   K1.07   [3.0/3.3]
QID:             P1241   (B842)

A 480 VAC motor is supplied power via an electrical disconnect in series with a circuit breaker. Which one of the following describes the proper operation to isolate power to the load?

A.  Open the disconnect first, then the breaker.

B.  Open the breaker first, then the disconnect.

C.  Open the breaker and disconnect at the same time.

D.  Sequence is not important as long as motor is operating.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.07   [3.0/3.3]
QID:            P2940   (B3141)

Which one of the following is an <u>unsafe</u> practice if performed when working on or near energized electrical equipment?

A.  Use insulated tools to prevent inadvertent contact with adjacent equipment.

B.  Cover exposed energized circuits with insulating material to prevent inadvertent contact.

C.  Attach a metal strap from your body to a nearby neutral ground to ensure that you are grounded.

D.  Have a person standing by with the ability to remove you from the equipment in the event of an emergency.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P41      (B342)

The <u>primary</u> reason for isolating emergency electrical loads from their power supply bus prior to energizing the bus via the emergency diesel generator is to prevent an...

A.  overcurrent condition on the generator.

B.  overcurrent condition on the loads.

C.  underfrequency condition on the generator.

D.  underfrequency condition on the loads.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P43     (B1941)

A main generator is being connected to an infinite power grid that is operating at 60 Hz.  Generator output voltage is equal to the grid voltage but generator frequency is at 57 Hz.

Which one of the following generator conditions is most likely to occur if the generator output breaker is closed with voltages in phase (synchronized) but with the existing frequency difference? (Assume <u>no</u> generator breaker protective trip occurs.)

A.  Reverse power

B.  Underfrequency

C.  Undervoltage

D.  Overspeed

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P107    (B122)

Closing the output breaker of a three-phase generator onto a deenergized bus can result in...

A.  an overvoltage condition on the bus.

B.  an overcurrent condition on the generator if the bus was not first unloaded.

C.  a reverse power trip of the generator circuit breaker if generator frequency is low.

D.  a large reactive current in the generator.

ANSWER:  B.

TOPIC:            191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:              P241    (B1843)

A main generator is being paralleled to an infinite power grid. Closing the output breaker of the generator with the frequency of the generator 0.1 Hz <u>higher</u> than grid frequency will result in the generator...

A.  supplying a portion of the grid reactive load (MVAR).

B.  supplying a portion of the grid real load (MW).

C.  behaving as a reactive load to the grid.

D.  behaving as a real load to the grid.

ANSWER:  B.

TOPIC:            191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:              P242    (B243)

Which one of the following generator conditions is <u>most</u> <u>likely</u> to cause generator damage because of high current?

A.  Tripping the output breaker under full-load conditions

B.  Tripping the generator prime mover under full-load conditions

C.  Closing the output breaker on a bus that has an open-circuit fault

D.  Closing the output circuit breaker on a bus that has a short-circuit fault

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P340

A main generator is about to be connected to an infinite power grid.  Closing the generator output breaker with the generator voltage slightly lower than grid voltage and with generator frequency slightly higher than grid frequency will initially result in:  (Assume <u>no</u> generator breaker protective trip occurs.)

A.  the generator supplying reactive power to the grid.

B.  the generator attaining a leading power factor.

C.  the generator acting as a real load to the grid.

D.  motoring of the generator.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P341    (B343)

A main generator is being paralleled to the power grid.  Generator voltage has been properly adjusted and the synchroscope is rotating slowly in the clockwise direction.

The generator breaker must be closed just as the synchroscope pointer reaches the 12 o'clock position to prevent...

A.  motoring of the generator due to unequal frequencies.

B.  excessive MW load transfer to the generator due to unequal frequencies.

C.  excessive MW load transfer to the generator due to out-of-phase voltages.

D.  excessive arcing within the generator output breaker due to out-of-phase voltages.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:  K1.08   [3.3/3.5]
QID:            P441    (B440)

During paralleling operations of the main generator to an infinite power grid, closing the generator output breaker with the frequency of the generator at 61 hertz and the grid frequency at 60 hertz will...

A.  cause the generator to immediately increase load.

B.  trip open the generator breaker on reverse power.

C.  cause the generator voltage to increase.

D.  cause the generator current to decrease.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:  K1.08   [3.3/3.5]
QID:            P743    (B743)

Which one of the following evolutions will draw the <u>highest</u> current from the main generator during operation of the output breaker?

A.  Opening the output breaker under full-load conditions

B.  Opening the output breaker under no-load conditions

C.  Closing the output breaker with voltages out of phase

D.  Closing the output breaker with voltages in phase

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P940

Under which one of the following preexisting conditions will closing a circuit breaker between two electrical generators cause a sudden large and possibly damaging mechanical torque to be exerted on <u>both</u> of the generators?

A.  One generator is supplying a 3% higher voltage than the other.

B.  One generator is supplying a 3% higher frequency than the other.

C.  The voltage of one generator is out of phase with the other by 30°.

D.  The capacity of one generator is twice that of the other generator.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1143   (B1143)

A main generator is about to be connected to an infinite power grid with the following conditions:

   Generator frequency:   59.5 Hz
   Grid frequency:        59.8 Hz
   Generator voltage:     115.1 KV
   Grid voltage:          114.8 KV

When the generator output breaker is closed the generator will...

A.  acquire real load and reactive load.

B.  acquire real load but become a reactive load to the grid.

C.  become a real load to the grid but acquire reactive load.

D.  become a real load and a reactive load to the grid.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1242

A main generator is about to be connected to an infinite power grid.  Closing the generator output breaker with generator and grid voltages matched, but with generator frequency lower than grid frequency will initially result in the generator...

A.  picking up a portion of the grid real load.

B.  picking up a portion of the grid reactive load.

C.  experiencing reverse power conditions.

D.  experiencing overspeed conditions.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1342

A main generator is about to be connected to an infinite power grid.  Closing the generator output breaker with the _____ of the generator higher than that of the grid will initially result in generator real load _____.

A.  frequency; decreasing

B.  frequency; increasing

C.  voltage; decreasing

D.  voltage; increasing

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1542

A main generator is about to be connected to an infinite power grid.  Closing the generator output breaker with generator and grid voltages matched, but with generator frequency 0.1 Hz higher than grid frequency will initially result in the generator...

A.  picking up a portion of the grid real load.

B.  picking up a portion of the grid reactive load.

C.  experiencing reverse power conditions.

D.  experiencing overspeed conditions.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1642

A main generator is about to be connected to an infinite power grid with the following conditions:

    Generator frequency   = 59.8 Hz
    Grid frequency          = 59.5 Hz
    Generator voltage      = 114.8 kV
    Grid voltage             = 115.1 kV

When the generator output breaker is closed, the generator will initially...

A.  acquire real load and reactive load.

B.  acquire real load, but become a reactive load to the grid.

C.  become a real load to the grid, but acquire reactive load.

D.  become a real load and a reactive load to the grid.

ANSWER:  B.

TOPIC:              191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:                 P1741   (B1744)

A main generator is being paralleled to an infinite power grid.  Generator voltage has been properly adjusted and the synchroscope is rotating slowly in the <u>counterclockwise</u> direction.

If the generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position, which one of the following will occur?

A.  The breaker will close and the generator will supply MW to the grid.

B.  The breaker will close and the generator will supply MW and MVAR to the grid.

C.  The breaker will close and then open due to overcurrent.

D.  The breaker will close and then open due to reverse power.

ANSWER:  D.

TOPIC:              191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:                 P1839   (B43)

A main generator is being connected to an infinite power grid.  Which one of the following will occur if the generator output breaker is closed with generator frequency 0.1 Hz <u>lower</u> than power grid frequency?  (Assume that <u>no</u> generator protection relay actuates.)

A.  The generator will motorize.

B.  The generator will accept too much load.

C.  The voltage of the generator will decrease to compensate for the lower frequency.

D.  The entire connected system will operate at the frequency of the lowest frequency (the oncoming) generator.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1842   (B1240)

A main generator is being prepared for paralleling with an infinite power grid.  Which one of the following indicates that the main generator and the grid are in phase?

A.  The synchroscope pointer is at the 12 o'clock position.

B.  The frequency of the generator is equal to the frequency of the grid.

C.  The synchroscope pointer is turning slowly in the clockwise direction.

D.  The synchroscope pointer is turning slowly in the counterclockwise direction.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P1940   (B341)

Closing a circuit breaker between two electrical generators that are out of phase will cause...

A.  one generator to become a motor and the other generator to supply the motoring current.

B.  a voltage reduction in both generators until normal voltage is manually restored.

C.  a sudden large mechanical torque to be exerted on both of the generators.

D.  a frequency reduction in both generators until normal frequency is manually restored.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2040   (B2042)

A main generator is being prepared for paralleling with an infinite power grid.  Which one of the following conditions will cause the main generator to immediately supply reactive power (MVAR) to the grid when the generator output breaker is closed?

A.  Generator voltage is 1% higher than grid voltage.

B.  Generator voltage is 1% lower than grid voltage.

C.  The synchroscope is turning slowly in the clockwise direction.

D.  The synchroscope is turning slowly in the counterclockwise direction.

ANSWER:  A.


TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2044   (B2043)

Two identical 1,000 MW electrical generators are being connected to the same electrical bus.  Generator A is currently supplying the bus.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 4,160 Volts | 4,140 Volts |
| 60.2 Hertz | 60.8 Hertz |
| 25 MW | 0 MW |
| 10 MVAR | 0 MVAR |

When the output breaker for generator B is closed, which generator is more likely to trip on reverse power?

A.  Generator A due to the higher initial voltage

B.  Generator A due to the lower initial frequency

C.  Generator B due to the lower initial voltage

D.  Generator B due to the higher initial frequency

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:  K1.08   [3.3/3.5]
QID:             P2143  (B2044)

A main generator is about to be connected to an infinite power grid.  Generator voltage equals grid voltage and the synchroscope is rotating slowly in the <u>clockwise</u> direction.  The generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position.

Which one of the following will occur after the breaker is closed?

A.  The breaker will remain closed and the generator will supply only MW to the grid.

B.  The breaker will remain closed and the generator will supply both MW and MVAR to the grid.

C.  The breaker will remain closed and the generator will become an electrical load on the grid.

D.  The breaker will open due to reverse power.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:  K1.08   [3.3/3.5]
QID:             P2240

A main generator is being prepared for paralleling with an infinite power grid.  Which one of the following indicates that the generator and grid voltages are in phase?

A.  The voltage of the generator is equal to the voltage of the grid.

B.  The frequency of the generator is equal to the frequency of the grid.

C.  The synchroscope pointer is turning slowly in the clockwise direction.

D.  The synchroscope pointer is passing through the 12 o'clock position.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2244

An isolated electrical bus is being supplied by generator A.  Generator B is about to be connected to the same electrical bus.  Generators A and B are both rated at 1,000 MW.  Generator A and B output indications are as follows:

| Generator A | Generator B |
|---|---|
| 4,140 Volts | 4,160 Volts |
| 60.8 Hertz | 60.2 Hertz |
| 25 MW | 0 MW |
| 10 MVAR | 0 MVAR |

When the output breaker for generator B is closed, which generator is more likely to trip on reverse power?

A.  Generator A due to the lower initial voltage

B.  Generator A due to the higher initial frequency

C.  Generator B due to the higher initial voltage

D.  Generator B due to the lower initial frequency

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2343   (B2343)

A main generator is about to be connected to an infinite power grid.  Generator voltage is slightly higher than grid voltage and the synchroscope is rotating slowly in the <u>clockwise</u> direction.  The generator breaker is closed just as the synchroscope pointer reaches the 12 o'clock position.

Which one of the following will occur after the breaker is closed?

A.  The breaker will remain closed and the generator will supply only MW to the grid.

B.  The breaker will remain closed and the generator will supply both MW and MVAR to the grid.

C.  The breaker will open due to overcurrent.

D.  The breaker will open due to reverse power.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2440   (B2643)

A main generator is being prepared for paralleling with an infinite power grid.  If the synchroscope pointer is stopped, at which one of the following positions is the main generator output voltage the farthest out of phase with the grid voltage?

A.  3 o'clock

B.  6 o'clock

C.  9 o'clock

D.  12 o'clock

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2441   (B2443)

A main generator is about to be connected to an infinite power grid.  Generator voltage is equal to grid voltage and the synchroscope is rotating slowly in the <u>counterclockwise</u> direction.  The generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position.

Which one of the following will most likely occur after the breaker is closed?

A.  If the breaker remains closed, the generator will supply only MW to the grid.

B.  If the breaker remains closed, the generator will supply both MW and MVAR to the grid.

C.  The breaker will open due to overcurrent.

D.  The breaker will open due to reverse power.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P2642

A main generator is about to be connected to an infinite power grid.  Generator voltage is slightly higher than grid voltage and the synchroscope is rotating slowly in the <u>clockwise</u> direction.  The generator breaker is closed just as the synchroscope pointer reaches the 3 o'clock position.

Which one of the following will occur after the breaker is closed?

A.  The breaker will remain closed and the generator will supply only MW to the grid.

B.  The breaker will remain closed and the generator will supply both MW and MVAR to the grid.

C.  The breaker will open due to overcurrent.

D.  The breaker will open due to reverse power.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P2743   (B2742)

A main generator is about to be connected to an infinite power grid with the following conditions:

    Generator frequency:  59.9 Hz
    Grid frequency:          60.1 Hz
    Generator voltage:     114.8 kV
    Grid voltage:             115.1 kV

When the generator output breaker is closed, the generator will...

A.  acquire real load and reactive load.

B.  acquire real load, but become a reactive load to the grid.

C.  become a real load to the grid, but acquire reactive load.

D.  become a real load and a reactive load to the grid.

ANSWER:  D.


TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P2943

A main generator is about to be connected to an infinite power grid with the following conditions:

    Generator frequency:  60.1 Hz
    Grid frequency:          59.9 Hz
    Generator voltage:     115.1 kV
    Grid voltage:             114.8 kV

When the generator output breaker is closed, the generator will...

A.  acquire real load and reactive load.

B.  acquire real load, but become a reactive load to the grid.

C.  become a real load to the grid, but acquire reactive load.

D.  become a real load and a reactive load to the grid.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P3142   (B3130)

A nuclear power plant is operating at 80% power in the middle of a fuel cycle.  The main generator is connected to an infinite power grid with the following initial main generator output parameters:

Frequency:       60 Hz
Voltage:         25 KV
Reactive Load:   300 MVAR (out)
Real Load:       800 MW

A hydraulic oil system malfunction causes the main turbine steam inlet valves to begin to slowly drift closed.  Over the next 10 minutes, the main generator real load decreases to 600 MW. Assuming no operator actions were taken during the above 10 minutes, how have the following main generator output parameters been affected?

|    | Frequency | Voltage | Reactive Load |
|----|-----------|---------|---------------|
| A. | Decreased | Decreased | No change |
| B. | Decreased | No change | Decreased |
| C. | No change | No change | No change |
| D. | No change | Decreased | Decreased |

ANSWER:  C.

TOPIC:           191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P3841   (B3842)

Which one of the following will cause the most damage to the contact surfaces of a main generator output breaker?

A.  An operator attempts to close the main generator breaker with the generator and power grid frequencies matched but with voltages 180 degrees out of phase.

B.  An operator attempts to close the main generator breaker with the generator and power grid voltages in phase but with generator frequency 0.5% higher than power grid frequency.

C.  The main generator breaker automatically trips open on a loss of offsite power while the main generator is operating at its minimum rated load.

D.  The main generator breaker automatically trips open on a loss of offsite power while the main generator is operating at its maximum rated load.

ANSWER:  A.

TOPIC:           191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:             P4321   (B4321)

A main generator is about to be connected to an infinite power grid.  The main generator has the following initial conditions:

    Generator frequency:   59.9 Hz      Generator voltage:   115.1 kV
    Grid frequency:           60.1 Hz      Grid voltage:           114.8 kV

When the generator output breaker is closed, the generator will...

A.  acquire real load and reactive load.

B.  acquire real load, but become a reactive load to the grid.

C.  become a real load and a reactive load to the grid.

D.  become a real load to the grid, but acquire reactive load.

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P4322   (B4322)

During a routine inspection of a main generator output breaker, a technician discovers severely damaged main contact surfaces.  Which one of the following is the most likely cause of the damaged contact surfaces?

A.  The main generator breaker automatically tripped open after it was closed with the generator and power grid voltages 60 degrees out of phase.

B.  The main generator breaker automatically tripped open due to a faulty trip relay actuation while the main generator was operating unloaded.

C.  The main generator breaker automatically tripped open on a loss of offsite power while the main generator was operating at its maximum rated load.

D.  The main generator breaker automatically tripped open after it was closed with the generator and power grid voltages in phase but with generator frequency 0.2 Hz lower than power grid frequency.

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.08   [3.3/3.5]
QID:            P5121   (B5122)

A main generator is about to be connected to an infinite power grid.  Generator output frequency is slightly higher than grid frequency and generator output voltage is equal to grid voltage.

Which one of the following situations will exist when the main generator electrical conditions stabilize immediately after the generator output breaker is closed?  (Assume no additional operator actions are taken.)

A.  Generator output current will be 0.

B.  Generator power factor will be 0.

C.  Generator output MVAR will be 0.

D.  Generator output MW will be 0.

ANSWER:  C.

TOPIC:        191008
KNOWLEDGE:  K1.08  [3.3/3.5]
QID:          P5620  (B5621)

A main generator is being connected to an infinite power grid.  The following frequencies exist just prior to closing the generator output breaker:

    Generator frequency:    59.9 Hz
    Grid frequency:          60.1 Hz

When conditions stabilize just after the generator output breaker is closed, the generator frequency will be _____ and the grid frequency will be _____.

A.  59.9 Hz; 59.9 Hz

B.  59.9 Hz; 60.1 Hz

C.  60.0 Hz; 60.0 Hz

D.  60.1 Hz; 60.1 Hz

ANSWER:  D.

TOPIC:        191008
KNOWLEDGE:  K1.09  [2.8/3.1]
QID:          P642    (B44)

When a typical 4,160 volt breaker is racked to the "test" position, control power is _____ the breaker and the breaker is _____ the load.

A.  available to; connected to

B.  available to; isolated from

C.  removed from; connected to

D.  removed from; isolated from

ANSWER:  B.

TOPIC:            191008
KNOWLEDGE:   K1.09   [2.8/3.1]
QID:              P938

Which one of the following functions or capabilities would <u>remain</u> following a loss of control power to a typical 480 VAC bus feeder breaker?

A.  Remote breaker control capability

B.  Breaker closing spring automatic recharging capability

C.  Remote bus voltage indication

D.  Remote breaker position indication

ANSWER:  C.

TOPIC:            191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:              P42

Which one of the following statements describes the use of high-voltage disconnects?

A.  Disconnects should be limited to normal load current interruption.

B.  Disconnects may be used to isolate transformers in an unloaded network.

C.  Disconnects trip open like circuit breakers, but must be manually closed.

D.  Disconnects must be closed with caution when under load because of possible arcing.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:            P243    (B1842)

The function of high voltage electrical disconnects is to provide_____ electrical isolation of equipment during _____ conditions.

A.  manual; no-load

B.  manual; overload

C.  automatic; no-load

D.  automatic; overload

ANSWER:  A.

TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:            P844    (B644)

High voltage electrical disconnects are used to...

A.  adjust the output voltage range from a main power transformer.

B.  protect bus feeder breakers by opening upon bus short-circuit faults.

C.  provide equipment isolation under no-load conditions.

D.  bypass and isolate an electrical bus while maintaining the downstream buses energized.

ANSWER:  C.

TOPIC:           191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:             P943     (B2244)

What is an advantage of using high voltage electrical disconnects  instead of breakers to isolate main power transformers?

A.  Disconnects can be operated either locally or remotely.

B.  Disconnects provide direct visual indication that the circuit is broken.

C.  Disconnects are cheaper and provide the same automatic protection as a breaker.

D.  Disconnects are capable of interrupting a higher current flow with less heating than a breaker.

ANSWER:  B.

TOPIC:           191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:             P1043

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.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:            P1343

Typical high voltage electrical disconnects are designed to...

A.  protect circuits during overcurrent conditions.

B.  automatically trip open to protect breakers.

C.  isolate equipment electrically during no-load conditions.

D.  interrupt circuits under load.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:            P1840   (B1544)

Typical main transformer high voltage electrical disconnects are designed to...

A.  automatically protect the transformer from overcurrent conditions.

B.  automatically trip open prior to transformer output breaker trip.

C.  manually isolate the transformer during no-load conditions.

D.  manually interrupt the transformer output circuit under load when grounds are detected.

ANSWER:  C.

TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:             P2742   (B2744)

Refer to the simplified drawing of an electrical distribution system (see figure below).

The high voltage side of each step-down transformer has a remote-operated disconnect to allow transformer maintenance while keeping the other transformers in service.  The control circuit for each disconnect is position-interlocked with the associated MCC feeder breaker.

Which one of the following describes the purpose served by the interlock?

A.  Prevent damage to the disconnect.

B.  Prevent damage to the transformer.

C.  Prevent damage to the feeder breaker.

D.  Prevent damage to the 480V MCC.

ANSWER:  A.



SIMPLIFIED ELECTRICAL DISTRIBUTION SYSTEM
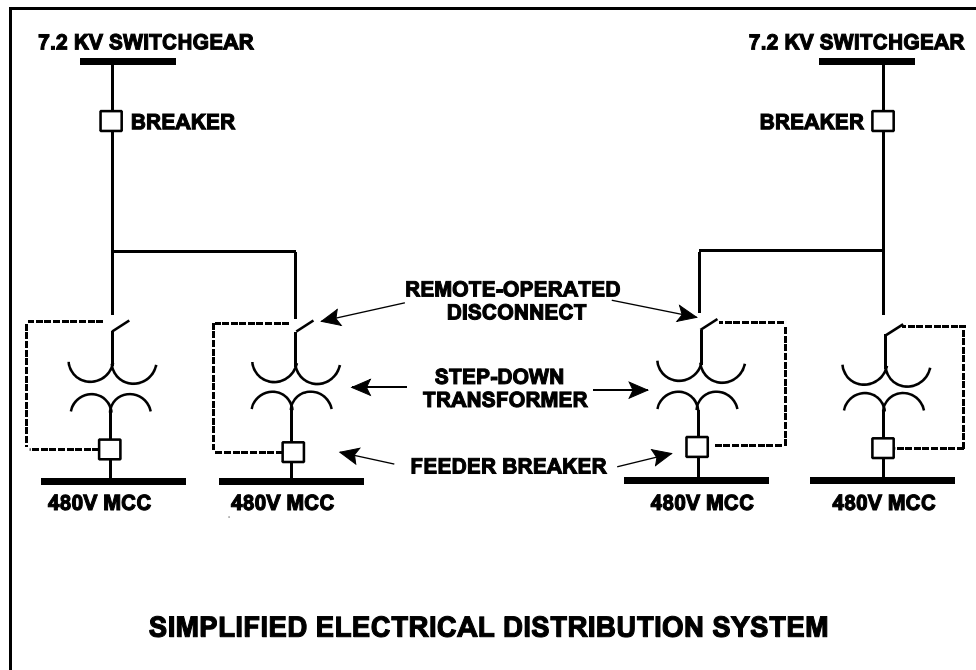
TOPIC:          191008
KNOWLEDGE:   K1.10   [2.7/3.1]
QID:            P2944   (B2944)


A 480 VAC motor control center supplies a load through a breaker and a manual disconnect.  If both isolation devices are operated to isolate the load, which one of the following sequences will provide the greatest level of personnel safety when deenergizing the load for maintenance and when reenergizing the load after the maintenance?

DEENERGIZING           REENERGIZING

A.  Open breaker first        Shut breaker first

B.  Open breaker first        Shut disconnect first

C.  Open disconnect first     Shut breaker first

D.  Open disconnect first     Shut disconnect first

ANSWER:  B.

TOPIC:              191008
KNOWLEDGE:   K1.10    [2.7/3.1]
QID:                P3744   (B3744)

Refer to the simplified drawing of an electrical distribution system showing 7.2 KV switchgear, step-down transformers, and 480 V motor control centers (MCCs) (see figure below).  The high voltage side of each step-down transformer has a remote-operated disconnect.  The control circuit for each disconnect is position-interlocked with the associated MCC feeder breaker.

Which one of the following describes the interlock operating scheme that will provide the greatest protection for the disconnect?

A.  Permits opening the feeder breaker only if the disconnect is closed.

B.  Permits opening the feeder breaker only if the disconnect is open.

C.  Permits opening the disconnect only if the feeder breaker is closed.

D.  Permits opening the disconnect only if the feeder breaker is open.

ANSWER:  D.



**SIMPLIFIED ELECTRICAL DISTRIBUTION SYSTEM**
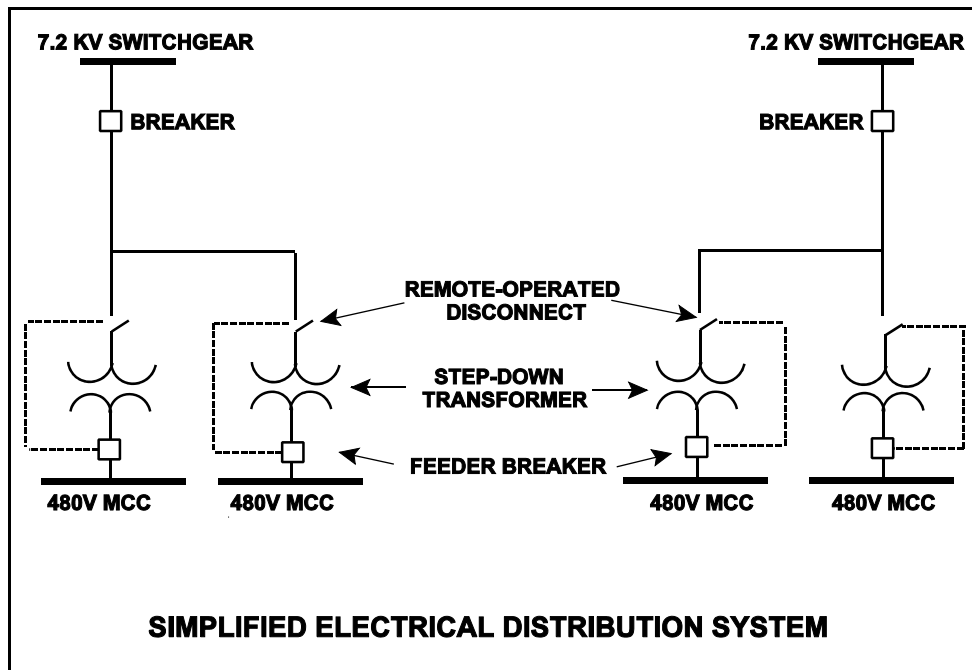
TOPIC:          191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:             P239

The following remote indications are observed for a 480 VAC load center supply breaker.  (The breaker is normally open.)

    Red indicating light is on.
    Green indicating light is off.
    Load center voltage indicates 0 volts.
    Breaker incoming 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 "test" position

D.  Closed and racked to "test" position

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:             P244

The following indications are observed for a motor breaker in the
control room:

    Red position indicating light is off.
    Green position indicating light is off.
    Load amps indicate normal load current.

Assuming one of the indicating lights is burned out, what is the condition of the breaker?

A.  Closed and racked in

B.  Open and racked in

C.  Closed and racked to "test" position

D.  Open and racked to "test" position

ANSWER:  A.

TOPIC:           191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:              P1044

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 on.
> Green position indicating light is off.
> 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 "test" position

D.  Closed and racked to "test" position

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P1140

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

    Red position indicating light is on.
    Green position indicating light is off.
    Load current indicates 50 amps.
    Supply voltage indicates 480 volts.

What is the condition of the breaker?

A.  Open and racked to "test" position

B.  Closed and racked to "test" position

C.  Open and racked in

D.  Closed and racked in

ANSWER:  D.

TOPIC:         191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P1438   (B1440)

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

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

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

A.  open; in

B.  closed; in

C.  open; out

D.  closed; out

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P1838   (B2143)

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

    Green breaker position indicating light is lit.
    Red breaker position indicating light is out.
    MCC voltmeter indicates zero volts.
    MCC ammeter indicates zero amperes.

Based on these indications, the operator can accurately report that the breaker is open and racked to _____ position.

A.  the OUT

B.  the IN

C.  the TEST

D.  an unknown

ANSWER:  D.

TOPIC:          191008
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P1932   (B2640)

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

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

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

A.  open; in

B.  closed; in

C.  open; to the test position

D.  closed; to the test position

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.12   [2.9/2.9]
QID:            P1444   (B2240)

Breaker local overcurrent trip flag indicators, when actuated, indicate that...

A.  a breaker trip will occur unless current is reduced.

B.  a breaker overcurrent condition is responsible for a breaker trip.

C.  an overcurrent condition has cleared and the breaker can be closed.

D.  the associated breaker has failed to trip open during an overcurrent condition.

ANSWER:  B.

TOPIC:          191008
KNOWLEDGE:   K1.12   [2.9/2.9]
QID:            P3444   (B3440)

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 volts

Assuming <u>no</u> 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.

ANSWER:  A.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                  P545    (B1845)

Delayed neutrons are neutrons that...

A.  have reached thermal equilibrium with the surrounding medium.

B.  are expelled as thermal neutrons.

C.  are expelled at a lower average kinetic energy than most other fission neutrons.

D.  are responsible for the majority of U-235 fissions.

ANSWER:  C.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                  P845    (B1945)

Delayed neutrons are the neutrons that...

A.  have reached thermal equilibrium with the surrounding medium.

B.  are expelled within $10^{-14}$ seconds of the fission event.

C.  are produced from the radioactive decay of certain fission fragments.

D.  are responsible for the majority of U-235 fissions.

ANSWER:  C.

TOPIC:          192001
KNOWLEDGE:  K1.02   [2.4/2.5]
QID:            P1145  (B1545)

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

A.  Expelled with an average kinetic energy of 0.5 MeV.

B.  Usually emitted by the excited nucleus of a fission product.

C.  Accounts for more than 99% of fission neutrons.

D.  Released an average of 13 seconds after the fission event.

ANSWER:  C.

TOPIC:          192001
KNOWLEDGE:  K1.02   [2.4/2.5]
QID:            P1445  (B1345)

A neutron that is expelled $1.0 \times 10^{-2}$ seconds after the associated fission event is a _____
neutron.

A.  thermal

B.  delayed

C.  prompt

D.  capture

ANSWER:  B.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P1545  (B1345)

A neutron that is expelled 1.0 x 10$^{-6}$ seconds after the associated fission event is a _____ neutron.

A.  thermal

B.  delayed

C.  prompt

D.  capture

ANSWER:  B.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P1945  (B1146)

Which one of the following types of neutrons has an average neutron generation lifetime of 12.5 seconds?

A.  Prompt

B.  Delayed

C.  Fast

D.  Thermal

ANSWER:  B.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                  P2045   (B2046)

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

A.  require a greater number of collisions to become a thermal neutron.

B.  be captured by U-238 at a resonance energy peak between 1 eV and 1000 eV.

C.  be expelled with a lower kinetic energy.

D.  cause thermal fission of a U-235 nucleus.

ANSWER:  A.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                  P2145   (B2145)

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

A.  cause fast fission of a U-238 nucleus.

B.  be captured by a U-238 nucleus at a resonance energy between 1 eV and 1000 eV.

C.  be captured by a Xe-135 nucleus.

D.  cause thermal fission of a U-235 nucleus.

ANSWER:  A.

TOPIC:           192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P2345   (B2345)

A neutron that is released 1.0 x $10^{-10}$ seconds after the associated fission event is classified as a _____ fission neutron.

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER:  A.

TOPIC:           192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P2445   (B3345)

As compared to a prompt neutron, a delayed neutron, produced from the same fission event, requires _____ collisions in the moderator to become thermal and is _____ likely to cause fission of a U-238 nucleus.  (Neglect the effects of neutron leakage.)

A. more; more

B. more; less

C. fewer; more

D. fewer; less

ANSWER:  D.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P2545  (B2545)

In a comparison between a delayed neutron and a prompt neutron produced 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.

ANSWER:  A.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P2645  (B2645)

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

A.  leak out of the core.

B.  cause fission of a U-238 nucleus.

C.  become a thermal neutron.

D.  cause fission of a Pu-240 nucleus.

ANSWER:  C.

TOPIC:            192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:              P2845   (B3145)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, $1.0 \times 10^3$ delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted during this same time interval?

A.  $1.5 \times 10^5$

B.  $6.5 \times 10^6$

C.  $1.5 \times 10^7$

D.  $6.5 \times 10^8$

ANSWER:  A.

TOPIC:            192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:              P2945   (B2945)

Which one of the following types of neutrons in a nuclear reactor is more likely to cause fission of a U-238 nucleus in the reactor fuel?  (Assume that each type of neutron remains in the reactor core until it interacts with a U-238 nucleus.)

A.  Thermal neutron

B.  Prompt fission neutron beginning to slow down

C.  Delayed fission neutron beginning to slow down

D.  Neutron at a U-238 resonance energy

ANSWER:  B.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                 P3545   (B3545)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, $1.0 \times 10^5$ delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted in the reactor during this same time interval?

A.  $1.5 \times 10^5$

B.  $6.5 \times 10^6$

C.  $1.5 \times 10^7$

D.  $6.5 \times 10^8$

ANSWER:  C.

TOPIC:              192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:                 P4123   (B4123)

A neutron that appears $1.0 \times 10^{-16}$ seconds after the associated fission event is classified as a _____ fission neutron.

A.  delayed

B.  prompt

C.  thermal

D.  spontaneous

ANSWER:  B.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:              P4923   (B4923)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, 4.25 x $10^5$ delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted in the reactor during this same time interval?

A.  1.5 x $10^6$

B.  6.5 x $10^6$

C.  1.5 x $10^7$

D.  6.5 x $10^7$

ANSWER:  D.

TOPIC:          192001
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:              P5023   (B2245)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the delayed neutron is more likely to... (Assume that each neutron remains in the core unless otherwise stated.)

A.  cause fission of a U-238 nucleus.

B.  require a greater number of collisions to become a thermal neutron.

C.  be absorbed in a B-10 nucleus.

D.  leak out of the core.

ANSWER:  C.

TOPIC:            192002
KNOWLEDGE:   K1.07   [3.1/3.1]
QID:              P44      (B186)

A nuclear reactor is initially subcritical with the effective multiplication factor ($K_{eff}$) equal to 0.998. After a brief withdrawal of control rods, $K_{eff}$ equals 1.002.  The reactor is currently...

A.  prompt critical.

B.  supercritical.

C.  exactly critical.

D.  subcritical.

ANSWER:  B.

TOPIC:            192002
KNOWLEDGE:   K1.07   [3.1/3.1]
QID:              P445     (B247)

Which one of the following conditions describes a nuclear reactor that is exactly critical?

A.  $K_{eff} = 0$; $\Delta K/K = 0$

B.  $K_{eff} = 0$; $\Delta K/K = 1$

C.  $K_{eff} = 1$; $\Delta K/K = 0$

D.  $K_{eff} = 1$; $\Delta K/K = 1$

ANSWER:  C.

TOPIC:           192002
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:             P45

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation is the...

A.  effective multiplication factor.

B.  fast fission factor.

C.  neutron nonleakage factor.

D.  neutron reproduction factor.

ANSWER:  A.

TOPIC:           192002
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:             P1346   (B1447)

The effective multiplication factor ($K_{eff}$) can be determined by dividing the number of neutrons produced from fission in the third generation by the number of neutrons produced from fission in the _____ generation.

A.  first

B.  second

C.  third

D.  fourth

ANSWER:  B.

TOPIC:            192002
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:              P1846  (B847)

The effective multiplication factor ($K_{eff}$) describes the ratio of the number of fission neutrons at the end of one generation to the number of fission neutrons at the _____ of the _____ generation.

A.  end; previous

B.  beginning; next

C.  beginning; previous

D.  end; next

ANSWER:  A.

TOPIC:            192002
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:              P2647  (B2647)

A thermal neutron is about to interact with a U-238 nucleus in an operating nuclear reactor core. Which one of the following describes the most likely interaction and the effect on core $K_{eff}$?

A.  The neutron will be scattered, thereby leaving $K_{eff}$ unchanged.

B.  The neutron will be absorbed and U-238 will undergo fission, thereby decreasing $K_{eff}$.

C.  The neutron will be absorbed and U-238 will undergo fission, thereby increasing $K_{eff}$.

D.  The neutron will be absorbed and U-238 will undergo radioactive decay to Pu-239, thereby increasing $K_{eff}$.

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:             P3046   (B3147)

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

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

A.  Core $K_{eff}$ will gradually increase during the entire period.

B.  Core $K_{eff}$ will gradually decrease during the entire period.

C.  Core $K_{eff}$ will tend to increase, but inherent reactivity feedback will maintain $K_{eff}$ at 1.0.

D.  Core $K_{eff}$ will tend to decrease, but inherent reactivity feedback will maintain $K_{eff}$ at 1.0.

ANSWER:  D.

TOPIC:          192002
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:             P546

During core refueling, burnable poisons are often installed in the core to help control $K_{excess}$.  Why are more burnable poison rods installed during fuel load for the first fuel cycle than for subsequent fuel cycles?

A.  Control rod worth is lower at the beginning of subsequent fuel cycles.

B.  More fuel reactivity is present at the beginning of subsequent fuel cycles.

C.  More fission product poisons are present at the beginning of subsequent fuel cycles.

D.  Reactor coolant boron concentration is higher at the beginning of subsequent fuel cycles.

ANSWER:  C.

TOPIC:           192002
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:             P646    (B1848)

Select the equation that defines K-excess (excess reactivity).

A.  $K_{eff} + 1$

B.  $K_{eff} - 1$

C.  $K_{eff}(1-SDM)$

D.  $1/(1-K_{eff})$

ANSWER:  B.

TOPIC:           192002
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:             P946

Which one of the following combinations of critical core conditions indicates the <u>most</u> excess reactivity exists in the core?

| CONTROL ROD POSITION | RCS BORON CONCENTRATION |
|---|---|
| A.  25% inserted | 500 ppm |
| B.  50% inserted | 500 ppm |
| C.  25% inserted | 1,000 ppm |
| D.  50% inserted | 1,000 ppm |

ANSWER:  D.

TOPIC:          192002
KNOWLEDGE:  K1.09  [2.5/2.7]
QID:              P1147

The following are combinations of critical conditions that exist for the same nuclear reactor operating at the point of adding heat at different times in core life.  Which one of the following combinations indicates the least amount of excess reactivity present in the core?

|  | CONTROL ROD POSITION | RCS BORON CONCENTRATION |
|---|---|---|
| A. | 25% inserted | 500 ppm |
| B. | 25% inserted | 1,000 ppm |
| C. | 50% inserted | 500 ppm |
| D. | 50% inserted | 1,000 ppm |

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:  K1.09  [2.5/2.7]
QID:              P1246   (B2048)

Which one of the following is a reason for installing excess reactivity ($K_{excess}$) in a reactor core?

A.  To compensate for burnout of Xe-135 and Sm-149 during power changes.

B.  To ensure the fuel temperature coefficient remains negative throughout core life.

C.  To compensate for the negative reactivity added by the power coefficient during a power increase.

D.  To compensate for the conversion of U-238 to Pu-239 over core life.

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:            P2847  (B2747)

A nuclear reactor is operating at full power at the beginning of a fuel cycle.  A neutron has just been absorbed by a U-238 nucleus at a resonance energy of 6.7 electron volts.

Which one of the following describes the most likely reaction for the newly formed U-239 nucleus and the effect of this reaction on $K_{excess}$?

A.  Decays over several days to Pu-239, which increases $K_{excess}$.

B.  Decays over several days to Pu-240, which increases $K_{excess}$.

C.  Immediately undergoes fast fission, which decreases $K_{excess}$.

D.  Immediately undergoes thermal fission, which decreases $K_{excess}$.

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:   K1.09   [2.5/2.7]
QID:            P3547  (B3547)

Which one of the following is a benefit of installing excess reactivity ($K_{excess}$) in a nuclear reactor core?

A.  Ensures that sufficient control rod negative reactivity is available to shut down the reactor.

B.  Ensures that the reactor can be made critical during a peak xenon condition after a reactor trip.

C.  Ensures that positive reactivity additions result in controllable reactor power responses.

D.  Ensures that the U-235 fuel enrichment is the same at the beginning and the end of a fuel cycle..

ANSWER:  B.

TOPIC:       192002
KNOWLEDGE:  K1.10  [3.2/3.6]
QID:         P127

Shutdown margin is the actual amount of reactivity...

A.  inserted by burnable poisons at beginning of life.

B.  due to dissolved boron in the reactor coolant system.

C.  by which the reactor is subcritical.

D.  which would be inserted by shutdown bank rods.

ANSWER:  C.

TOPIC:       192002
KNOWLEDGE:  K1.10  [3.2/3.6]
QID:         P245    (B248)

When determining the shutdown margin for an operating nuclear reactor, how many control rods are assumed to remain <u>fully</u> withdrawn?

A.  A single control rod of the highest reactivity worth

B.  A symmetrical pair of control rods of the highest reactivity worth

C.  A single control rod of average reactivity worth

D.  A symmetrical pair of control rods of average reactivity worth

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:  K1.10   [3.2/3.6]
QID:            P345

With a nuclear power plant operating at 85% power and rod control in Manual, the operator borates the reactor coolant system an additional 10 ppm.  Assuming reactor power does not change during the boration, shutdown margin will...

A.  decrease and stabilize at a lower value.

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

C.  increase and stabilize at a higher value.

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

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:  K1.10   [3.2/3.6]
QID:            P746

With a nuclear power plant operating at 75% power and rod control in Manual, the operator dilutes reactor coolant system (RCS) boron concentration by 5 ppm to adjust RCS temperature.  Assuming that reactor power does not change, shutdown margin will...

A.  increase and stabilize at a higher value.

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

C.  decrease and stabilize at a lower value.

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

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.10   [3.2/3.6]
QID:            P1747

A nuclear power plant is operating with the following initial conditions:

Reactor power is 50%
Rod control is in manual
Reactor coolant system (RCS) boron concentration is 600 ppm

Disregarding the effects of fission product poisons, which one of the following will result in a decrease in the available shutdown margin once the plant stabilizes?

A.  Reactor power is reduced to 45% with final RCS boron concentration at 620 ppm.

B.  Reactor power is increased to 55% with final RCS boron concentration at 580 ppm.

C.  Control rods are withdrawn 3 inches with no change in steady-state reactor power or RCS boron concentration.

D.  Control rods are inserted 3 inches with no change in steady-state reactor power or RCS boron concentration.

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.10   [3.2/3.6]
QID:            P2347   (B2348)

Which one of the following core changes will <u>decrease</u> shutdown margin?  Assume no operator actions.

A.  Depletion of fuel during reactor operation

B.  Depletion of burnable poisons during reactor operation

C.  Buildup of Sm-149 following a reactor power transient

D.  Buildup of Xe-135 following a reactor power transient

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.10   [3.2/3.6]
QID:            P2546

A nuclear power plant is operating at 100% power with rod control in Manual.  If no operator action is taken, then during the next two weeks of steady-state operation at 100% power shutdown margin will...

A.  continuously decrease

B.  initially decrease, then return to the same value due to changing coolant temperature.

C.  continuously increase

D.  initially increase, then return to the same value due to changing coolant temperature.

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.11   [2.9/3.0]
QID:            P46

Reactivity is defined as the fractional change in...

A.  reactor power per second.

B.  neutron population per second.

C.  reactor period from criticality.

D.  the effective multiplication factor from criticality.

ANSWER:  D.

TOPIC:           192002
KNOWLEDGE:  K1.11   [2.9/3.0]
QID:             P846

Which term is described by the following?

"The fractional change of the effective multiplication factor from criticality."

A.  1/M

B.  $K_{eff}$

C.  Reactor period

D.  Reactivity

ANSWER:  D.

TOPIC:           192002
KNOWLEDGE:  K1.12   [2.4/2.5]
QID:             P130

With $K_{eff} = 0.985$, how much reactivity must be added to make the nuclear reactor critical?

A.  1.48% ΔK/K

B.  1.50% ΔK/K

C.  1.52% ΔK/K

D.  1.54% ΔK/K

ANSWER:  C.

TOPIC:             192002
KNOWLEDGE:   K1.12   [2.4/2.5]
QID:               P446    (B1548)

With core $K_{eff}$ equal to 0.987, how much reactivity must be added to make the nuclear reactor <u>exactly</u> critical?  (Answer options are rounded to the nearest 0.01% $\Delta K/K$.)

A.  1.01% $\Delta K/K$

B.  1.03% $\Delta K/K$

C.  1.30% $\Delta K/K$

D.  1.32% $\Delta K/K$

ANSWER:  D.

TOPIC:             192002
KNOWLEDGE:   K1.12   [2.4/2.5]
QID:               P1946   (B648)

In a subcritical reactor, $K_{eff}$ was increased from 0.85 to 0.95 by rod withdrawal.  Which one of the following is the approximate amount of reactivity that was added to the core?

A.  0.099 $\Delta K/K$

B.  0.124 $\Delta K/K$

C.  0.176 $\Delta K/K$

D.  0.229 $\Delta K/K$

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:  K1.12   [2.4/2.5]
QID:             P2146   (B2848)

With $K_{eff}$ = 0.982, how much positive reactivity is required to make the nuclear reactor critical?

A.  1.720% ΔK/K

B.  1.767% ΔK/K

C.  1.800% ΔK/K

D.  1.833% ΔK/K

ANSWER:  D.

TOPIC:          192002
KNOWLEDGE:  K1.12   [2.4/2.5]
QID:             P2447   (B1947)

With $K_{eff}$ = 0.985, how much positive reactivity is required to make the nuclear reactor exactly critical?

A.  1.487% ΔK/K

B.  1.500% ΔK/K

C.  1.523% ΔK/K

D.  1.545% ΔK/K

ANSWER:  C.

TOPIC:            192002
KNOWLEDGE:    K1.12    [2.4/2.5]
QID:              P3347    (B748)

With $K_{eff}$ equal to 0.983, how much positive reactivity must be added to make the reactor <u>exactly</u> critical?  (Round answer to nearest 0.01% ΔK/K.)

A.  1.70% ΔK/K

B.  1.73% ΔK/K

C.  3.40% ΔK/K

D.  3.43% ΔK/K

ANSWER:  B.

TOPIC:            192002
KNOWLEDGE:    K1.13    [3.5/3.7]
QID:              P246

A nuclear reactor at the end of core life has been shut down from 100% power and cooled down to 140°F over three days.  During the cooldown, 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.

    Control rods             = ( ) 6.918% ΔK/K
    Xenon                    = ( ) 2.675% ΔK/K
    Power defect             = ( ) 1.575% ΔK/K
    Boron                    = ( ) 1.040% ΔK/K
    Cooldown temperature     = ( ) 0.500% ΔK/K

A.  -8.558% ΔK/K

B.  -6.358% ΔK/K

C.  -3.208% ΔK/K

D.  -1.128% ΔK/K

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:            P346

A nuclear reactor was operating at steady-state 100% power with all control rods fully withdrawn and RCS  $T_{ave}$ at 588°F when a reactor trip occurred.

After the trip $T_{ave}$ stabilized at the no-load temperature of 557°F and all control rods were verified to be fully inserted.

Given the following information, select the current value of core reactivity.  (Assume no operator actions and disregard any reactivity effects of xenon.)

   Power coefficient                           = -0.015% ΔK/K/% power
   Control rod worth                           = -6.918% ΔK/K
   Moderator temperature coefficient  = -0.0012% ΔK/K per °F

A.  -5.381% ΔK/K

B.  -5.418% ΔK/K

C.  -8.383% ΔK/K

D.  -8.418% ΔK/K

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:             P447

A nuclear reactor is operating at steady-state 90% power with all control rods fully withdrawn and $T_{ave}$ at 580 °F.  A reactor trip occurs, after which $T_{ave}$ stabilizes at the no-load temperature of 550 °F and all control rods are verified to be fully inserted.

Given the following information, calculate the current value of core reactivity.  Assume no operator actions and disregard any reactivity effects of xenon.

    Power coefficient                  = -0.01% ΔK/K/% power
    Control rod worth                  = -6.918% ΔK/K
    Moderator temperature coefficient  = -0.01% ΔK/K per °F

A.  -5.718% ΔK/K

B.  -6.018% ΔK/K

C.  -7.518% ΔK/K

D.  -7.818% ΔK/K

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:            P647

Immediately after a reactor trip from 100% power, shutdown margin was determined to be -5.883% ΔK/K.  Over the next 72 hours the reactor coolant system was cooled down and boron concentration was increased.  The reactivities affected by the change in plant conditions are as follows:

| Reactivity | Change (+ or -) |
|---|---|
| Xenon | 2.675% ΔK/K |
| Moderator temperature | 0.5% ΔK/K |
| Boron | 1.04% ΔK/K |

What is the value of core reactivity 72 hours after the trip?  (Assume end of core life.)

A.  -1.668% ΔK/K

B.  -3.748% ΔK/K

C.  -7.018% ΔK/K

D.  -9.098% ΔK/K

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:            P747

A nuclear reactor at end of life has been shut down from 100% power and cooled down to 140 ˚F over three days.  During the cooldown, 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

ANSWER:  C.

TOPIC:         192002
KNOWLEDGE:  K1.13   [3.5/3.7]
QID:           P1047

A nuclear reactor at end of core life has been shut down from 100% power and cooled down to 140 °F over three days.  During the cooldown, 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.

        Moderator temperature   = ( ) 0.50% ΔK/K
        Control rods             = ( ) 6.50% ΔK/K
        Boron                    = ( ) 1.50% ΔK/K
        Power defect             = ( ) 1.75% ΔK/K
        Xenon                    = ( ) 2.75% ΔK/K

A.  -0.0% ΔK/K

B.  -3.0% ΔK/K

C.  -3.5% ΔK/K

D.  -8.5% ΔK/K

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:            P1446

A nuclear reactor at the beginning of core life has been shut down from 100% power and cooled down to 340 ˚F over three days.  During the cooldown, boron concentration was increased by 200 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                     = ( ) 3.0% ΔK/K
    Boron                     = ( ) 3.5% ΔK/K
    Power defect              = ( ) 4.0% ΔK/K
    Control rods              = ( ) 7.0% ΔK/K
    Moderator temperature     = ( ) 2.0% ΔK/K

A.  -1.5% ΔK/K

B.  -2.5% ΔK/K

C.  -7.5% ΔK/K

D.  -9.5% ΔK/K

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:            P1647

A nuclear reactor was operating at 100% power for two months when a reactor trip occurred. During the 14 hours since the trip the reactor has been cooled to 340°F and boron concentration has been increased by 200 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                    = ( ) 2.0% ΔK/K
    Boron                    = ( ) 2.5% ΔK/K
    Power defect             = ( ) 4.0% ΔK/K
    Control rods             = ( ) 7.0% ΔK/K
    Moderator temperature    = ( ) 2.0% ΔK/K

A.  -1.5% ΔK/K

B.  -3.5% ΔK/K

C.  -5.5% ΔK/K

D.  -7.5% ΔK/K

ANSWER:  C.

TOPIC:            192002
KNOWLEDGE:   K1.13   [3.5/3.7]
QID:              P5224

A nuclear reactor was initially operating at steady-state 100% power when it was shut down and cooled down to 200°F over a three-day period.  During the cooldown reactor coolant boron concentration was increased by 80 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.

    Control rods            = ( ) 6.75% ΔK/K
    Xenon                 = ( ) 2.50% ΔK/K
    Power defect           = ( ) 2.00% ΔK/K
    Boron                 = ( ) 1.25% ΔK/K
    Moderator temperature   = ( ) 0.50% ΔK/K

A.  -0.5% ΔK/K

B.  -3.0% ΔK/K

C.  -7.0% ΔK/K

D.  -8.0% ΔK/K

ANSWER:  B.

TOPIC:            192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:              P124

Which one of the following plant parameter changes will result in an <u>increase</u> in shutdown margin for a shutdown nuclear reactor at end of core life?

A.  Reactor coolant boron concentration is decreased by 100 ppm.

B.  One control rod is fully withdrawn for a test.

C.  Xenon has decayed for 72 hours following shutdown.

D.  The reactor coolant system is allowed to heat up 30 °F.

ANSWER:  D.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:             P547

A nuclear power plant is operating at 70% power with manual rod control.  Which one of the following conditions will <u>increase</u> shutdown margin?  (Assume that no unspecified operator actions occur and the reactor does not trip.)

A.  The reactor coolant system is diluted by 10 ppm.

B.  A control rod in a shutdown bank (safety group) drops.

C.  Power is decreased to 50% using boration.

D.  The plant experiences a 3% load rejection.

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:             P2046

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

Which one of the following will increase core $K_{eff}$?

A.  An unrodded spent fuel assembly is removed from the core.

B.  Refueling water temperature is increased to $105°F$.

C.  A new neutron source is installed in the core.

D.  Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:              P2247

A nuclear reactor is operating at 80% power when the operator adds 10 gallons of boric acid to the reactor coolant system (RCS).  Over the next several minutes, the operator adjusts control rod position as necessary to maintain a constant reactor coolant average temperature.

When the plant stabilizes, shutdown margin will be _____; and axial power distribution will have shifted toward the _____ of the core.

A.  the same; top

B.  the same; bottom

C.  larger; top

D.  larger; bottom

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:              P2547

A nuclear power plant malfunction requires a rapid reactor power decrease from 100% to 90%.  The crew hurriedly performs the downpower transient using control rod insertion when necessary.  Reactor coolant boron concentration is <u>not</u> changed.

If the initial shutdown margin was 3.5% $\Delta K/K$, which one of the following describes the shutdown margin at the lower power level?  (Neglect any changes in core fission product reactivity.)

A.  Less than 3.5% $\Delta K/K$ due only to the power defect.

B.  Greater than 3.5% $\Delta K/K$ due only to the insertion of control rods.

C.  Less than 3.5% $\Delta K/K$ due to the combined effects of control rod insertion and power defect.

D.  Equal to 3.5% $\Delta K/K$ regardless of the reactivity effects of control rod insertion and power defect.

ANSWER:  D.

TOPIC:          192002
KNOWLEDGE:  K1.14   [3.8/3.9]
QID:             P2746

A nuclear reactor is shutdown with the reactor vessel head removed for refueling.  The core is covered by 23 feet of refueling water at 105°F with a boron concentration of 2,200 ppm.

Which one of the following will increase core $K_{eff}$?

A.  A new neutron source is installed in the core.

B.  Refueling water temperature is decreased to 100°F.

C.  A spent fuel assembly is replaced with a new fuel assembly.

D.  Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER:  C.

TOPIC:          192002
KNOWLEDGE:  K1.14   [3.8/3.9]
QID:             P2747

Nuclear reactors A and B are identical except that reactor A is operating at steady-state 80% power while reactor B is operating at steady-state 100% power.  Initial control rod positions are the same for each reactor.

How will the shutdown margins (SDM) compare for the two reactors following a reactor trip? (Assume <u>no</u> post-trip operator actions are taken that would affect SDM.)

A.  Reactor A will have the greater SDM.

B.  Reactor B will have the greater SDM.

C.  When sufficient time has passed to allow both cores to become xenon-free, the SDMs will be equal.

D.  Within a few minutes after the trips, when all parameters have returned to normal post-trip conditions, the SDMs will be equal.

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:            P2947

A nuclear reactor is operating at steady-state 50% power.  A plant test requires a 4°F decrease in reactor coolant system (RCS) average temperature (T-avg).  The operator accomplishes this temperature decrease by adjusting RCS boron concentration.  No other operator actions are taken.

If the initial shutdown margin was 3.0% ΔK/K, which one of the following describes the shutdown margin at the lower RCS T-avg with the reactor still at steady-state 50% power?

A.  Less than 3.0% ΔK/K, because RCS T-avg is lower.

B.  More  than 3.0% ΔK/K, because RCS boron concentration is higher.

C.  Equal to 3.0% ΔK/K, because the reactivity change caused by the change in RCS T-avg offsets the reactivity change caused by the change in RCS boron concentration.

D.  Equal to 3.0% ΔK/K because shutdown margin in an operating reactor will <u>not</u> change unless control rod position changes.

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:            P3647   (B3648)

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

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

A.  the same; smaller

B.  the same; the same

C.  less negative; smaller

D.  less negative; the same

ANSWER:  B.

TOPIC:          192002
KNOWLEDGE:  K1.14   [3.8/3.9]
QID:            P3747  (B3748)

A nuclear power plant has just completed a refueling outage.  Reactor engineers have predicted a control rod configuration at which the reactor will become critical during the initial reactor startup following the refueling outage based on the expected core loading.  However, the burnable poisons scheduled to be loaded were inadvertently omitted.

Which one of the following describes the effect of the burnable poison omission on achieving reactor criticality during the initial reactor startup following the refueling outage?

A.  The reactor will become critical before the predicted critical control rod configuration is achieved.

B.  The reactor will become critical after the predicted critical control rod configuration is achieved.

C.  The reactor will be unable to achieve criticality because the fuel assemblies contain insufficient positive reactivity to make the reactor critical.

D.  The reactor will be unable to achieve criticality because the control rods contain insufficient positive reactivity to make the reactor critical.

ANSWER:  A.

TOPIC:          192002
KNOWLEDGE:  K1.14   [3.8/3.9]
QID:            P4224

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

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

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.

ANSWER:  A.

TOPIC:              192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:                 P4924

Nuclear reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle (BOC) and reactor B is operating near the end of a fuel cycle (EOC).  Both reactors are operating at 100% thermal power with all control rods fully withdrawn.

If the total reactivity worth of the control rods is the same for both reactors, which reactor will have the lower $K_{eff}$ five minutes after a reactor trip, and why?

A.  Reactor A, because the power coefficient is less negative near the BOC.

B.  Reactor A, because the concentration of U-235 in the fuel rods is higher near the BOC.

C.  Reactor B, because the power coefficient is more negative near the EOC.

D.  Reactor B, because the concentration of U-235 in the fuel rods is lower near the EOC.

ANSWER:  A.

TOPIC:              192002
KNOWLEDGE:   K1.14   [3.8/3.9]
QID:                 P5324

A nuclear reactor is shutdown with the reactor vessel head removed for refueling.  The core is covered by 23 feet of refueling water at 105°F with a boron concentration of 2,000 ppm.

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

A.  Refueling water temperature decreases by 5°F.

B.  A depleted neutron source is removed from the core.

C.  A spent fuel assembly is replaced with a new fuel assembly.

D.  Refueling water boron concentration decreases by 5 ppm.

ANSWER:  A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P347 (B350)

Which one of the following statements is a characteristic of subcritical multiplication?

A. The subcritical neutron level is directly proportional to the neutron source strength.

B. Doubling the indicated count rate by reactivity additions will reduce the margin to criticality by approximately one quarter.

C. For equal reactivity additions, it takes less time for the new equilibrium source range count rate to be reached as $K_{eff}$ approaches unity.

D. An incremental withdrawal of a given control rod will produce an equivalent equilibrium count rate increase, whether $K_{eff}$ is 0.88 or 0.92.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P448 (B1949)

A subcritical nuclear reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% ΔK/K. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5% ΔK/K

B. 1.0% ΔK/K

C. 1.5% ΔK/K

D. 2.0% ΔK/K

ANSWER: B.

TOPIC:          192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:            P848    (B2149)


A subcritical nuclear reactor has an initial $K_{eff}$ of 0.8 with a stable source range count rate of 100 cps.  If positive reactivity is added until $K_{eff}$ equals 0.95, at what value will the source range count rate stabilize?

A.  150 cps

B.  200 cps

C.  300 cps

D.  400 cps

ANSWER:  D.


TOPIC:          192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:            P1348   (B1449)


A nuclear reactor is shutdown by 1.8% $\Delta K/K$.  Positive reactivity is added which increases stable neutron count rate from 15 to 300 cps.

Assuming the reactor is still subcritical, what is the current value of $K_{eff}$?

A.  0.982

B.  0.990

C.  0.995

D.  0.999

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:  K1.01   [2.7/2.8]
QID:            P1448   (B1840)

A subcritical nuclear reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% $\Delta K/K$.  Approximately how much positive reactivity must be added to establish a stable count rate of 600 cps?

A.  0.5% $\Delta K/K$

B.  1.0% $\Delta K/K$

C.  1.5% $\Delta K/K$

D.  2.0% $\Delta K/K$

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:  K1.01   [2.7/2.8]
QID:            P1748

A subcritical nuclear reactor has an initial source/startup range count rate of 60 cps with a shutdown reactivity of -2.0% $\Delta K/K$.  How much positive reactivity must be added to establish a stable count rate of 300 cps?

A.  0.4% $\Delta K/K$

B.  0.6% $\Delta K/K$

C.  1.4% $\Delta K/K$

D.  1.6% $\Delta K/K$

ANSWER:  D.

TOPIC:           192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:              P1848   (B1170)

A nuclear power plant that has been operating at rated power for two months experiences a reactor trip.  Two months after the reactor trip, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source/startup range nuclear instruments.

The majority of the source/startup range detector output is being caused by the interaction of _____ with the detector.

A.  intrinsic source neutrons

B.  fission gammas from previous power operation

C.  fission neutrons from subcritical multiplication

D.  delayed fission neutrons from previous power operation

ANSWER:  C.

TOPIC:           192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:              P2248   (B2249)

Two nuclear reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 200 neutrons per second. Control rods are stationary and Keff is 0.98 in both reactors.   Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

|  | Reactor A | Reactor B |
|---|---|---|
| A. | 5,000 | 10,000 |
| B. | 10,000 | 20,000 |
| C. | 10,000 | 40,000 |
| D. | 20,000 | 40,000 |

ANSWER:  A.

TOPIC:            192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:              P2448   (B2649)

A nuclear reactor startup is being performed with xenon-free conditions.  Control rod withdrawal is stopped when $K_{eff}$ equals 0.995 and count rate stabilizes at 1,000 cps.  No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A.  1,000 cps and constant.

B.  Less than 1,000 cps and decreasing toward the prestartup count rate.

C.  Less than 1,000 cps and stable above the prestartup count rate.

D.  Greater than 1,000 cps and increasing toward criticality.

ANSWER:  A.

TOPIC:            192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:              P3048   (B3049)

A nuclear reactor startup is being commenced with initial source (startup) range count rate stable at 20 cps.  After a period of control rod withdrawal, count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal is 4.5 %ΔK/K, how much additional positive reactivity must be inserted to make the reactor critical?

A.  1.5 %ΔK/K

B.  2.0 %ΔK/K

C.  2.5 %ΔK/K

D.  3.0 %ΔK/K

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:            P3348

A xenon-free shutdown nuclear power plant is slowly cooling down due to an unisolable steam leak. The leak began when reactor coolant temperature was 400°F and the readings on all source range channels were 80 cps.  Currently, reactor coolant temperature is 350°F and all source range channels indicate 160 cps.

Assume that the moderator temperature coefficient remains constant throughout the cooldown, and no operator action is taken.  What will be the status of the reactor when reactor coolant temperature reaches 290°F?

A.  Subcritical, with source range count rate below 320 cps.

B.  Subcritical, with source range count rate above 320 cps.

C.  Supercritical, with source range count rate below 320 cps.

D.  Supercritical, with source range count rate above 320 cps.

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:            P3848   (B3849)

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

A.  10%

B.  20%

C.  80%

D.  100%

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:  K1.01   [2.7/2.8]
QID:             P3925   (B3925)

A nuclear reactor startup is in progress at a nuclear power plant with core $K_{eff}$ equal to 0.90.  By what factor will the core neutron level have increased when the reactor is stabilized with core $K_{eff}$ equal to 0.99?

A.  10

B.  100

C.  1,000

D.  10,000

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:  K1.01   [2.7/2.8]
QID:             P4225   (B4225)

A nuclear reactor is shutdown with a $K_{eff}$ 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 $K_{eff}$ reaches 0.995?

A.  400 cps

B.  800 cps

C.  4,000 cps

D.  8,000 cps

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:             P4525   (B4525)

A nuclear power plant is being cooled down from 500°F to 190°F.  Just prior to commencing the cooldown, the readings for all source range nuclear instruments were stable at 32 counts per second (cps).  After two hours, with reactor coolant temperature at 350°F, the source range count rate is stable at 64 cps.

Assume that the moderator temperature coefficient remains constant throughout the cooldown, reactor power remains below the point of adding heat, and <u>no</u> reactor protection actions occur.

Without additional operator action, what will be the status of the reactor when reactor coolant temperature reaches 190°F?

A.  Subcritical, with source range count rate below 150 cps

B.  Subcritical, with source range count rate above 150 cps

C.  Exactly critical

D.  Supercritical

ANSWER:  D.

TOPIC:             192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:               P5025

A nuclear power plant is initially shutdown with an effective multiplication factor ($K_{eff}$) of 0.92 and a stable source range count rate of 200 cps.  Then, a reactor startup is initiated.  All control rod motion is stopped when $K_{eff}$ equals 0.995.  The instant that rod motion stops, source range count rate is 600 cps.

When source range count rate stabilizes, count rate will be approximately...

A.  600 cps

B.  650 cps

C.  1,800 cps

D.  3,200 cps

ANSWER:  D.

TOPIC:             192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:               P5225   (B5225)

A nuclear power plant was initially shutdown with a stable source range count rate of 30 cps.  Using many small additions of positive reactivity, a total of 0.1% $\Delta K/K$ was added to the core and stable source range count rate is currently 60 cps.

What was the stable source range count rate after 0.05% $\Delta K/K$ was added to the core?

A.  40 cps

B.  45 cps

C.  50 cps

D.  55 cps

ANSWER:  A.

TOPIC:            192003
KNOWLEDGE:   K1.01   [2.7/2.8]
QID:              P5625

A PWR nuclear power plant has been shut down for two weeks and has the following stable initial conditions:

   Reactor coolant temperature:            550°F
   Reactor coolant boron concentration:   800 ppm
   Source range count rate:                32 cps

A reactor coolant boron dilution is commenced.  After two hours, with reactor coolant boron concentration stable at 775 ppm, the source range count rate is stable at 48 cps.

Assume the boron differential reactivity worth remains constant throughout the dilution.  Also assume that reactor coolant  temperature remains constant, control rod position does <u>not</u> change, and <u>no</u> reactor protection actuations occur.

If the reactor coolant boron concentration is reduced further to750 ppm, what will be the status of the reactor?

A.  Subcritical, with a stable source range count rate of approximately 64 cps.

B.  Subcritical, with a stable source range count rate of approximately 96 cps.

C.  Critical, with a stable source range count rate of approximately 64 cps.

D.  Critical, with a stable source range count rate of approximately 96 cps.

ANSWER: B.

TOPIC:          192003
KNOWLEDGE:   K1.05   [2.7/2.8]
QID:            P548

Reactor power was increased from $10^{-9}$% to $10^{-6}$% in 6 minutes.  The average startup rate was _____ decades per minute.

A.  0.5

B.  1.3

C.  2.0

D.  5.2

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.05   [2.7/2.8]
QID:            P648

Reactor power increases from $10^{-8}$% to 5 x $10^{-7}$% in 2 minutes.  What is the average startup rate?

A.  0.95 dpm

B.  0.90 dpm

C.  0.85 dpm

D.  0.82 dpm

ANSWER:  C.

TOPIC:        192003
KNOWLEDGE:  K1.05  [2.7/2.8]
QID:           P2349  (B2351)

During a nuclear reactor startup, reactor power increases from 1E-8% to 2E-8% in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A.  173 seconds

B.  235 seconds

C.  300 seconds

D.  399 seconds

ANSWER:  A.

TOPIC:        192003
KNOWLEDGE:  K1.05  [2.7/2.8]
QID:           P2648  (B1651)

During a nuclear reactor startup, reactor power increases from $3 \times 10^{-6}\%$ to $5 \times 10^{-6}\%$ in 2 minutes with no operator action. Which one of the following was the average reactor period during the power increase?

A.  357 seconds

B.  235 seconds

C.  155 seconds

D.  61 seconds

ANSWER:  B.

TOPIC:           192003
KNOWLEDGE:  K1.06   [3.2/3.3]
QID:               P47      (B451)

A small amount of positive reactivity is added to a critical reactor in the source/startup range.  The amount of reactivity added is much less than the effective delayed neutron fraction.

Which one of the following will have a <u>significant</u> effect on the magnitude of the stable reactor period achieved for this reactivity addition?

A.  Moderator temperature coefficient

B.  Fuel temperature coefficient

C.  Prompt neutron lifetime

D.  Effective decay constant

ANSWER:  D.

TOPIC:           192003
KNOWLEDGE:  K1.06   [3.2/3.3]
QID:               P126

A nuclear power plant is operating steady-state at 50% power at middle of core life.  Which one of the following conditions will initially produce a positive startup rate?

A.  Increase in turbine loading

B.  Unintentional boration

C.  Turbine runback

D.  Closure of a letdown isolation valve

ANSWER:  A.

TOPIC:         192003
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:           P248

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical nuclear reactor is dependent on the _____ and _____.

A.  prompt neutron lifetime; axial flux distribution

B.  prompt neutron lifetime; effective delayed neutron fraction

C.  effective decay constant; effective delayed neutron fraction

D.  effective decay constant; axial flux distribution

ANSWER:  C.

TOPIC:         192003
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:           P2748   (B2751)

A nuclear reactor is exactly critical at $10^{-8}$% power during a reactor startup.  $\overline{\beta}_{eff}$ for this reactor is 0.0072.  Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable startup rate of 1 dpm?

A.  0.2% ΔK/K

B.  0.5% ΔK/K

C.  1.0% ΔK/K

D.  2.0% ΔK/K

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P3148   (B3151)

A nuclear reactor is being started for the first time following a refueling outage.  Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1% $\Delta$K/K into the reactor core.  Assuming no other reactivity additions, what will be the approximate stable reactor period for this reactor until the point of adding heat is reached?

A.  20 seconds

B.  40 seconds

C.  60 seconds

D.  80 seconds

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:   K1.06   [3.2/3.3]
QID:            P3548   (B3551)

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

Given:

    Reactor A $K_{eff}$ = 0.999
    Reactor B $K_{eff}$ = 0.998

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

A.  Reactor A stable SUR will be higher because it will have the higher positive reactivity in the core.

B.  Reactor B stable SUR will be higher because it has the smaller effective delayed neutron fraction.

C.  Reactors A and B will have the same stable SUR because both reactors will remain subcritical.

D.  Reactors A and B will have the same stable SUR because both reactors received the same amount of positive reactivity.

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P48      (B1950)

Over core life, plutonium isotopes are produced with delayed neutron fractions that are _____ than uranium delayed neutron fractions, thereby causing reactor power transients to be _____ near the end of core life.

A.  larger; slower

B.  larger; faster

C.  smaller; slower

D.  smaller; faster

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P129

When does the power decrease rate initially stabilize at negative one-third decade per minute following a reactor trip?

A.  When decay gamma heating starts adding negative reactivity

B.  When the long-lived delayed neutron precursors have decayed away

C.  When the installed neutron source contribution to the total neutron flux becomes significant

D.  When the short-lived delayed neutron precursors have decayed away

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:             P249

Delayed neutrons contribute more to nuclear reactor stability than prompt neutrons because they _____ the average neutron generation time and are born at a _____ kinetic energy.

A.  increase; lower

B.  increase; higher

C.  decrease; lower

D.  decrease; higher

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:             P348    (B2450)

Which one of the following statements describes the <u>effect</u> of changes in the core delayed neutron fraction from beginning of core life (BOL) to end of core life (EOL)?

A.  A given set of plant parameters at EOL yields a greater shutdown margin (SDM) than at BOL.

B.  A given set of plant parameters at EOL yields a smaller SDM than at BOL.

C.  A given reactivity addition at EOL results in a higher startup rate (SUR) than it would at BOL.

D.  A given reactivity addition at EOL results in a lower SUR than it would at BOL.

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P1149   (B2651)

Delayed neutrons are important for nuclear reactor control because...

A.  they are produced with higher average kinetic energy than prompt neutrons.

B.  they prevent the moderator temperature coefficient from becoming positive.

C.  they are the largest fraction of the neutrons produced from fission.

D.  they greatly extend the average neutron generation lifetime.

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P1248   (B1349)

Two nuclear reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life.  Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, reactor A will attain a negative _____ second stable period and reactor B will attain a negative _____second stable period.  (Assume control rod worth equals -0.9700 $\Delta K/K$ and $\lambda_{eff}$ equals 0.0124 sec$^{-1}$.)

A.  80; 56

B.  80; 80

C.  56; 56

D.  56; 80

ANSWER:  B.

TOPIC:            192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:             P1548  (B1250)

Two nuclear reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life.  Both reactors are critical at $10^{-5}$% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A.  A; smaller

B.  A; larger

C.  B; smaller

D.  B; larger

ANSWER:  A.

TOPIC:            192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:             P1649  (B1649)

Two nuclear reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life.  Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, a power level of $10^{-5}$% will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A.  A; larger

B.  B; larger

C.  A; smaller

D.  B; smaller

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P1749  (B1751)

Which one of the following is the reason that delayed neutrons are so effective at controlling the rate of reactor power changes?

A.  Delayed neutrons make up a large fraction of the fission neutrons in the core compared to prompt neutrons.

B.  Delayed neutrons have a long mean lifetime compared to prompt neutrons.

C.  Delayed neutrons produce a large amount of fast fission compared to prompt neutrons.

D.  Delayed neutrons are born with high kinetic energy compared to prompt neutrons.

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P2249  (B2250)

Which one of the following distributions of fission percentages in a nuclear reactor will result in the largest reactor core effective delayed neutron fraction?

|     | U-235 | U-238 | Pu-239 |
|-----|-------|-------|--------|
| A.  | 90%   | 7%    | 3%     |
| B.  | 80%   | 6%    | 14%    |
| C.  | 70%   | 7%    | 23%    |
| D.  | 60%   | 6%    | 34%    |

ANSWER:  A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2348 (B2349)

Which one of the following percentages of fission, by fuel, occurring in a nuclear reactor will result in the smallest reactor core effective delayed neutron fraction?

| U-235 | U-238 | Pu-239 |
|-------|-------|--------|
| A. 90% | 7% | 3% |
| B. 80% | 6% | 14% |
| C. 70% | 7% | 23% |
| D. 60% | 6% | 34% |

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2849 (B2850)

Two nuclear reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is at the end of core life. Both reactors are critical at $10^{-5}$% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: C.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P2948  (B2950)

A typical  PWR nuclear power plant is operating at equilibrium 50% power when a control rod is ejected from the core.  Which one of the following combinations of fission percentages, by fuel, would result in the highest reactor startup rate?  (Assume the reactivity worth of the ejected control rod is the same for each case.)

|  | U-235 | U-238 | Pu-239 |
|---|---|---|---|
| A. | 60% | 6% | 34% |
| B. | 70% | 7% | 23% |
| C. | 80% | 6% | 14% |
| D. | 90% | 7% | 3% |

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P3248  (B3249)

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

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

A.  A; larger

B.  B; larger

C.  A; smaller

D.  B; smaller

ANSWER:  B.

TOPIC:         192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:           P3648  (B3650)

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

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

A.  A; larger

B.  B; larger

C.  A; smaller

D.  B; smaller

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P3748   (B3749)

A step positive reactivity addition of 0.001 ΔK/K is made to a nuclear reactor with a stable neutron population and an initial core $K_{eff}$ of 0.99.  Consider the following two cases:

    Case 1:  The reactor is near the beginning of core life.
    Case 2:  The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case.  Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

A.  The prompt jump will be greater for case 1, but the final stable neutron population will be the same for both cases.

B.  The prompt jump will be greater for case 2, but the final stable neutron population will be the same for both cases.

C.  The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 1.

D.  The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 2.

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:            P3849

A nuclear reactor is critical in the source range during the initial reactor startup immediately following a refueling outage.  The core effective delayed neutron fraction is 0.0062.  The operator adds positive reactivity to establish a stable 0.5 dpm startup rate.

If the reactor had been at the end of core life with a core effective delayed neutron fraction of 0.005, what would be the approximate stable startup rate after the addition of the same amount of positive reactivity?

A.  0.55 dpm

B.  0.65 dpm

C.  0.75 dpm

D.  0.85 dpm

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:              P4425   (B4425)

The following data is given for the fuel in an operating nuclear reactor core:

| Nuclide | Delayed Neutron Fraction | Fraction of Total Fuel Composition | Fraction of Total Fission Rate |
|---------|--------------------------|-------------------------------------|--------------------------------|
| U-235   | 0.0065                   | 0.03                                | 0.73                           |
| U-238   | 0.0148                   | 0.96                                | 0.07                           |
| Pu-239  | 0.0021                   | 0.01                                | 0.20                           |

What is the approximate core delayed neutron fraction for this reactor?

A.  0.0052

B.  0.0054

C.  0.0062

D.  0.0068

ANSWER:  C.

TOPIC:            192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:              P5425   (B5425)

The following data is given for the fuel in an operating nuclear reactor core:

| Nuclide | Delayed Neutron Fraction | Fraction of Total Fuel Composition | Fraction of Total Fission Rate |
|---------|--------------------------|-----------------------------------|-------------------------------|
| U-235   | 0.0065                   | 0.023                             | 0.63                          |
| U-238   | 0.0148                   | 0.965                             | 0.07                          |
| Pu-239  | 0.0021                   | 0.012                             | 0.30                          |

What is the core delayed neutron fraction for this reactor?

A.  0.0052

B.  0.0058

C.  0.0072

D.  0.0078

ANSWER:  B.

TOPIC:            192003
KNOWLEDGE:   K1.07   [3.0/3.0]
QID:              P5525   (B5525)

Which characteristic of delayed neutrons is primarily responsible for enhancing the stability of a nuclear reactor following a reactivity change?

A.  They are born at a lower average energy than prompt neutrons.

B.  They are more likely to experience resonance absorption than prompt neutrons.

C.  They comprise a smaller fraction of the total neutron flux than prompt neutrons.

D.  They require more time to be produced following a fission event than prompt neutrons.

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:  K1.08   [2.8/2.9]
QID:            P549    (B3351)

Which one of the following describes a condition in which a nuclear reactor is prompt critical?

A.  A very long reactor period makes reactor control very sluggish and unresponsive.

B.  The fission process is occurring so rapidly that the delayed neutron fraction approaches zero.

C.  Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D.  The net positive reactivity in the core is greater than or equal to the magnitude of the effective delayed neutron fraction.

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:  K1.08   [2.8/2.9]
QID:            P748    (B664)

A critical nuclear reactor will become prompt critical when reactivity is added equal in magnitude to the...

A.  shutdown margin.

B.  effective delayed neutron fraction.

C.  effective decay constant.

D.  worth of the most reactive rod.

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:             P949

A nuclear reactor is operating at 75% power with the following conditions:

Power defect                          = -0.0157 Δ/K/K
Shutdown margin                   = 0.0241 Δ/K/K
Effective delayed neutron fraction  = 0.0058
Effective prompt neutron fraction  = 0.9942

How much positive reactivity must be added to take the reactor "prompt critical"?

A.  0.0157 ΔK/K

B.  0.0241 ΔK/K

C.  0.0058 ΔK/K

D.  0.9942 ΔK/K

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:             P1449

A nuclear reactor is exactly critical several decades below the point of adding heat (POAH) with a xenon-free core.  The operator continuously withdraws control rods until a positive 0.5 decades per minute (dpm) startup rate (SUR) is reached and then stops control rod motion.

When rod motion is stopped, SUR will immediately...    (Neglect any reactivity effects of fission products.)

A.  stabilize at 0.5 dpm until power reaches the POAH.

B.  decrease, and then stabilize at a value less than 0.5 dpm until power reaches the POAH.

C.  stabilize at 0.5 dpm, and then slowly and continuously decrease until power reaches the POAH.

D.  decrease, and then continue to slowly decrease until power reaches the POAH.

ANSWER:  B.

TOPIC:           192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:             P1948   (B1150)

Positive reactivity is continuously added to a critical nuclear reactor.  Which one of the following values of core $K_{eff}$ will first result in a prompt critical reactor?

A.  1.0001

B.  1.001

C.  1.01

D.  1.1

ANSWER:  C.

TOPIC:           192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:             P2049

A nuclear reactor has a stable positive 1.0 dpm startup rate with no control rod motion several decades below the point of adding heat (POAH).  The operator then inserts control rods until a positive 0.5 dpm startup rate is attained and then stops control rod motion.

When rod insertion is stopped, reactor startup rate will immediately...

A.  stabilize at 0.5 dpm until power reaches the POAH.

B.  increase, and then stabilize at a value greater than 0.5 dpm until power reaches the POAH.

C.  stabilize, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

D.  increase, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:            P2549  (B2550)

A nuclear reactor was stable at 80% power when the reactor operator withdrew control rods continuously for 2 seconds.  Which one of the following affects the amount of "prompt jump" increase in reactor power for the control rod withdrawal?

A.  The duration of control rod withdrawal

B.  The differential control rod worth

C.  The total control rod worth

D.  The magnitude of the fuel temperature coefficient

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:            P2949  (B2951)

A nuclear reactor is operating at equilibrium 75% power with the following conditions:

Total power defect              = -0.0185 $\Delta K/K$
Shutdown margin                 =  0.0227 $\Delta K/K$
Effective delayed neutron fraction =  0.0061
Effective prompt neutron fraction  =  0.9939

How much positive reactivity must be added to make the reactor "prompt critical"?

A.  0.0061 $\Delta K/K$

B.  0.0185 $\Delta K/K$

C.  0.0227 $\Delta K/K$

D.  0.9939 $\Delta K/K$

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:             P3249   (B3250)

Refer to the unlabeled nuclear reactor response curve shown below for a reactor that was initially stable in the source range.   Both axes have linear scales.  A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that was initially _____.

A.  startup rate; subcritical

B.  startup rate; critical

C.  reactor fission rate; subcritical

D.  reactor fission rate; critical

ANSWER:  C.
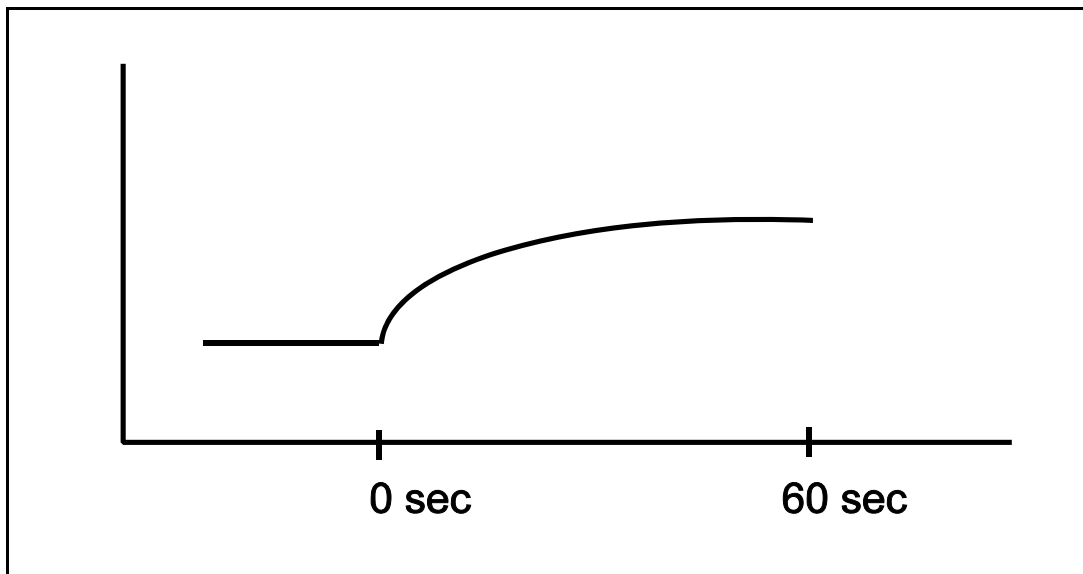
TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3449 (B3450)

Two nuclear reactors, A and B, are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 $\Delta K/K$) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be _____ than reactor A (BOL); and the stable startup rate observed for reactor B (EOL) will be _____ than reactor A (BOL).

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

ANSWER: A.

TOPIC:         192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:         P3649  (B3651)

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

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

A.   startup rate; exactly critical

B.   startup rate; supercritical

C.   reactor fission rate; exactly critical

D.   reactor fission rate; supercritical

ANSWER:  D.
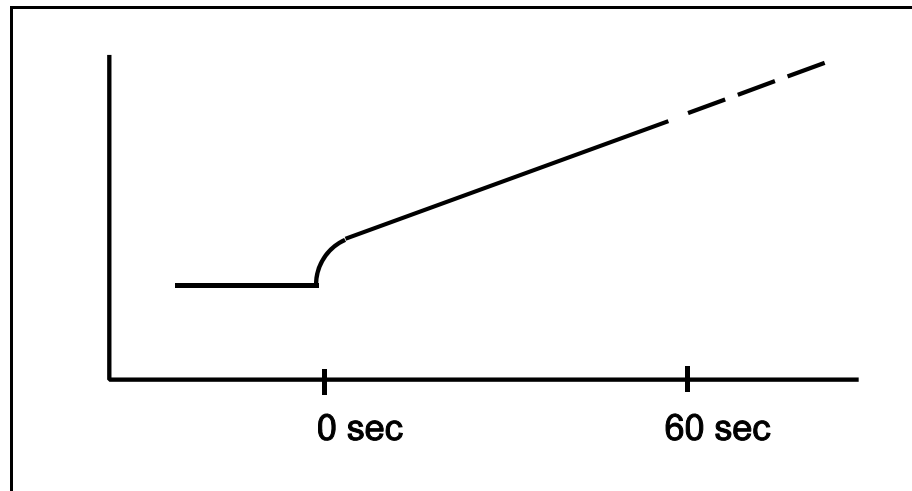
TOPIC:          192003
KNOWLEDGE:   K1.08   [2.8/2.9]
QID:            P3749   (B3750)

A nuclear reactor is operating at equilibrium 75% power with the following conditions:

Total power defect                      = -0.0176 ΔK/K
Shutdown margin                        = 0.0234 ΔK/K
Effective delayed neutron fraction   = 0.0067
Effective prompt neutron fraction    = 0.9933

How much positive reactivity must be added to make the reactor "prompt critical"?

A.   0.0067 ΔK/K

B.   0.0176 ΔK/K

C.   0.0234 ΔK/K

D.   0.9933 ΔK/K

ANSWER:  A.

TOPIC:          192003
KNOWLEDGE:   K1.11   [2.7/2.8]
QID:            P49

An installed neutron source...

A.   maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B.   provides a means to allow reactivity changes to occur in a subcritical reactor.

C.   generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D.   provides a neutron level that is detectable on the source range nuclear instrumentation.

ANSWER:  D.

TOPIC:          192003
KNOWLEDGE:   K1.11   [2.7/2.8]
QID:             P349

Neutron sources are installed in the nuclear reactor core for which one of the following reasons?

A.  To decrease the amount of fuel load required for criticality

B.  To compensate for those neutrons absorbed in burnable poisons

C.  To augment shutdown neutron population to allow detection on nuclear instrumentation

D.  To provide enough neutrons in a shutdown reactor to start a chain reaction for reactor startup

ANSWER:  C.

TOPIC:          192003
KNOWLEDGE:   K1.11   [2.7/2.8]
QID:             P1249

Which one of the following neutron reactions produces the largest contribution to the intrinsic source neutron level immediately following a reactor trip from extended power operations during the tenth fuel cycle?  (Neglect any contribution from an installed neutron source.)

A.  Alpha-neutron reactions

B.  Beta-neutron reactions

C.  Photo-neutron reactions

D.  Spontaneous fission

ANSWER:  C.

TOPIC:              192003
KNOWLEDGE:    K1.11    [2.7/2.8]
QID:                  P1549   (B1549)

Which one of the following intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period immediately following a reactor trip from steady-state 100% power?

A.   Spontaneous fission reactions

B.   Photo-neutron reactions

C.   Alpha-neutron reactions

D.   Transuranic isotope decay

ANSWER:  B.

TOPIC:              192003
KNOWLEDGE:    K1.11    [2.7/2.8]
QID:                  P2149   (B2150)

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation for a significant time period following a reactor shutdown from extended power operations, without installed neutron sources.  This is because a sufficient number of source neutrons is being produced by intrinsic sources, with the largest contributor during the first few days after shutdown being...

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.

ANSWER:  B.

TOPIC:          192003
KNOWLEDGE:   K1.11   [2.7/2.8]
QID:            P3149   (B967)

Which one of the following describes the purpose of a neutron source that is installed in a nuclear reactor during refueling for the third fuel cycle?

A.  Ensures shutdown neutron level is large enough to be detected by nuclear instrumentation.

B.  Provides additional excess reactivity to increase the length of the fuel cycle.

C.  Amplifies the electrical noise fluctuations observed in source/startup range instrumentation during shutdown.

D.  Supplies the only shutdown source of neutrons available to begin a reactor startup.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.01   [3.1/3.2]
QID:            P133

Moderator temperature coefficient is defined as the change in core reactivity per degree change in...

A.  fuel temperature.

B.  fuel clad temperature.

C.  reactor vessel temperature.

D.  reactor coolant temperature.

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.02   [3.0/3.2]
QID:            P350    (B353)

Which one of the following will result in a <u>less</u> <u>negative</u> 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.

ANSWER:  D.

TOPIC:        192004
KNOWLEDGE:  K1.02  [3.0/3.2]
QID:          P650   (B1952)

Which one of the following isotopes is the <u>most</u> significant contributor to resonance capture of fission neutrons in a nuclear reactor core at the beginning of core life?

A. U-233

B. U-238

C. Pu-239

D. Pu-240

ANSWER:  B.

TOPIC:        192004
KNOWLEDGE:  K1.02  [3.0/3.2]
QID:          P1950  (B753)

Factors that affect resonance absorption of a neutron by a nucleus include...

A.  kinetic energy of the nucleus, kinetic energy of the neutron, and excitation energy of the nucleus.

B.  kinetic energy of the neutron, excitation energy of the nucleus, and excitation energy of the neutron.

C.  excitation energy of the nucleus, excitation energy of the neutron, and kinetic energy of the nucleus.

D.  excitation energy of the neutron, kinetic energy of the nucleus, and kinetic energy of the neutron.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.02   [3.0/3.2]
QID:            P2050   (B3352)

Which one of the following isotopes is the most significant contributor to resonance capture of fission neutrons in a nuclear reactor core at the end of a fuel cycle?

A.  U-235

B.  U-238

C.  Pu-239

D.  Pu-240

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.02   [3.0/3.2]
QID:            P3150   (B3153)

Which one of the following exhibits the smallest microscopic cross section for absorption of a thermal neutron in an operating nuclear reactor?

A.  Uranium-235

B.  Uranium-238

C.  Samarium-149

D.  Xenon-135

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:              P251    (B2252)

Under which one of the following conditions is a nuclear reactor core most likely to have a <u>positive</u> moderator temperature coefficient?

A.  Low coolant temperature at beginning-of-life

B.  Low coolant temperature at end-of-life

C.  High coolant temperature at beginning-of-life

D.  High coolant temperature at end-of-life

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:              P1150

A nuclear reactor has operated at steady-state 100% power for the past 6 months.  Compared to 6 months ago, current moderator temperature coefficient is...

A.  more negative due to control rod withdrawal.

B.  less negative due to control rod insertion.

C.  more negative due to decreased reactor coolant system (RCS) boron concentration.

D.  less negative due to increased RCS boron concentration.

ANSWER:  C.

TOPIC:            192004
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:               P1650   (B652)

Which one of the following contains the pair of nuclides that are the <u>most</u> significant contributors to the total resonance capture in the core near the end of a fuel cycle?

A.  Pu-239 and U-235

B.  Pu-239 and Pu-240

C.  U-238 and Pu-240

D.  U-238 and Pu-239

ANSWER:  C.

TOPIC:            192004
KNOWLEDGE:   K1.03   [2.9/3.1]
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:               P2150

Which one of the following conditions will cause the moderator temperature coefficient (MTC) to become more negative?  (Consider only the direct effect of the indicated change on MTC.)

A.  The controlling bank of control rods is inserted 5% into the core.

B.  Fuel temperature decreases from 1500°F to 1200°F.

C.  Reactor coolant boron concentration increases by 20 ppm.

D.  Moderator temperature decreases from 500°F to 450°F.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:            P2151  (B2152)

Which one of the following contains the nuclides responsible for most of the resonance capture of fission neutrons in a nuclear reactor core at the beginning of the sixth fuel cycle?  (Assume that each refueling replaces one-third of the fuel.)

A.  U-235 and Pu-239

B.  U-235 and U-238

C.  U-238 and Pu-239

D.  U-238 and Pu-240

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.03   [2.9/3.1]
QID:            P2251  (B652)

Which one of the following contains two isotopes, both of which are responsible for the negative reactivity inserted when fuel temperature increases near the end of core life?

A.  U-235 and Pu-239

B.  U-235 and Pu-240

C.  U-238 and Pu-239

D.  U-238 and Pu-240

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P50

As the reactor coolant boron concentration increases, the moderator temperature coefficient becomes less negative.  This is because, at higher boron concentrations, a 1°F increase in reactor coolant temperature at higher boron concentrations results in a larger increase in the...

A.  fast fission factor.

B.  thermal utilization factor.

C.  total nonleakage probability.

D.  resonance escape probability.

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P123

In which of the following conditions is the moderator temperature coefficient <u>most</u> negative?

A.  Beginning of core life (BOL), high temperature

B.  BOL, low temperature

C.  End of core life (EOL), high temperature

D.  EOL, low temperature

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:             P252

During a nuclear power plant heat-up at end of core life, the moderator temperature coefficient becomes increasingly more <u>negative</u> .  This is because...

A.  as moderator density decreases, more thermal neutrons are absorbed by the moderator than by the fuel.

B.  the change in the thermal utilization factor dominates the change in the resonance escape probability.

C.  a greater density change per °F occurs at higher reactor coolant temperatures.

D.  the core transitions from an undermoderated condition to an overmoderated condition.

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:             P450

The moderator temperature coefficient will be least negative at a _____ reactor coolant temperature and a _____ reactor coolant boron concentration.

A.  high; high

B.  high; low

C.  low; high

D.  low; low

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P751    (B651)

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

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.

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P951    (B2452)

During a reactor coolant system (RCS) cooldown, positive reactivity is added to the core (assuming a negative moderator temperature coefficient).  This is partially due to...

A.  a decrease in the thermal utilization factor.

B.  an increase in the thermal utilization factor.

C.  a decrease in the resonance escape probability.

D.  an increase in the resonance escape probability.

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P1250

As the core ages, the moderator temperature coefficient becomes more negative.  This is primarily due to...

A.  fission product poison buildup in the fuel.

B.  decreasing fuel centerline temperature.

C.  decreasing control rod worth.

D.  decreasing reactor coolant system boron concentration.

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P1450

The moderator temperature coefficient will be <u>most</u> negative at a _____ reactor coolant temperature and a _____ reactor coolant boron concentration.

A.  low; low

B.  high; low

C.  low; high

D.  high; high

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P1752  (B1752)

Which one of the following describes the net reactivity effect of a moderator temperature decrease in an undermoderated nuclear reactor core?

A.  Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B.  Negative reactivity will be added because more neutrons will be captured by the moderator.

C.  Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

D.  Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:            P1850

Which one of the following describes why the moderator temperature coefficient is more negative at the end of core life (EOL) compared to the beginning of core life (BOL)?

A.  Increased nucleate boiling at the EOL amplifies the negative reactivity added by a 1°F moderator temperature increase.

B.  Increased control rod insertion at the EOL amplifies the negative reactivity added by a 1°F moderator temperature increase.

C.  Decreased fuel temperature at the EOL results in reduced resonance neutron capture for a 1°F increase in moderator temperature.

D.  Decreased coolant boron concentration at the EOL results in fewer boron atoms leaving the core for a 1°F moderator temperature increase.

ANSWER:  D.

TOPIC:        192004
KNOWLEDGE:  K1.06  [3.1/3.1]
QID:          P2650  (B2652)

Which one of the following describes the net reactivity effect of a moderator temperature decrease in an overmoderated reactor core?

A.  Positive reactivity will be added because fewer neutrons will be captured by the moderator.

B.  Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

C.  Negative reactivity will be added because more neutrons will be captured by the moderator.

D.  Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

ANSWER:  C.

TOPIC:        192004
KNOWLEDGE:  K1.06  [3.1/3.1]
QID:          P2750

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.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:  K1.06   [3.1/3.1]
QID:             P2950   (B2952)

Which one of the following describes the net reactivity effect of a moderator temperature increase in an overmoderated nuclear reactor core?

A.  Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B.  Negative reactivity will be added because more neutrons will be captured by the moderator.

C.  Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down..

D.  Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:  K1.06   [3.1/3.1]
QID:             P3151   (B3152)

How does the addition of boric acid to the reactor coolant affect the moderator temperature coefficient in an undermoderated nuclear reactor core?

A.  The initially negative MTC becomes more negative.

B.  The initially negative MTC becomes less negative.

C.  The initially positive MTC becomes more positive.

D.  The initially positive MTC becomes less positive.

ANSWER:  B.

TOPIC:            192004
KNOWLEDGE:   K1.06   [2.5/2.6]
QID:              P3352

As compared to the moderator temperature coefficient (MTC) of reactivity at the beginning of core life, the MTC at the end of core life is:  (Assume 100% power for all cases.)

A.  more negative because as U-235 depletes, more fission neutrons are able to escape resonance capture.

B.  less negative because as U-238 depletes, more fission neutrons are able to escape resonance capture.

C.  more negative because as reactor coolant boron concentration decreases, the thermal utilization of fission neutrons increases.

D.  less negative because as control rods are withdrawn from the core, the thermal utilization of fission neutrons increases.

ANSWER:  C.

TOPIC:            192004
KNOWLEDGE:   K1.06   [3.1/3.1]
QID:              P3650   (B3652)

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

A.  Negative reactivity will be added because more neutrons will be absorbed by U-238 at resonance energies while slowing down.

B.  Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.

C.  Positive reactivity will be added because fewer neutrons will be absorbed by U-238 at resonance energies while slowing down.

D.  Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P51

Why does the fuel temperature (Doppler) coefficient becomes <u>less</u> negative at higher fuel temperatures?

A.  As reactor power increases, the rate of increase in the fuel temperature diminishes.

B.  Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

C.  The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

D.  The amount of Doppler broadening per degree change in fuel temperature diminishes.

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P651

Which one of the following will cause the Doppler power coefficient to become <u>more</u> negative?

A.  Increased clad creep

B.  Increased pellet swell

C.  Lower power level

D.  Higher reactor coolant boron concentration

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P1052

As core age increases, for the same power level the fuel temperature coefficient of reactivity becomes _____ negative because average fuel temperature _____.

A.  more; decreases

B.  more; increases

C.  less; decreases

D.  less; increases

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P1851

Which one of the following pairs of isotopes is responsible for the negative reactivity associated with a fuel temperature increase near the end of core life?

A.  U-235 and Pu-239

B.  U-235 and Pu-240

C.  U-238 and Pu-239

D.  U-238 and Pu-240

ANSWER:  D.

TOPIC:           192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:             P1951   (B1553)

A nuclear power plant is operating at 70% power.  Which one of the following will result in a less negative fuel temperature coefficient?  (Consider only the direct effect of the change in each listed parameter.)

A.  Increase in Pu-240 inventory in the core

B.  Increase in moderator temperature

C.  Increase in fuel temperature

D.  Increase in void fraction

ANSWER:  C.

TOPIC:           192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:             P2052   (B2053)

Compared to operation at a low power level, the fuel temperature coefficient of reactivity at a high power level is _____ negative due to _____.  (Assume the same core age.)

A.  less; improved pellet-to-clad heat transfer

B.  more; buildup of fission product poisons

C.  less; higher fuel temperature

D.  more; increased neutron flux

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:             P2352   (B2453)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 (see figure below).

If fuel temperature increases, the area under the curve will _____ and negative reactivity will be added to the core because _____.

A.  increase; neutrons of a wider range of energies will be absorbed by U-238

B.  increase; more neutrons will be absorbed by U-238 at the resonance neutron energy

C.  remain the same; neutrons of a wider range of energies will be absorbed by U-238

D.  remain the same; more neutrons will be absorbed by U-238 at the resonance neutron energy

ANSWER:  C.
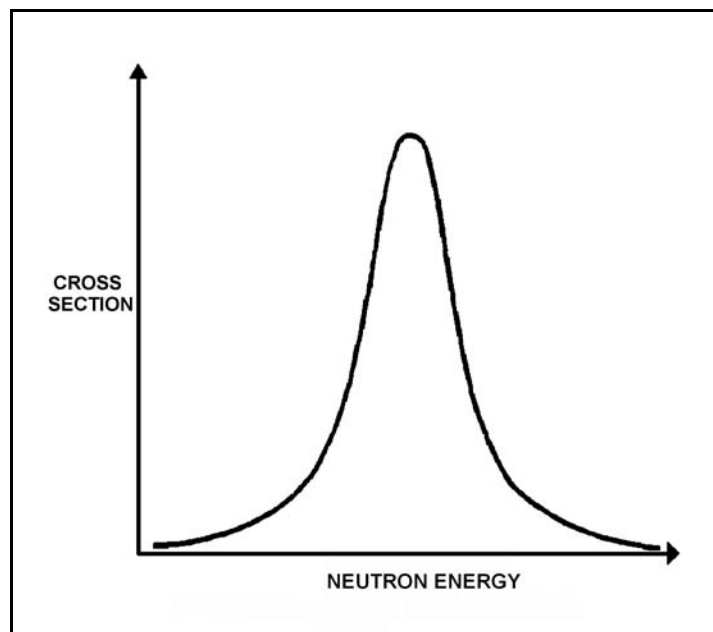
TOPIC:          192004
KNOWLEDGE:  K1.07   [2.9/2.9]
QID:             P2451   (B552)

Which one of the following describes how the magnitude of the fuel temperature coefficient of reactivity is affected over core life?

A.  It remains essentially constant over core life.

B.  It becomes more negative due to the buildup of Pu-240.

C.  It becomes less negative due to the decrease in RCS boron concentration.

D.  It becomes more negative initially due to buildup of fissions product poisons, then less negative due to fuel depletion.

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:  K1.07   [2.9/2.9]
QID:             P2651   (B2553)

The fuel temperature (Doppler) coefficient of reactivity is more negative at the _____ of a fuel cycle because _____.  (Assume the same initial fuel temperature throughout the fuel cycle.)

A.  end; more Pu-240 is in the core

B.  end; more fission products are in the core

C.  beginning; more U-238 is in the core

D.  beginning; less fission products are in the core

ANSWER:  A.

TOPIC:           192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:              P2751   (B2753)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (ev) resonance peak in U-238 for a nuclear reactor operating at 50% 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

ANSWER:  C.
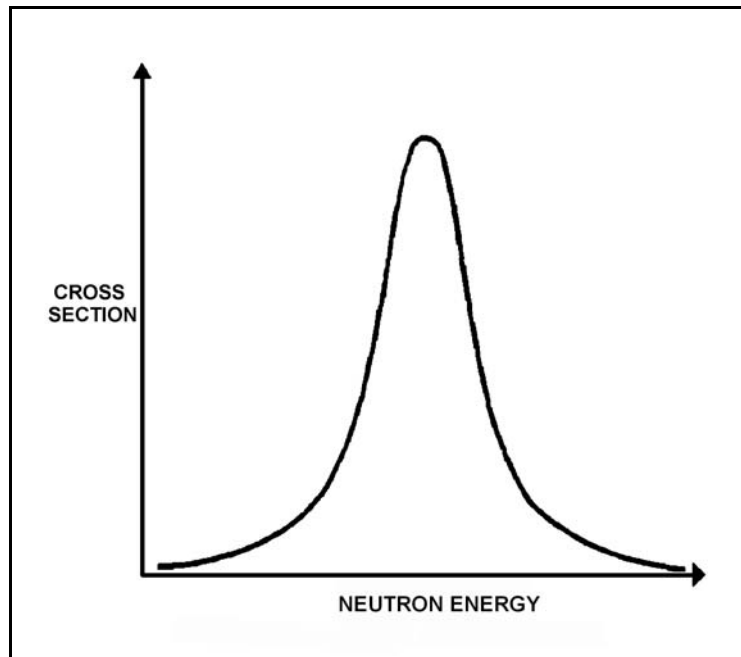
TOPIC:            192004
KNOWLEDGE:  K1.07   [2.9/2.9]
QID:               P2850   (B2852)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a nuclear reactor operating at 80% power (see figure below).

If reactor power is increased to 100%, the height of the curve will _____ and the area under the curve will _____.

A.  increase; increase

B.  increase; remain the same

C.  decrease; decrease

D.  decrease; remain the same

ANSWER:  D
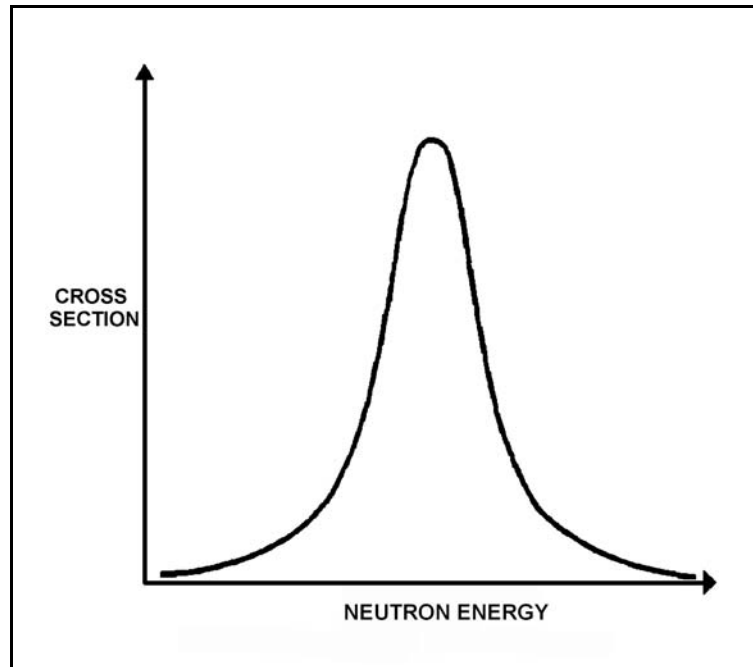
TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P3750  (B3753)

Refer to the drawing of a curve showing the neutron absorption characteristics of a typical U-238 nucleus at a resonance neutron energy (see figure below).  The associated nuclear reactor is currently operating at steady-state 80% power.

During a subsequent reactor power decrease to 70%, the curve will become _____; and the percentage of the core neutron population lost to resonance capture by U-238 will _____.

A.  taller and more narrow; decrease

B.  taller and more narrow; increase

C.  shorter and broader; decrease

D.  shorter and broader; increase

ANSWER:  A.
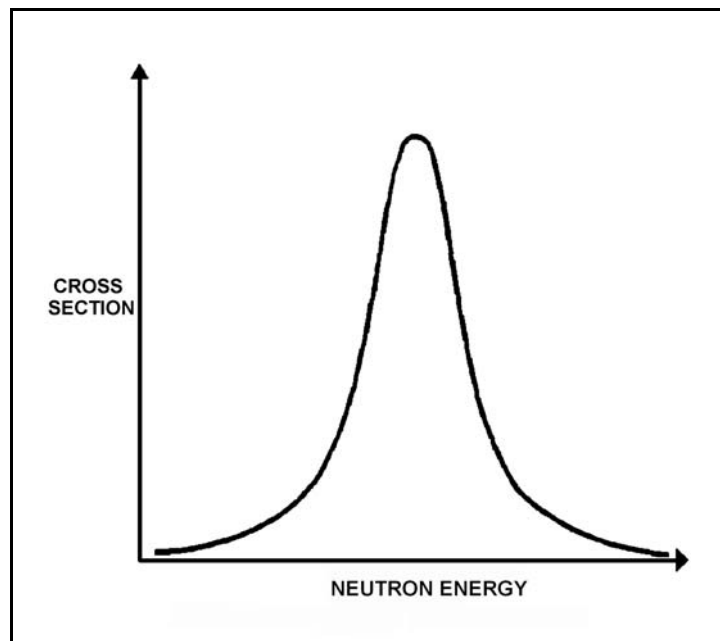
TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P3850 (B3852)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a nuclear reactor operating at 80% power (see figure below).

If reactor power is decreased to 60%, the height of the curve will _____ and the area under the curve will _____ .

A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.

*August 2008*
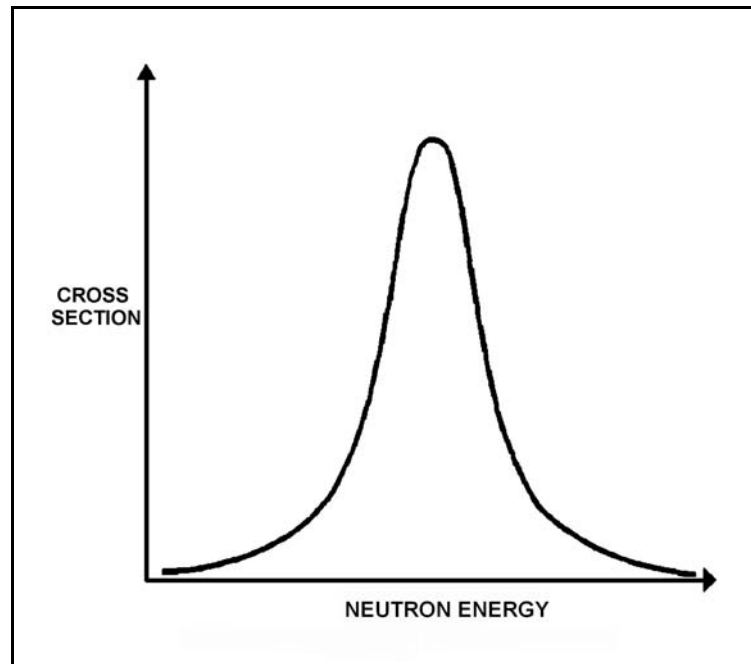
TOPIC:          192004
KNOWLEDGE:   K1.07   [2.9/2.9]
QID:            P4826   (B4826)

If the average temperature of a fuel pellet decreases by 50°F, the microscopic cross-section for absorption of neutrons at a resonance energy of U-238 will _____; and the microscopic cross-sections for absorption of neutrons at energies that are slightly higher or lower than a U-238 resonance energy will _____.

A.  increase; increase

B.  increase; decrease

C.  decrease; increase

D.  decrease; decrease

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.08   [3.1/3.1]
QID:            P253

Which one of the following groups contain parameters that, if varied, will each have a <u>direct</u> effect on the power coefficient?

A.  Control rod position, reactor power, moderator voids

B.  Moderator temperature, RCS pressure, Xenon level

C.  Fuel temperature, xenon level, control rod (CEA) position

D.  Moderator voids, fuel temperature, moderator temperature

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:   K1.08   [3.1/3.1]
QID:            P652

Which one of the following adds the most positive reactivity following a reactor trip/scram from full power at the beginning of core life?  (Assume reactor coolant system parameters stabilize at their normal post-trip values.)

A.  Void coefficient

B.  Pressure coefficient

C.  Fuel temperature coefficient

D.  Moderator temperature coefficient

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.08   [3.1/3.1]
QID:            P851

A nuclear power plant is initially operating at 50% power.  Which one of the following contains only parameters that, if varied, will each directly change the magnitude of the power defect?

A.  Control rod position, reactor power, and moderator voids

B.  Moderator voids, fuel temperature, and moderator temperature

C.  Fuel temperature, xenon concentration, and control rod position

D.  Moderator temperature, reactor coolant pressure, and xenon concentration

ANSWER:  B.

TOPIC:            192004
KNOWLEDGE:   K1.08   [3.1/3.1]
QID:              P1353

A nuclear reactor is exactly critical at the point of adding heat during a xenon-free reactor startup at the beginning of core life.  Reactor power is ramped to 50% over the next 4 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A.  buildup of core Xe-135.

B.  increased fuel temperature.

C.  burnout of burnable poisons.

D.  increased reactor coolant temperature.

ANSWER:  B.

TOPIC:            192004
KNOWLEDGE:   K1.08   [3.1/3.1]
QID:              P1551

A nuclear reactor has been operating at steady state 50% power for one month following a refueling outage.  Reactor power is ramped to 100% over the next 2 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A.  increased reactor coolant temperature.

B.  buildup of core Xe-135.

C.  burnout of burnable poisons.

D.  increased fuel temperature.

ANSWER:  D.

TOPIC:         192004
KNOWLEDGE:  K1.09   [2.8/2.9]
QID:           P552

As reactor coolant boron concentration is reduced differential  boron reactivity worth (ΔK/K per ppm) becomes...

A.  less negative due to the increased number of water molecules in the core.

B.  more negative due to the increased number of water molecules in the core.

C.  less negative due to the decreased number of boron molecules in the core.

D.  more negative due to the decreased number of boron molecules in the core.

ANSWER:  D.

TOPIC:         192004
KNOWLEDGE:  K1.09   [2.8/2.9]
QID:           P1350

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; lower

B.  higher; higher

C.  lower; lower

D.  lower; higher

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:  K1.10   [2.9/2.9]
QID:            P1152

Differential boron reactivity worth will become _____ negative as moderator temperature increases because, at higher moderator temperatures, a 1 ppm increase in reactor coolant system boron concentration will add _____ boron atoms to the core.

A.  more; fewer

B.  more; more

C.  less; fewer

D.  less; more

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:  K1.10   [2.9/2.9]
QID:            P1252

Differential boron worth ($\Delta K/K$/ppm) becomes more negative as...

A.  burnable poisons deplete.

B.  boron concentration increases.

C.  moderator temperature increases.

D.  fission product poison concentration increases.

ANSWER:  A.

TOPIC:          192004
KNOWLEDGE:   K1.10   [2.9/2.9]
QID:            P3552

The following are the <u>initial</u> conditions for a nuclear power plant:

Reactor power is 50%.
Average reactor coolant temperature is 570°F.

After a power increase, <u>current</u> plant conditions are as follows:

Reactor power is 80%.
Average reactor coolant temperature is 582°F.

Assume that the initial and current reactor coolant boron concentrations are the same.  Which one of the following describes the current differential boron worth (DBW) in comparison to the initial DBW?

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

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

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

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

ANSWER:  D.

TOPIC:              192004
KNOWLEDGE:   K1.11   [2.9/3.1]
QID:                   P351

The amount of boric acid required to increase the reactor coolant boron concentration by 50 ppm at the beginning of core life (1200 ppm) is approximately _____ as the amount of boric acid required to increase boron concentration by 50 ppm at the end of core life (100 ppm).

A.  the same

B.  four times as large

C.  eight times as large

D.  twelve times as large

ANSWER:  A.

TOPIC:              192004
KNOWLEDGE:   K1.11   [2.9/3.1]
QID:                   P1050

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

A.  one-tenth

B.  the same as

C.  10 times

D.  100 times

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:  K1.12   [2.7/2.7]
QID:            P52

A reactivity coefficient measures a/an _____ change in reactivity while a reactivity defect measures a _____ change in reactivity due to a change in the measured parameter.

A.  integrated; total

B.  integrated; differential

C.  unit; total

D.  unit; differential

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:  K1.12   [2.7/2.7]
QID:            P352

Given the following initial parameters, select the final reactor coolant boron concentration required to <u>decrease</u> average coolant temperature by 4°F.  (Assume no change in rod position or reactor/turbine power).

   Initial reactor coolant system boron concentration  = 600 ppm
   Moderator temperature coefficient                     = -0.015% ΔK/K per °F
   Differential boron worth                              = -0.010% ΔK/K per ppm
   Inverse boron worth                                   = -100 ppm/% ΔK/K

A.  606 ppm

B.  603 ppm

C.  597 ppm

D.  594 ppm

ANSWER:  A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P852

Given the following initial parameters, select the final reactor coolant boron concentration required to <u>increase</u> average coolant temperature by 6°F. (Assume no change in rod position or reactor/turbine power.)

Initial boron concentration = 500 ppm
Moderator temperature coefficient = -0.012% ΔK/K per °F
Differential boron worth = -0.008% ΔK/K per ppm
Inverse boron worth = -125 ppm/% ΔK/K

A. 491 ppm

B. 496 ppm

C. 504 ppm

D. 509 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P953

Given the following initial parameters:

Total power coefficient = -0.016% ΔK/K/%
Boron worth = -0.010% ΔK/K/ppm
Rod worth = -0.030% ΔK/K/inch inserted
Initial reactor coolant system
 (RCS) boron concentration = 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30% to 80% by boration/dilution with 10 inches of outward control rod motion. (Assume no change in xenon reactivity.)

A. 390 ppm

B. 420 ppm

C. 450 ppm

D. 470 ppm

ANSWER: C.

TOPIC:          192004
KNOWLEDGE:   K1.12   [2.7/2.7]
QID:            P1553

A nuclear power plant is operating at steady-state 100% power.  Given the following initial parameters, select the final reactor coolant boron concentration required to <u>decrease</u> average coolant temperature by 6°F.  (Assume no change in control rod position or reactor/turbine power.)

Initial boron concentration          = 500 ppm
Moderator temperature coefficient   = -0.012% ΔK/K per °F
Differential boron worth             = -0.008% ΔK/K per ppm
Inverse boron worth                  = -125 ppm/% ΔK/K

A.  509 ppm

B.  504 ppm

C.  496 ppm

D.  491 ppm

ANSWER:  A.

TOPIC:         192004
KNOWLEDGE:   K1.12  [2.7/2.7]
QID:           P1753

Given the following initial parameters:

   Total power coefficient        = -0.020% $\Delta$K/K/%
   Boron worth                 = -0.010% $\Delta$K/K/ppm
   Rod worth                   = -0.025% $\Delta$K/K/inch inserted
   Initial reactor coolant system
     (RCS) boron concentration  = 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30% to 80% by boration/dilution with 10 inches of outward control rod motion? (Assume no change in xenon reactivity.)

A.  425 ppm

B.  450 ppm

C.  550 ppm

D.  575 ppm

ANSWER:  A.

TOPIC:      192004
KNOWLEDGE:  K1.12  [2.7/2.7]
QID:       P2353

Given the following initial parameters:

| | |
|---|---|
| Total power coefficient | = -0.020% ΔK/K/% |
| Boron worth | = -0.010% ΔK/K/ppm |
| Rod worth | = -0.025% ΔK/K/inch inserted |
| Initial reactor coolant system (RCS) boron concentration | = 500 ppm |

Which one of the following is the final RCS boron concentration required to support decreasing plant power from 80% to 30% by boration/dilution with 10 inches of inward control rod motion? (Assume no change in xenon reactivity.)

A.  425 ppm

B.  475 ppm

C.  525 ppm

D.  575 ppm

ANSWER:  D.

TOPIC:           192004
KNOWLEDGE:   K1.12   [2.7/2.7]
QID:             P2453

Given the following initial parameters:

   Total power coefficient      = -0.020% ΔK/K/%
   Boron worth               = -0.010% ΔK/K/ppm
   Control rod worth         = -0.025% ΔK/K/inch inserted
   Initial reactor coolant system
     (RCS) boron concentration   = 600 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 40% to 80% with 40 inches of outward control rod motion?   (Ignore any change in fission product poison reactivity.)

A.  420 ppm

B.  580 ppm

C.  620 ppm

D.  780 ppm

ANSWER:  C.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P2553

Given the following initial parameters:

Reactor power = 100%
Total power coefficient = -0.020% ΔK/K/%
Boron worth = -0.010% ΔK/K/ppm
Rod worth = -0.025% ΔK/K/inch inserted
Initial reactor coolant system
  (RCS) boron concentration = 500 ppm

Which one of the following is the final RCS boron concentration required to support decreasing plant power to 30% by boration/dilution with 20 inches of inward control rod motion? (Assume no change in core xenon reactivity.)

A. 410 ppm

B. 425 ppm

C. 575 ppm

D. 590 ppm

ANSWER: D.

TOPIC:          192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:            P53

During power operation, while changing power level, core reactivity is affected most quickly by...

A.  boron concentration adjustments.

B.  power defect (deficit).

C.  xenon transients.

D.  fuel depletion.

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:            P131

Which one of the following statements concerning the power defect is correct?

A.  The power defect necessitates the use of a ramped $T_{ave}$ program to maintain an adequate reactor coolant system subcooling margin.

B.  The power defect increases the rod height requirements necessary to maintain the desired shutdown margin following a reactor trip.

C.  The power defect is more negative at the beginning of core life because of the higher boron concentration.

D.  The power defect causes control rods to be withdrawn as reactor power is decreased.

ANSWER:  B.

TOPIC:          192004
KNOWLEDGE:  K1.13   [2.9/2.9]
QID:              P2071   (B2070)

Neglecting the effects of changes in core Xe-135, which one of the following power changes requires the <u>greatest</u> amount of positive reactivity addition?

A.  3% power to 5% power

B.  5% power to 15% power

C.  15% power to 30% power

D.  30% power to 60% power

ANSWER:  D.

TOPIC:          192004
KNOWLEDGE:  K1.13   [2.9/2.9]
QID:              P2169   (B2669)

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

A.  2% power to 5% power

B.  5% power to 15% power

C.  15% power to 30% power

D.  30% power to 50% power

ANSWER:  A.

TOPIC:             192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:                P2851   (B2470)

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

A.  3% power to 10% power

B.  10% power to 25% power

C.  25% power to 60% power

D.  60% power to 100% power

ANSWER:  D.

TOPIC:             192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:                P2953   (B5034)

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

A.  3% power to 10% power

B.  10% power to 25% power

C.  25% power to 65% power

D.  65% power to 100% power

ANSWER:  C.

TOPIC:          192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:            P3050  (B3051)

A nuclear 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 rod withdrawal that results in adding 0.3 %ΔK/K reactivity.

Given:

    All rod motion has been stopped.
    No automatic system or operator actions occur to inhibit the power increase.
    Power coefficient = -0.04 %ΔK/K / % power
    Average effective delayed neutron fraction = 0.006

What is the approximate power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A.  3.0%

B.  5.0%

C.  6.7%

D.  7.5%

ANSWER:  D.

TOPIC:              192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:                   P3753   (B3769)

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

A.  3% power to 10% power

B.  10% power to 15% power

C.  15% power to 30% power

D.  30% power to 40% power

ANSWER:  B.

TOPIC:              192004
KNOWLEDGE:   K1.13   [2.9/2.9]
QID:                   P4327   (B4325)

A nuclear 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 rod withdrawal that results in adding 0.2 %$\Delta$K/K reactivity.

Given:

   All rod motion has been stopped.
   No automatic system or operator actions occur to inhibit the power increase.
   Power coefficient = -0.04 %$\Delta$K/K / % power
   Average effective delayed neutron fraction = 0.006

What is the approximate reactor power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A.  3.3%

B.  5.0%

C.  6.7%

D.  7.5%

ANSWER:  B.

TOPIC:            192005
KNOWLEDGE:   K1.03
QID:                P254     (B2254)

A nuclear reactor is exactly critical below the point of adding heat (POAH) during a reactor startup at the end of core life.  Control rods are withdrawn for 20 seconds to establish a 0.5 dpm startup rate.

Reactor power will increase...

A.  continuously until control rods are reinserted.

B.  and stabilize at a value slightly below the POAH.

C.  temporarily, then stabilize at the original value.

D.  and stabilize at a value slightly above the POAH.

ANSWER:  D.

TOPIC:            192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:                P354     (B356)

A nuclear reactor is critical below the point of adding heat.  If control rods are manually inserted for 5 seconds, reactor power will decrease...

A.  to a shutdown power level low in the source (startup) range.

B.  temporarily, then return to the original value due to the resulting decrease in moderator temperature.

C.  until inherent positive reactivity feedback causes the reactor to become critical at a lower neutron level.

D.  temporarily, then return to the original value due to subcritical multiplication.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:            P754    (B755)

A nuclear reactor is exactly critical below the point of adding heat (POAH) during a normal reactor startup.  If a control rod is manually withdrawn for 5 seconds, reactor power will increase...

A.  to a stable critical power level below the POAH.

B.  temporarily, then decrease and stabilize at the original value.

C.  to a stable critical power level at the POAH.

D.  temporarily, then decrease and stabilize below the original value.

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:            P1054

A nuclear reactor is operating near the end of a fuel cycle at steady state 50% power level when the operator withdraws a group of control rods for 5 seconds.  (Assume that main turbine load remains constant and the reactor does not scram/trip.)

Actual reactor power will stabilize _____ the initial power level and reactor coolant temperature will stabilize _____ the initial temperature.

A.  at; at

B.  at; above

C.  above; at

D.  above; above

ANSWER:  B.

TOPIC:           192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:             P1254

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

A.  stabilize in the source range.

B.  stabilize at a lower value in the power range.

C.  increase and stabilize above the original value.

D.  increase and stabilize at the original value.

ANSWER:  D.

TOPIC:           192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:             P1654

A nuclear reactor is operating at steady state 50% power near the end of core life when the operator inserts a group of control rods for 5 seconds.  Assume turbine load remains constant and the reactor does <u>not</u> scram/trip.

Actual reactor power will stabilize _____ the initial power level and coolant temperature will stabilize _____ the initial temperature.

A.  at; at

B.  at; below

C.  below; at

D.  below; below

ANSWER:  B.

TOPIC:             192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:                 P1854   (B2155)

A nuclear reactor has been shut down for three weeks with all control rods fully inserted.  If a center control rod is fully withdrawn from the core, neutron population will:  (Assume the reactor remains subcritical.)

A.  increase and stabilize at a new higher level.

B.  increase, then decrease and stabilize at the original value.

C.  increase, then decrease and stabilize above the original value.

D.  remain the same.

ANSWER:  A.

TOPIC:             192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:                 P1955   (B954)

A nuclear reactor has been shut down for three weeks with all control rods fully inserted.  If a center control rod is fully withdrawn from the core, neutron population will:  (Assume the reactor remains subcritical.)

A.  increase and stabilize at a new higher level.

B.  increase temporarily then return to the original value.

C.  increase exponentially until the operator inserts the control rod.

D.  remain the same.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.03   [3.5/3.6]
QID:            P3854

Criticality has been achieved during a xenon-free nuclear reactor startup.  The core neutron flux level is low in the intermediate range and a stable 0.5 dpm startup rate (SUR) has been established.  The operator begins inserting control rods in an effort to stabilize the core neutron flux level near its current value.  The operator stops inserting control rods exactly when the SUR indicates 0.0 dpm.

Immediately after the operator stops inserting the control rods, the SUR will become _____ ; then the core neutron flux level will _____.

A.  positive; increase exponentially

B.  positive; increase linearly

C.  negative; decrease exponentially

D.  negative; decrease linearly

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:            P555    (B856)

The total amount of reactivity added by a control rod position change from a reference height to any other rod height is called...

A.  differential rod worth.

B.  shutdown reactivity.

C.  integral rod worth.

D.  reference reactivity.

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:          P654

Integral control rod worth is the change in _____ per _____ change in rod position.

A.  reactor power; total

B.  reactivity; unit

C.  reactor power; unit

D.  reactivity; total

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:          P755    (B756)

A control rod is positioned in a nuclear reactor with the following neutron flux parameters:

   Core average thermal neutron flux = $10^{12}$ neutrons/cm$^2$-sec
   Control rod tip neutron flux = 5 x $10^{12}$ neutrons/cm$^2$-sec

If the control rod is slightly withdrawn such that the tip of the control rod is located in a neutron flux of $10^{13}$ neutrons/cm$^2$-sec, then the differential control rod worth will increase by a factor of _____. (Assume the average flux is constant.)

A.  0.5

B.  1.4

C.  2.0

D.  4.0

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:            P1354

Integral rod worth is the...

A.  change in reactivity per unit change in rod position.

B.  reactivity inserted by moving a control rod from a reference point to another point.

C.  change in worth of a control rod per unit change in reactor power.

D.  rod worth associated with the most reactive control rod.

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:            P1471

Reactor power was ramped from 80% power to 100% power over 4 hours.  The 80% conditions were as follows:

Reactor coolant system (RCS) boron concentration:  600 ppm
Control rod position:                              110 inches
RCS average temperature:                           575 °F

The 100% conditions are as follows:

RCS boron concentration:    580 ppm
Control rod position:       130 inches
RCS average temperature:    580 °F

Given the following reactivity coefficient/worth values, and neglecting changes in fission product poison reactivity, what is the differential control rod worth?

Power coefficient:                      -0.03% ΔK/K/%
Moderator temperature coefficient:   -0.02% ΔK/K/°F
Differential boron worth:               -0.01% ΔK/K/ppm

A.  -0.02% ΔK/K/inch

B.  -0.025% ΔK/K/inch

C.  -0.04% ΔK/K/inch

D.  -0.05% ΔK/K/inch

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:            P1554  (B1057)

A control rod is positioned in a nuclear reactor with the following neutron flux parameters:

Core average thermal neutron flux    = 1 x $10^{12}$ n/cm$^2$-sec
Control rod tip thermal neutron flux = 5 x $10^{12}$ n/cm$^2$-sec

If the control rod is slightly withdrawn such that the control rod tip is located in a thermal neutron flux of 1 x $10^{13}$ n/cm$^2$-sec, then the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A.  2

B.  4

C.  10

D.  100

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.05   [2.8/3.1]
QID:            P1755  (B1855)

A control rod is positioned in a nuclear reactor with the following neutron flux parameters:

Core average thermal neutron flux    = 1.0 x $10^{12}$ n/cm$^2$-sec
Control rod tip thermal neutron flux = 4.0 x $10^{12}$ n/cm$^2$-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.2 x $10^{13}$ n/cm$^2$-sec, then the differential control rod worth will be increased by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A.  1/3

B.  3

C.  9

D.  27

ANSWER:  C.

TOPIC:       192005
KNOWLEDGE:  K1.05  [2.8/3.1]
QID:          P2255

A nuclear reactor is operating at steady state 70% power with the following conditions:

    RCS boron concentration:    600 ppm
    Control rod position:         110 inches
    RCS average temperature:  575 °F

Reactor power is increased to 100% over the next four hours.  The 100% reactor power conditions are as follows:

    RCS boron concentration:    590 ppm
    Control rod position:         130 inches
    RCS average temperature:  580 °F

Given the following reactivity coefficient/worth values, and neglecting fission product poison reactivity changes, what is the differential control rod worth?

    Power coefficient:                        -0.3% ΔK/K/%
    Moderator temperature coefficient:  -0.2% ΔK/K/°F
    Differential boron worth:          -0.1% ΔK/K/ppm

A.  0.2% ΔK/K/inch

B.  0.25% ΔK/K/inch

C.  0.4% ΔK/K/inch

D.  0.5% ΔK/K/inch

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:  K1.05   [2.8/3.1]
QID:              P2554  (B2655)

A control rod is positioned in a nuclear reactor with the following neutron flux parameters:

    Core average thermal neutron flux   $= 1.0 \times 10^{12}$ n/cm$^2$-sec
    Control rod tip thermal neutron flux $= 4.0 \times 10^{12}$ n/cm$^2$-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of $1.6 \times 10^{13}$ n/cm$^2$-sec, then the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A.  2

B.  4

C.  8

D.  16

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:  K1.06   [2.6/2.9]
QID:              P134    (B1755)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A.  DRW is the IRW at a specific rod position.

B.  DRW is the square root of the IRW at a specific rod position.

C.  DRW is the slope of the IRW curve at a specific rod position.

D.  DRW is the area under the IRW curve at a specific rod position.

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:   K1.06   [2.6/2.9]
QID:            P655    (B2255)

Which one of the following parameters typically has the <u>greatest</u> effect on the shape of a differential rod worth curve?

A.  Core radial neutron flux distribution

B.  Core axial neutron flux distribution

C.  Core xenon distribution

D.  Burnable poison distribution

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.06   [2.6/2.9]
QID:            P856

During normal full power operation, the differential control rod worth is less negative at the top and bottom of the core compared to the center regions due to the effects of...

A.  reactor coolant boron concentration.

B.  neutron flux distribution.

C.  xenon concentration.

D.  fuel temperature distribution.

ANSWER:  B.

TOPIC:           192005
KNOWLEDGE:   K1.06   [2.6/2.9]
QID:             P1555   (B1657)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A.  IRW is the slope of the DRW curve.

B.  IRW is the inverse of the DRW curve.

C.  IRW is the sum of the DRWs between the initial and final control rod positions.

D.  IRW is the sum of the DRWs of all control rods at any specific control rod position.

ANSWER:  C.

TOPIC:           192005
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:             P54

As moderator temperature increases, the differential rod worth becomes more negative because...

A.  decreased moderator density causes more neutron leakage out of the core.

B.  moderator temperature coefficient decreases, causing decrease competition.

C.  fuel temperature increases, decreasing neutron absorption in fuel.

D.  decreased moderator density increases neutron migration length.

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:  K1.07   [2.5/2.8]
QID:              P454

Differential rod worth will become most negative if reactor coolant system (RCS) temperature is _____ and RCS boron concentration is _____.

A.  increased; decreased

B.  decreased; decreased

C.  increased; increased

D.  decreased; increased

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:  K1.07   [2.5/2.8]
QID:              P955

With a nuclear power plant operating normally at full power, a 5°F decrease in moderator temperature will cause the differential control rod worth to become...

A.  more negative due to better moderation of neutrons.

B.  less negative due to shorter neutron migration length.

C.  more negative due to increased neutron absorption in moderator.

D.  less negative due to increased resonance absorption of neutrons.

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P1556  (B2656)

As moderator temperature increases, the differential rod worth will become...

A.  more negative due to longer neutron migration length.

B.  less negative due to reduced moderation of neutrons.

C.  more negative due to decreased resonance absorption of neutrons.

D.  less negative due to decreased moderator absorption of neutrons.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.07   [2.5/2.8]
QID:            P2156

A nuclear reactor is operating at 80% power near the end of a fuel cycle with the controlling group of control rods inserted 5% into the core.  Which one of the following will cause group differential rod worth to become <u>less</u> negative?  (Consider only the direct effect of the indicated change.)

A.  Burnable poison rods become increasingly depleted.

B.  Core Xe-135 concentration decreases toward an equilibrium value.

C.  Reactor coolant temperature is allowed to decrease from 575°F to 570°F.

D.  Reactor power is decreased to 70% using control rods for control of RCS temperature.

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:  K1.07   [2.5/2.8]
QID:              P2356

A nuclear reactor startup is in progress from a cold shutdown condition.  During the RCS heatup phase of the startup, control rod differential reactivity worth (∆K/K per inch insertion) becomes _____ negative; and during the complete withdrawal of the initial bank of control rods, control rod differential reactivity worth becomes _____.

A.  more; more negative and then less negative

B.  more; less negative and then more negative

C.  less; more negative during the entire withdrawal

D.  less; less negative during the entire withdrawal

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:  K1.07   [2.5/2.8]
QID:              P2655

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

A.  During long-term full power operation, fuel temperature decreases as the fuel pellets come into contact with the fuel clad.

B.  The reactor coolant system is cooled from 170°F to 120°F in preparation for a core refueling.

C.  Core Xe-135 builds up in the lower half of the core.

D.  Early in core life, the concentration of burnable poison decreases.

ANSWER:  B.

TOPIC:           192005
KNOWLEDGE:   K1.08   [2.7/2.9]
QID:             P857    (B3356)

The main reason for designing and operating a nuclear reactor with a flattened neutron flux distribution is to...

A.  provide even burnup of control rods.

B.  reduce neutron leakage from the core.

C.  allow a higher average power density.

D.  provide more accurate nuclear power indication.

ANSWER:  C.

TOPIC:           192005
KNOWLEDGE:   K1.08   [2.7/2.9]
QID:             P2456   (B2457)

Which one of the following is a reason for neutron flux shaping in a nuclear reactor core?

A.  To minimize local power peaking by more evenly distributing the core thermal neutron flux

B.  To reduce thermal neutron leakage by decreasing the neutron flux at the edge of the reactor core

C.  To reduce the size and number of control rods needed to ensure the reactor remains subcritical following a reactor trip

D.  To increase control rod worth by peaking the thermal neutron flux at the top of the reactor core

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.09   [2.8/3.0]
QID:            P55

What is a purpose of control rod bank overlap?

A.  Provides a more uniform differential rod worth and axial flux distribution.

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

C.  Ensures that all rods remain within the allowable tolerance between their individual position indicators and their group counters, and ensures rod insertion limits are <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.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.09   [2.8/3.0]
QID:            P656

The purposes of using control rod bank overlap are to...

A.  provide a more uniform axial power distribution <u>and</u> to provide a more uniform differential rod worth.

B.  provide a more uniform differential rod worth <u>and</u> to provide a more uniform radial power distribution.

C.  provide a more uniform radial power distribution <u>and</u> to maintain individual and group rod position indicators within allowable tolerances.

D.  maintain individual and group rod position indicators within allowable tolerances <u>and</u> to provide a more uniform axial power distribution.

ANSWER:  A.

TOPIC:           192005
KNOWLEDGE:   K1.09   [2.8/3.0]
QID:             P1156

One purpose of using control rod bank/group overlap is to...

A.  ensure adequate shutdown margin.

B.  provide a more uniform differential rod worth.

C.  allow dampening of xenon-induced flux oscillation.

D.  ensure control rod insertion limits are <u>not</u> exceeded.

ANSWER:  B.

TOPIC:           192005
KNOWLEDGE:   K1.10   [3.0/3.3]
QID:             P455

Which one of the following describes why most of the power is produced in the lower half of a nuclear reactor core that has been operating at 100% power for several weeks with all control rods withdrawn at the beginning of core life?

A.  Xenon concentration is lower in the lower half of the core.

B.  The moderator to fuel ratio is lower in the lower half of the core.

C.  The fuel loading in the lower half of the core contains a higher U-235 enrichment.

D.  The moderator temperature coefficient of reactivity is adding less negative reactivity in the lower half of the core.

ANSWER:  D.

TOPIC:           192005
KNOWLEDGE:   K1.10   [3.0/3.3]
QID:              P1357

A nuclear reactor is operating at 75% power in the middle of a fuel cycle.  Which one of the following actions will cause the greatest shift in reactor power distribution toward the top of the core?  (Assume control rods remain fully withdrawn.)

A.  Decrease reactor power by 25%.

B.  Decrease reactor coolant boron concentration by 10 ppm.

C.  Decrease average reactor coolant temperature by 5°F.

D.  Decrease reactor coolant system operating pressure by 15 psia.

ANSWER:  A.

TOPIC:           192005
KNOWLEDGE:   K1.10   [3.0/3.3]
QID:              P2656

A nuclear reactor has been operating at 100% power for 3 weeks shortly after a refueling outage.  All control rods are fully withdrawn,.  Which one of the following describes why most of the power is being produced in the lower half of the core?

A.  The fuel loading in the lower half of the core contains a higher U-235 enrichment.

B.  Reactor coolant boron is adding more negative reactivity in the upper half of the core.

C.  There is a greater concentration of Xe-135 in the upper half of the core.

D.  The moderator temperature coefficient of reactivity is adding more negative reactivity in the upper half of the core.

ANSWER:  D.

TOPIC:              192005
KNOWLEDGE:   K1.11   [2.8/3.2]
QID:                   P1157

If core quadrant power distribution (sometimes referred as 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.

ANSWER:  B.

TOPIC:              192005
KNOWLEDGE:   K1.12   [2.9/3.1]
QID:                   P255

A comparison of the heat flux in the hottest coolant channel to the average heat flux in the core describes...

A.  a core correction calibration factor.

B.  a hot channel/peaking factor.

C.  a heat flux normalizing factor.

D.  an axial/radial flux deviation factor.

ANSWER:  B.

TOPIC:            192005
KNOWLEDGE:   K1.12   [2.9/3.1]
QID:              P256

A nuclear reactor has been taken critical following a refueling outage and is currently at the point of adding heat during a normal reactor startup.  Which one of the following describes the axial power distribution in the core as power is increased to 10% by control rod withdrawal?  (Neglect reactivity effects of reactor coolant temperature change.)

A.  Shifts toward the bottom of the core.

B.  Shifts toward the top of the core.

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

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

ANSWER:  B.

TOPIC:            192005
KNOWLEDGE:   K1.12   [2.9/3.1]
QID:              P355

By maintaining the radial and axial core power distributions within their prescribed limits, the operator is assured that _____ will remain within acceptable limits.

A.  power density (kW/foot) and departure from nucleate boiling ratio (DNBR)

B.  DNBR and shutdown margin

C.  core delta-T and power density (kW/foot)

D.  shutdown margin and core delta-T

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.13   [2.8/3.2]
QID:            P3156

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

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

A.  Upper core value decreases while lower core value increases.

B.  Upper core value increases while lower core value decreases.

C.  Both upper and lower core values decrease.

D.  Both upper and lower core values increase.

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:   K1.14   [3.2/3.5]
QID:            P356    (B358)

A nuclear reactor is operating at equilibrium full power when a single control rod fully inserts (from the fully withdrawn position).  Reactor power is returned to full power with the control rod still fully inserted.

Compared to the initial axial neutron flux shape, the current flux shape will have a...

A.  minor distortion, because a fully inserted control rod has zero reactivity worth.

B.  minor distortion, because the fully inserted control rod is an axially uniform poison.

C.  major distortion, because the upper and lower core halves are loosely coupled.

D.  major distortion, because power production along the length of the rod drastically decreases.

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.14   [3.2/3.5]
QID:            P956

After a control rod is fully inserted (from the fully withdrawn position), the effect on the axial flux shape is minimal.  This is because...

A.  the differential rod worth is constant along the length of the control rod.

B.  the fully inserted control rod is an axially uniform poison.

C.  a control rod only has reactivity worth if it is moving.

D.  a variable poison distribution exists throughout the length of the control rod.

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.15   [3.4/3.9]
QID:            P57

Why are the control rod insertion limits power dependent?

A.  Power defect increases as power increases.

B.  Control rod worth decreases as power increases.

C.  Doppler (fuel temperature) coefficient decreases as power increases.

D.  Equilibrium core xenon-135 negative reactivity increases as power increases.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.15   [3.4/3.9]
QID:            P1055

Control rod insertion limits are established for power operation because excessive rod insertion will...

A.  adversely affect core power distribution.

B.  generate excessive liquid waste due to dilution.

C.  cause reduced control rod lifetime.

D.  cause unacceptable fast and thermal neutron leakage.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.15   [3.4/3.9]
QID:            P1456

Control rod insertion limits ensure that control rods will be more withdrawn as reactor power _____ to compensate for the change in _____.

A.  increases; xenon reactivity

B.  decreases; xenon reactivity

C.  increases; power defect

D.  decreases; power defect

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:   K1.15   [3.4/3.9]
QID:            P1757

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 trip.

D.  To ensure sufficient positive reactivity is available to compensate for the existing power defect.

ANSWER:  C.

TOPIC:          192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:            P557

A nuclear reactor has been operating at 80% power for four weeks with the controlling rod group inserted 10% from the fully withdrawn position.

Which one of the following will be most significantly affected by inserting the controlling group an additional 5%?  (Assume reactor power does not change.)

A.  Total xenon reactivity

B.  Radial power distribution

C.  Quadrant (azimuthal) power distribution

D.  Axial power distribution

ANSWER:  D.

TOPIC:            192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:              P1457

A nuclear reactor is operating at 75% power.  Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping a center control rod to the effects of partially inserting (50%) the same control rod?

A.  A dropped rod causes a greater change in shutdown margin.

B.  A dropped rod causes a smaller change in shutdown margin.

C.  A dropped rod causes a greater change in axial power distribution.

D.  A dropped rod causes a greater change in radial power distribution.

ANSWER:  D.

TOPIC:            192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:              P1657

A nuclear reactor is operating at 75% power with all control rods fully withdrawn.  Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping (full insertion) a single center control rod to the effects of partially inserting (50%) the same control rod?

A.  A partially inserted rod causes a greater change in axial power distribution.

B.  A partially inserted rod causes a greater change in radial power distribution.

C.  A partially inserted rod causes a greater change in shutdown margin.

D.  A partially inserted rod causes a smaller change in shutdown margin.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:             P2157

A nuclear reactor is operating at 75% power with all control rods fully withdrawn.  Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping (full insertion) a single center control rod to the effects of partially inserting (50%) the same control rod?

A.  A dropped rod causes a smaller change in axial power distribution.

B.  A dropped rod causes a smaller change in radial power distribution.

C.  A dropped rod causes a smaller change in shutdown margin.

D.  A dropped rod causes a greater change in shutdown margin.

ANSWER:  A.

TOPIC:          192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:             P2257

A nuclear reactor is operating at 85% power with all control rods fully withdrawn.  Assuming reactor power does <u>not</u> change, which one of the following compares the effects of partially inserting (50%) a single center control rod to the effects of dropping (full insertion) the same control rod?

A.  A partially inserted rod causes a smaller change in axial power distribution.

B.  A partially inserted rod causes a smaller change in radial power distribution.

C.  A partially inserted rod causes a greater change in shutdown margin.

D.  A partially inserted rod causes a smaller change in shutdown margin.

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:  K1.16   [2.8/3.1]
QID:             P2457

A nuclear reactor is operating at 100% power at the beginning of a fuel cycle with all control rods fully withdrawn.  Assuming the reactor does <u>not</u> trip, which one of the following compares the effects of dropping a control rod in the center of the core to dropping an identical control rod at the periphery of the core?

A.  Dropping a center control rod causes a greater change in shutdown margin.

B.  Dropping a center control rod causes a smaller change in shutdown margin.

C.  Dropping a center control rod causes a greater change in axial power distribution.

D.  Dropping a center control rod causes a greater change in radial power distribution.

ANSWER:  D.

TOPIC:          192005
KNOWLEDGE:  K1.16   [2.8/3.1]
QID:             P2556

A nuclear reactor has been operating at 80% power for four weeks with the controlling rod group inserted 15% from the fully withdrawn position.

Which one of the following will be significantly affected by withdrawing the controlling rod group an additional 5%?  (Assume reactor power does <u>not</u> change.)

A.  Total xenon reactivity

B.  Axial power distribution

C.  Radial power distribution

D.  Quadrant (azimuthal) power distribution

ANSWER:  B.

TOPIC:          192005
KNOWLEDGE:   K1.16   [2.8/3.1]
QID:            P2857

A nuclear reactor is operating at steady state full power with all control rods fully withdrawn when one control rod at the core periphery falls completely into the core.  Assuming <u>no</u> reactor trip and <u>no</u> operator action, which one of the following will have changed significantly as a result of the dropped rod?

A.  Axial power distribution only

B.  Axial power distribution and shutdown margin

C.  Radial power distribution only

D.  Radial power distribution and shutdown margin

ANSWER:  C.

TOPIC:        192006
KNOWLEDGE:  K1.01  [2.5/2.6]
QID:         P58

Fission products that have large microscopic cross sections for capture of thermal neutrons are called...

A.  breeder fuels.

B.  burnable poisons.

C.  fissionable fuels.

D.  reactor poisons.

ANSWER:  D

TOPIC:        192006
KNOWLEDGE:  K1.01  [2.5/2.6]
QID:         P858    (B1858)

Fission product poisons can be differentiated from other fission products in that fission product poisons...

A.  have a longer half-life.

B.  are stronger absorbers of thermal neutrons.

C.  are produced in a larger percentage of fissions.

D.  have a higher fission cross section for thermal neutrons.

ANSWER:  B.

TOPIC: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P2058 (B2061)

A fission product poison can be differentiated from all other fission products in that a fission product poison...

A. will be produced in direct proportion to the fission rate in the core.

B. will remain radioactive for thousands of years after the final reactor criticality.

C. will depress the power production in some core locations and cause peaking in others.

D. will migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P2158

A fission product poison can be differentiated from all other fission products in that a fission product poison...

A. will be radioactive for thousands of years.

B. is produced in a relatively large percentage of thermal fissions.

C. has a relatively high probability of absorbing a fission neutron.

D. is formed as a gas and is contained within the fuel pellets and fuel rods.

ANSWER: C.

TOPIC:           192006
KNOWLEDGE:  K1.01   [2.5/2.6]
QID:             P2858   (B1558)

A fission product poison can be differentiated from all other fission products because a fission product poison...

A.  has a higher microscopic cross section for thermal neutron capture.

B.  has a longer half-life.

C.  is produced in a greater percentage of thermal fissions.

D.  is formed as a gas and is contained in the fuel pellets.

ANSWER:  A.

TOPIC:           192006
KNOWLEDGE:  K1.02   [3.0/1.1]
QID:             P658

Xenon-135 is considered a major fission product poison because it has a large...

A.  fission cross section.

B.  absorption cross section.

C.  elastic scatter cross section.

D.  inelastic scatter cross section.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.02   [3.0/1.1]
QID:             P1858   (B1058)

Which one of the following is a characteristic of xenon-135 in a nuclear reactor core?

A.  Xenon-135 is produced from the radioactive decay of barium-135.

B.  Xenon-135 is primarily a resonance absorber of epithermal neutrons.

C.  Thermal neutron flux level affects both the production and removal of xenon-135.

D.  Thermal neutrons interact with xenon-135 primarily through scattering reactions.

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:   K1.02   [3.0/1.1]
QID:             P2458   (B1658)

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating nuclear reactor core?

A.  Uranium-235

B.  Boron-10

C.  Samarium-149

D.  Xenon-135

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.02   [3.0/1.1]
QID:            P2658   (B256)

Compared to other poisons in the core, the two characteristics that cause Xe-135 to be a major reactor poison are its relatively _____ absorption cross section and its relatively _____ variation in concentration for large reactor power changes.

A.  small; large

B.  small; small

C.  large; small

D.  large; large

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:            P59

Immediately after a reactor trip from sustained high power operation, xenon-135 concentration in the nuclear reactor will...

A.  increase due to the decay of iodine already in the core.

B.  decrease because xenon is produced directly from fission.

C.  remain the same because the decay of iodine and xenon balance each other out.

D.  decrease initially, then slowly increase due to the differences in the half-lives of iodine and xenon.

ANSWER:  A.

TOPIC:        192006
KNOWLEDGE:  K1.03  [2.7/2.8]
QID:          P358   (B362)

Xenon-135 is produced in a nuclear reactor by two primary methods.  One is directly from fission, the other is from the decay of...

A.  cesium-135.

B.  iodine-135.

C.  xenon-136.

D.  iodine-136.

ANSWER:  B.

TOPIC:        192006
KNOWLEDGE:  K1.03  [2.7/2.8]
QID:          P1359  (B458)

A nuclear reactor has been operating at full power for several weeks.  Xenon-135 is being directly produced as a fission product in approximately _____% of all fissions.

A.  0.3

B.  3.0

C.  30

D.  100

ANSWER:  A.

TOPIC:           192006
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P1559   (B859)

Which one of the following lists the production mechanisms of Xe-135 in an operating power reactor?

A.  Primarily from fission, secondarily from iodine decay

B.  Primarily from fission, secondarily from promethium decay

C.  Primarily from iodine decay, secondarily from fission

D.  Primarily from promethium decay, secondarily from fission

ANSWER:  C.

TOPIC:           192006
KNOWLEDGE:   K1.03   [2.7/2.8]
QID:             P1859   (B257)

The <u>major</u> contributor to the production of Xe-135 in a nuclear reactor that has been operating at full power for two weeks is...

A.  the radioactive decay of I-135.

B.  the radioactive decay of Cs-135.

C.  direct production from fission of U-235.

D.  direct production from fission of U-238.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:            P60

Following a reactor trip from sustained power operation, the xenon-135 removal process consists <u>primarily</u> of...

A.  beta decay.

B.  gamma decay.

C.  electron capture.

D.  gamma capture.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:            P460    (B462)

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

A.  production from fission.

B.  decay to cesium.

C.  absorption of neutrons.

D.  production from iodine decay.

ANSWER:  C.

TOPIC:         192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:           P859

In a shut down nuclear reactor, which decay chain describes the primary means of removing xenon-135?

A. $^{135}\text{Xe} \xrightarrow{\beta^-} {}^{135}\text{Cs}$

B. $^{135}\text{Xe} \xrightarrow{n} {}^{134}\text{Xe}$

C. $^{135}\text{Xe} \xrightarrow{\alpha} {}^{131}\text{Te}$

D. $^{135}\text{Xe} \xrightarrow{\beta^+} {}^{135}\text{I}$
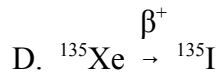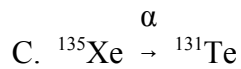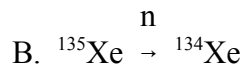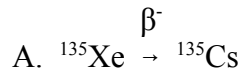
ANSWER:  A.

TOPIC:         192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:           P1059   (B359)

Xenon-135 undergoes radioactive decay to...

A.  iodine-135.

B.  cesium-135.

C.  tellurium-135.

D.  lanthanum-135.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:            P2558  (B2558)

Nuclear reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating at the end of core life (EOL) and reactor B is operating at the beginning of core life (BOL).

Which reactor core has the greater <u>concentration</u> of Xe-135?

A.  Reactor A (EOL) due to the smaller 100% power thermal neutron flux.

B.  Reactor A (EOL) due to the larger 100% power thermal neutron flux.

C.  Reactor B (BOL) due to the smaller 100% power thermal neutron flux.

D.  Reactor B (BOL) due to the larger 100% power thermal neutron flux.

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:   K1.04   [2.8/2.8]
QID:            P2659  (B3358)

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.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.05   [3.1/3.1]
QID:            P61     (B58)

A nuclear reactor has been operating at 50% power for one week when power is ramped in 4 hours to 100%.  Which one of the following describes the new equilibrium xenon concentration?

A.  Twice the 50% power concentration.

B.  Less than twice the 50% power concentration.

C.  More than twice the 50% power concentration.

D.  Remains the same because it is independent of power.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.05   [3.1/3.1]
QID:            P660    (B658)

A nuclear reactor was operating at 100% power for one week when power was decreased to 50%.  Which one of the following describes the equilibrium core xenon-135 concentration at 50% power?

A.  The same as the100% value.

B.  More than one-half the 100% value.

C.  Less than one-half the 100% value.

D.  One-half the 100% value.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:  K1.05   [3.1/3.1]
QID:            P1158   (B1160)

A nuclear reactor has been operating at 25% power for 24 hours following a 2-hour power reduction from steady-state full power.  Which one of the following describes the current status of core xenon-135 concentration?

A.  At equilibrium

B.  Decreasing toward an upturn

C.  Decreasing toward an equilibrium value

D.  Increasing toward a peak value

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:  K1.05   [3.1/3.1]
QID:            P1459   (B259)

Following a two-week shutdown, a nuclear reactor is taken critical and ramped to full power in 6 hours.  How long will it take to achieve an equilibrium xenon condition after the reactor reaches full power?

A.  70 to 80 hours

B.  40 to 50 hours

C.   8 to 10 hours

D.   1 to 2 hours

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.05  [3.1/3.1]
QID:            P2159  (B2659)

Which one of the following indicates that core Xe-135 is in equilibrium?

A.  Xe-135 production and removal rates are momentarily equal five hours after a power increase.

B.  A reactor has been operated at 80% power for five days.

C.  Xe-135 is being produced equally by fission and I-135 decay.

D.  A reactor is currently operating at 100% power.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.05  [3.1/3.1]
QID:            P2859  (B2760)

Nuclear reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating near the end of core life and reactor B is operating near the beginning of core life.

Which reactor is experiencing the most negative reactivity from equilibrium core Xe-135?

A.  Reactor A due to a greater concentration of equilibrium core Xe-135.

B.  Reactor A due to lower competition from the fuel for thermal neutrons.

C.  Reactor B due to a greater thermal neutron flux in the core.

D.  Reactor B due to a smaller accumulation of stable fission product poisons.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:            P259

A nuclear reactor has been operating at 50% power for one week when power is quickly ramped (over 4 hours) to 100%.  How will the core xenon-135 concentration respond?

A.  Decrease initially, then build to a new equilibrium concentration in 8 to 10 hours

B.  Increase steadily to a new equilibrium concentration in 20 to 30 hours

C.  Decrease initially, then build to a new equilibrium concentration in 40 to 50 hours

D.  Increase steadily to a new equilibrium concentration in 70 to 80 hours

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:            P659

A nuclear reactor has been operating at a steady-state power level for 15 hours following a rapid power reduction from 100% to 50% using boration for reactivity control.  Which one of the following describes the current core Xe-135 concentration?

A.  Increasing

B.  Decreasing

C.  At equilibrium

D.  Oscillating

ANSWER:  B.

TOPIC:           192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:             P959

A nuclear reactor was operating for 42 weeks at a stable reduced power level when a reactor trip occurred.  The reactor was returned to critical after 12 hours and then ramped to 60% power in 6 hours.

How much time at steady state 60% power will be required to reach equilibrium xenon?

A.  20 to 30 hours

B.  40 to 50 hours

C.  70 to 80 hours

D.  Unable to determine without knowledge of previous power history

ANSWER:  B.

TOPIC:           192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:             P1258

A nuclear reactor has been operating at 100% power for one week when power is ramped in 4 hours to 25% power.  The new equilibrium core xenon-135 level will be _____ the initial 100% equilibrium value.

A.  the same as

B.  about 80% of

C.  about 50% of

D.  less than 25% of

ANSWER:  C.

TOPIC:             192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:               P1360   (B1960)

A nuclear reactor has been operating at a constant power level for 15 hours following a rapid power reduction from 100% to 50%.  Which one of the following describes the current core xenon-135 concentration?

A.  Increasing toward a peak.

B.  Decreasing toward an upturn.

C.  Increasing toward equilibrium.

D.  Decreasing toward equilibrium.

ANSWER:  D.

TOPIC:             192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:               P1659

A nuclear reactor was operating for 24 weeks at a constant power level when a reactor trip occurred. The reactor was returned to critical after 12 hours and then ramped to 80% power in 6 hours.

Approximately how much time at steady state 80% power will be required to reach equilibrium core xenon-135?

A.  10 to 20 hours

B.  40 to 50 hours

C.  70 to 80 hours

D.  Cannot determine without knowledge of previous power history

ANSWER:  B.

TOPIC:             192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:                P1960   (B1262)

A nuclear reactor has been operating at 100% power for two weeks when power is decreased to 10% in 1 hour.  Immediately following the power decrease, core xenon-135 concentration will _____ for a period of _____.

A.  decrease; 4 to 6 hours

B.  increase; 4 to 6 hours

C.  decrease; 8 to 11 hours

D.  increase; 8 to 11 hours

ANSWER:  D.

TOPIC:             192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:                P2060

A nuclear reactor is initially operating at 50% of rated power with equilibrium core xenon-135. Power is increased to 100% 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 core 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

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:            P2061   (B2063)

A nuclear reactor had been operating at 100% power for two weeks when power was reduced to 10% over a one hour period.  In order to maintain plant parameters stable during the next 24 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.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:            P2160

A nuclear reactor had been operating at 50% power for two weeks when power was increased to 100% over a 3-hour period.  In order to maintain reactor power stable during the next 24 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

ANSWER:  D.

TOPIC:            192006
KNOWLEDGE:  K1.06   [3.2/3.4]
QID:              P2359  (B2660)

Which one of the following explains why core Xe-135 oscillations are a concern in a nuclear reactor?

A.  They can adversely affect core power distribution and can prevent a reactor startup following a reactor trip.

B.  They can adversely affect core power distribution and can require operation below full rated power.

C.  They can cause rapid reactor power changes during power operation and can prevent a reactor startup following a reactor trip.

D.  They can cause rapid reactor power changes during power operation and can require operation below full rated power.

ANSWER:  B.

TOPIC:            192006
KNOWLEDGE:  K1.06   [3.2/3.4]
QID:              P2360  (B2361)

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.

ANSWER:  D.

TOPIC:              192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:                  P2559   (B2561)

A nuclear reactor is initially operating at 100% power with equilibrium core xenon-135.  Power is decreased to 50% over a 1-hour period and average reactor coolant temperature is adjusted to 572°F using manual rod control.  Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 10 hours after the power change is completed?

A.  Less than 572°F and increasing slowly.

B.  Less than 572°F and decreasing slowly.

C.  Greater than 572°F and increasing slowly.

D.  Greater than 572°F and decreasing slowly.

ANSWER:  A.

TOPIC:              192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:                  P2760

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

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

A.  Greater than 585°F and decreasing slowly

B.  Greater than 585°F and increasing slowly

C.  Less than 585°F and decreasing slowly

D.  Less than 585°F and increasing slowly

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:   K1.06   [3.2/3.4]
QID:            P3460

A nuclear reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 40% over a 2 hour period and average reactor coolant temperature is adjusted to 562°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

If only the reactivity effects of core xenon-135 changes are considered, which one of the following describes the status of the average reactor coolant temperature 2 hours after the power change is completed?

A.  Greater than 562°F and decreasing slowly

B.  Greater than 562°F and increasing slowly

C.  Less than 562°F and decreasing slowly

D.  Less than 562°F and increasing slowly

ANSWER:  C.


TOPIC:          192006
KNOWLEDGE:   K1.07   [3.4/3.4]
QID:            P260    (B459)

Two identical nuclear reactors have been operating at a constant power level for one week. Reactor A is at 50% power and reactor B is at 100% power.

If both reactors trip/scram at the same time, Xe-135 will peak first in reactor _____ and the highest Xe-135 reactivity peak will occur in reactor _____.

A.  A; B

B.  A; A

C.  B; B

D.  B; A

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:  K1.07   [3.4/3.4]
QID:            P1159   (B1761)

Two identical nuclear reactors have been operating at a constant power level for one week.  Reactor A is at 100% power and reactor B is at 50% power.

If both reactors trip/scram at the same time, Xe-135 will peak first in reactor _____ and the <u>highest</u> Xe-135 reactivity peak will occur in reactor _____.

A.  A; B

B.  A; A

C.  B; B

D.  B; A

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:  K1.07   [3.4/3.4]
QID:            P1358   (B1361)

A nuclear reactor has been operating at 75% power for two months.  A manual reactor trip is required for a test.  The trip will be followed immediately by a reactor startup with criticality scheduled to occur 12 hours after the trip.

The greatest assurance that fission product poison reactivity will permit criticality during the startup will exist if the reactor is operated at _____ power for 48 hours prior to the trip and if criticality is rescheduled for _____ hours after the trip.

A.  100%; 8

B.  100%; 16

C.  50%; 8

D.  50%; 16

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:  K1.07   [3.4/3.4]
QID:               P1561   (B1561)

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to overcome peak core xenon-135 negative reactivity will be <u>smallest</u> after a reactor trip from equilibrium _____ reactor power at the _____ of core life.

A.  20%; beginning

B.  20%; end

C.  100%; beginning

D.  100%; end

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:  K1.07   [3.4/3.4]
QID:               P1660

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to compensate for peak core xenon-135 negative reactivity will be <u>greatest</u> after a reactor trip from equilibrium _____ reactor power at the _____ of core life.

A.  20%; beginning

B.  20%; end

C.  100%; beginning

D.  100%; end

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.07   [3.4/3.4]
QID:            P3860   (B3861)

A nuclear reactor has been operating at 80% power for two months.  A manual reactor trip is required for a test.  The trip will be followed by a reactor startup with criticality scheduled to occur 24 hours after the trip.

The greatest assurance that xenon reactivity will permit criticality during the reactor startup will exist if the reactor is operated at _____ power for 48 hours prior to the trip and if criticality is rescheduled for _____ hours after the trip.

A.  60%; 18

B.  60%; 30

C.  100%; 18

D.  100%; 30

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:            P62

Slow changes in axial power distribution in a nuclear reactor that has operated at a steady-state power for a long time can be caused by xenon...

A.  peaking.

B.  override.

C.  burnup.

D.  oscillation.

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:            P261

Xenon oscillations that tend to <u>dampen</u> themselves toward equilibrium over time are
_____ oscillations.

A.  converging

B.  diverging

C.  diffusing

D.  equalizing

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:            P372

Which one of the following occurrences can cause reactor power to fluctuate between the top and bottom of the core when steam demand is constant?

A.  Steam generator level transients

B.  Iodine spiking

C.  Xenon oscillations

D.  Inadvertent boron dilution

ANSWER:  C.

TOPIC:            192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:              P463

A nuclear reactor has been operating at 100% power for several weeks with a symmetrical axial power distribution that is peaked at the core midplane.  Reactor power is reduced to 50% using boration to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power reduction, the axial power distribution will...

A.  shift toward the top of the core.

B.  shift toward the bottom of the core.

C.  peak at the top and the bottom of the core.

D.  remain symmetrical and peaked at the core midplane.

ANSWER:  A.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P563

A nuclear reactor is operating at 100% power at the beginning of core life with equilibrium core xenon-135. Reactor power is reduced, within a 2 hour period, to 50%. Control rods are maintained fully withdrawn. The following parameter values are given:

|  | PRIOR TO POWER CHANGE | AFTER POWER CHANGE |
|---|---|---|
| Reactor power: | 100% | 50% |
| Reactor coolant system boron concentration: | 740 ppm | 820 ppm |
| Control rod position: | Fully Withdrawn | Fully Withdrawn |

What is the effect on power distribution in the core during the first 4 hours following the power reduction?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: A.

TOPIC:              192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:                 P761

When a nuclear reactor experiences xenon oscillations, the most significant shifts in power generation occur between the _____ of the core.

A. top and bottom

B. adjacent quadrants

C. center and periphery

D. opposite quadrants

ANSWER:  A.

TOPIC:              192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:                 P763

A nuclear reactor has been operating at 80% power for several weeks with power production equally distributed axially above and below the core midplane.  Reactor power is increased to 100% using boron dilution to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power increase, axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. remain evenly distributed above and below the core midplane.

D. peak at the top and the bottom of the core.

ANSWER:  B.

TOPIC:              192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:                P961

Which one of the following will cause reactor power to fluctuate slowly between the top and bottom of the core with steady state steam demand?

A.  Feedwater variations

B.  Dropped center control rod

C.  Xenon oscillation

D.  Samarium oscillation

ANSWER:  C.

TOPIC:              192006
KNOWLEDGE:   K1.08   [3.3/3.4]
QID:                P1160

Xenon-135 oscillations take about _____ hours to get from maximum xenon-135 negative reactivity to minimum xenon-135 negative reactivity.

A.  40 to 50

B.  24 to 28

C.  12 to 14

D.  6 to 7

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:  K1.08   [3.3/3.4]
QID:             P2764

A nuclear reactor is operating at 80% power at the beginning of core life with equilibrium core xenon-135.  Reactor power is increased, over a 2-hour period, to 100%.  The following information is provided:

|  | PRIOR TO POWER CHANGE | AFTER POWER CHANGE |
|---|---|---|
| Reactor power: | 80% | 100% |
| Reactor coolant system boron concentration: | 780 ppm | 760 ppm |
| Control rod position: | Fully Withdrawn | Fully Withdrawn |

What is the effect on power distribution in the core during the first 4 hours following the power increase?

A.  Power production in the top of the core increases relative to the bottom of the core.

B.  Power production in the top of the core decreases relative to the bottom of the core.

C.  There is no relative change in power distribution in the core.

D.  It is impossible to determine without additional information.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:  K1.08   [3.3/3.4]
QID:               P3060   (B3061)


A nuclear reactor has been operating at full power for one month following a refueling outage with core axial neutron flux distribution peaked in the bottom half of the core.  An inadvertent reactor trip occurs.  The reactor is restarted, with criticality occurring 6 hours after the trip.  Reactor power is increased to 60% over the next 4 hours and stabilized.

How will core axial neutron flux distribution be affected during the 1-hour period immediately following the return to 60% power?

The core axial neutron flux peak will be located _____ in the core than the pre-trip peak location, and the flux peak will be moving _____.

A.  higher; downward

B.  higher; upward

C.  lower; downward

D.  lower; upward

ANSWER:  A.


TOPIC:          192006
KNOWLEDGE:  K1.09   [3.0/3.1]
QID:               P353    (B355)


A nuclear power plant is being returned to operation following a refueling outage.  Fuel preconditioning requires reactor power to be increased from 10% to full power gradually over a one week period.

During this slow power increase, most of the positive reactivity added by the operator is required to overcome the negative reactivity from...

A.  fuel burnup.

B.  xenon buildup.

C.  fuel temperature increase.

D.  moderator temperature increase.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.09  [3.0/3.1]
QID:           P1263

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

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

A.  increasing toward a peak value.

B.  increasing toward an equilibrium value.

C.  decreasing toward an equilibrium value.

D.  decreasing toward an upturn.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.09   [3.0/3.1]
QID:           P1661

A nuclear reactor has been shut down for 5 days to perform maintenance.  A reactor startup is performed and power is ramped to 75% over a 16 hour period.

When power reaches 75%, the concentration of core xenon-135 will be...

A.  decreasing toward an upturn.

B.  increasing toward a peak value.

C.  decreasing toward an equilibrium value.

D.  increasing toward an equilibrium value.

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.09   [3.0/3.1]
QID:            P5631   (B5631)

A nuclear reactor was shut down for seven days to perform maintenance.  A reactor startup was performed, and power level was increased from 1% to 50% over a two hour period.

Ten hours after reactor power reaches 50%, the magnitude of core xenon-135 negative reactivity will be...

A.  increasing toward a downturn.

B.  increasing toward an equilibrium value.

C.  decreasing toward an equilibrium value.

D.  decreasing toward an upturn.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.10   [3.1/3.2]
QID:            P128

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

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

A.  sooner; the same

B.  sooner; smaller

C.  later; the same

D.  later; smaller

ANSWER:  A.

TOPIC:         192006
KNOWLEDGE:  K1.10   [3.1/3.2]
QID:           P1062

A nuclear reactor has been operating at 100% power for eight weeks when a reactor trip occurs.  The reactor is critical 6 hours later and power is increased to 100% over the next 6 hours.

What is the status of core xenon-135 concentration when power reaches 100%?

A.  Increasing toward an equilibrium value.

B.  Burning out faster than it is being produced.

C.  Increasing toward a peak value.

D.  At equilibrium.

ANSWER:  B.

TOPIC:         192006
KNOWLEDGE:  K1.10   [3.1/3.2]
QID:           P1262

Xenon poisoning in a nuclear reactor core is most likely to prevent a reactor startup following a reactor shutdown from _____ power at the _____ of core life.

A.  high; beginning

B.  low; beginning

C.  high; end

D.  low; end

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:  K1.10   [3.1/3.2]
QID:            P4631

A nuclear power plant startup is in progress 5 hours after a reactor trip from 100% equilibrium power.  The power plant is currently at 10% power and being returned to 100% power at 0.25% per minute instead of the normal rate of 0.5% per minute.

At the slower rate of power increase, the <u>maximum</u> amount of core xenon-135 will occur _____ than normal; and the amount of equilibrium core xenon-135 at 100% power will be _____.

A.  sooner; the same

B.  sooner; smaller

C.  later; the same

D.  later; smaller

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:  K1.11   [3.1/3.1]
QID:            P63

A nuclear reactor that has been operating at rated power for two weeks is quickly reduced in power to 50%.  Xenon-135 will reach a new equilibrium condition in _____ hours.

A.   8 to 10

B.  20 to 25

C.  30 to 35

D.  40 to 50

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:            P263

A nuclear reactor that has been operating at rated power for about two weeks is reduced in power to 50%.  What happens to the Xe-135 concentration in the core?

A.  There will be no change because iodine concentration is constant.

B.  Xenon will initially build up, then decrease to a new equilibrium value.

C.  Xenon will initially decrease, then build up to a new equilibrium value.

D.  Xenon will steadily decrease to a new equilibrium value.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:            P1860   (B2259)

Which one of the following describes the change in core xenon-135 concentration immediately following a power increase from equilibrium conditions?

A.  Initially decreases due to the increased rate of xenon-135 radioactive decay.

B.  Initially decreases due to the increased absorption of thermal neutrons by xenon-135.

C.  Initially increases due to the increased xenon-135 production from fission.

D.  Initially increases due to the increased iodine-135 production from fission.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:            P2261  (B2761)

A nuclear reactor has been operating at steady-state 50% power for 12 hours following a one-hour power reduction from steady-state 100% power.  Which one of the following describes the current core xenon-135 concentration?

A.  Increasing toward a peak

B.  Decreasing toward an upturn

C.  Increasing toward equilibrium

D.  Decreasing toward equilibrium

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:            P2762  (B2763)

A nuclear reactor that had been operating at 100% power for about two months was shutdown over a 2-hour period.  Following the shutdown, core xenon-135 will reach a long-term steady-state concentration in _____ hours.

A.  8 to 10

B.  20 to 25

C.  40 to 50

D.  70 to 80

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:  K1.11   [3.1/3.1]
QID:            P2961   (B2960)

A nuclear reactor has been operating at steady-state 30% power for 3 hours following a one-hour power reduction from steady-state 100% power.  Which one of the following describes the current core xenon-135 concentration?

A.  Increasing toward a peak

B.  Decreasing toward an upturn

C.  Increasing toward equilibrium

D.  Decreasing toward equilibrium

ANSWER:  A.

TOPIC:            192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:              P3261

A nuclear power plant is initially operating at equilibrium 100% power in the middle of a fuel cycle. The operators decrease main generator load while adding boric acid to the RCS over a period of 30 minutes.  At the end of this time period, reactor power is 70% and average reactor coolant temperature is 575°F.  All control rods remain fully withdrawn and in manual control.

Given:

   Total reactivity added by operator  = -3.3 x 10$^{-3}$ ΔK/K
   Total power coefficient            = -1.1 x 10$^{-4}$ ΔK/K/% power

Assuming no additional RCS boration occurs and no other operator actions are taken, what will average reactor coolant temperature be after an additional 60 minutes?

A.  575°F and stable

B.  Less than 575°F and increasing

C.  Less than 575°F and decreasing

D.  Less than 575°F and stable

ANSWER:  C.

TOPIC:            192006
KNOWLEDGE:   K1.11   [3.1/3.1]
QID:              P3362   (B2559)

A nuclear reactor has been operating at 70% power for 26 hours following a one-hour power reduction from steady-state 100% power.  Which one of the following describes the current core xenon-135 concentration?

A.  At equilibrium

B.  Increasing toward a peak

C.  Decreasing toward an upturn

D.  Decreasing toward equilibrium

ANSWER:  D.

TOPIC:            192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:              P360

Compare a nuclear reactor that has been operating at 50% power for several days when a reactor trip occurs, to a reactor that had been operating at full power prior to the trip.  For the 50% power reactor, xenon would peak _____ and the peak xenon reactivity would be _____.

A.  earlier; the same

B.  at the same time; the same

C.  earlier; less negative

D.  at the same time; less negative

ANSWER:  C.

TOPIC:            192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:              P663

Following a reactor trip, negative reactivity from xenon initially increases due to...

A.  xenon production from the decay of iodine-135.

B.  xenon production from the spontaneous fission of uranium.

C.  the reduction of xenon removal by decay.

D.  the reduction of xenon removal by recombination.

ANSWER:  A.

TOPIC:            192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:              P863    (B2262)

Twenty-four hours after a reactor trip from a long-term, steady-state, rated-power run, the core xenon-135 concentration will be approximately...

A.  the same as at the time of the trip and decreasing.

B.  the same as at the time of the trip and increasing.

C.  50% lower than at the time of the trip and decreasing.

D.  50% higher than at the time of the trip and increasing.

ANSWER:  A.

TOPIC:            192006
KNOWLEDGE:   K1.12   [3.1/3.1]
KNOWLEDGE:   K1.13   [2.9/3.0]
QID:              P963

A nuclear reactor has been operating at full power for several days when it is shut down rapidly (within 2 hours) for maintenance.  How will core xenon reactivity change?

A.  Peak in 2 to 4 hours and then decay to near zero in about 1 day.

B.  Peak in 2 to 4 hours and then decay to near zero in 3 to 4 days.

C.  Peak in 6 to 10 hours and then decay to near zero in about 1 day.

D.  Peak in 6 to 10 hours and then decay to near zero in 3 to 4 days.

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:             P1063   (B2159)

A nuclear reactor has been operating at 100% power for three weeks when a reactor trip occurs. Which one of the following describes the concentration of Xe-135 in the core 24 hours after the trip?

A.  At least 2 times the concentration at the time of the trip and decreasing

B.  Less than ½ the concentration at the time of the trip and decreasing

C.  At or approaching a peak value

D.  Approximately the same as at the time of the trip

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:             P2262   (B2461)

Fourteen hours after a reactor trip from 100% power equilibrium xenon conditions, the amount of core xenon-135 will be...

A.  lower than 100% equilibrium xenon, and will have added a net positive reactivity since the trip.

B.  lower than 100% equilibrium xenon, and will have added a net negative reactivity since the trip.

C.  higher than 100% equilibrium xenon, and will have added a net positive reactivity since the trip.

D.  higher than 100% equilibrium xenon, and will have added a net negative reactivity since the trip.

ANSWER:  D.

TOPIC:        192006
KNOWLEDGE:  K1.12  [3.1/3.1]
QID:         P2363

How does core xenon-135 change immediately following a reactor trip from equilibrium 100% power operation?

A.  Decreases due to xenon removal by decay.

B.  Decreases due to the reduction in xenon production directly from fission.

C.  Increases due to xenon production from the decay of iodine-135.

D.  Increases due to xenon production from the spontaneous fission of uranium.

ANSWER:  C.

TOPIC:        192006
KNOWLEDGE:  K1.12  [3.1/3.1]
QID:         P2662  (B2662)

Given:

• A nuclear reactor was operating at 100% power for six weeks when a reactor trip occurred.
• A reactor startup was performed and criticality was reached 16 hours after the trip.
• Two hours later, the reactor is currently at 30% power with control rods in Manual.

If <u>no</u> operator actions are taken over the next hour, average reactor coolant temperature will _____ because core Xe-135 concentration is _____.

A.  increase; decreasing

B.  increase; increasing

C.  decrease; decreasing

D.  decrease; increasing

ANSWER:  A.

TOPIC:           192006
KNOWLEDGE:   K1.12   [3.1/3.1]
QID:              P2862   (B1462)

A nuclear reactor has been operating at 100% power for two months when a reactor trip occurs. Four hours later, the reactor is critical and stable at 10% power.

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

A.  Add positive reactivity during the entire period

B.  Add negative reactivity during the entire period

C.  Add positive reactivity, then negative reactivity

D.  Add negative reactivity, then positive reactivity

ANSWER:  C.

TOPIC:           192006
KNOWLEDGE:   K1.13   [2.9/3.0]
QID:              P562

After a reactor shutdown from equilibrium core xenon conditions, the maximum xenon -135 negative reactivity (height of the xenon peak) is _____ the preshutdown equilibrium power level.

A.  independent of

B.  directly proportional to

C.  inversely proportional to

D.  dependent on but not directly proportional to

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:  K1.13   [2.9/3.0]
QID:             P1760

A nuclear power plant was shut down following three months of operation at full power.  The shutdown occurred over a 3 hour period with a constant rate of power decrease.

Which one of the following describes the reactivity added by core xenon during the shutdown?

A.  Xenon buildup added negative reactivity.

B.  Xenon buildup added positive reactivity.

C.  Xenon burnout added negative reactivity.

D.  Xenon burnout added positive reactivity.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:  K1.14   [3.2/3.3]
QID:             P262

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

A.  positive; increasing

B.  positive; decreasing

C.  negative; increasing

D.  negative; decreasing

ANSWER:  A.

TOPIC:              192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:                 P361    (B1862)

A nuclear power plant has been operating at 100% power for two months when a reactor trip occurs. Shortly after the reactor trip a reactor startup is commenced.  Six hours after the trip, reactor power is at 2%.  To maintain power stable at 2% over the next hour, the operator must add...

A.  positive reactivity because core xenon-135 is building up.

B.  negative reactivity because core xenon-135 is building up.

C.  positive reactivity because core xenon-135 is decaying away.

D.  negative reactivity because core xenon-135 is decaying away.

ANSWER:  A.

TOPIC:              192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:                 P561    (B562)

Following a seven day shutdown, a reactor startup is performed and the nuclear power plant is taken to 100% power over a 16-hour period.  After reaching 100% power, what type of reactivity will the operator need to add to compensate for core xenon-135 changes over the next 24 hours?

A.  Negative only

B.  Negative, then positive

C.  Positive only

D.  Positive, then negative

ANSWER:  C.

TOPIC:           192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:             P1462   (B1461)

A nuclear reactor has been operating at 100% power for two weeks.  Power is then decreased over a 1-hour period to 10%.

Assuming manual rod control, which one of the following operator actions is required to maintain a constant reactor coolant temperature at 10% power during the next 24 hours?

A.  Add negative reactivity during the entire period

B.  Add positive reactivity during the entire period

C.  Add positive reactivity, then negative reactivity

D.  Add negative reactivity, then positive reactivity

ANSWER:  C.

TOPIC:           192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:             P1762   (B1763)

A nuclear reactor startup is being conducted and criticality has been achieved 15 hours after a reactor trip from long term operation at full power.  After 1 additional hour, reactor power is stabilized at $10^{-4}$% power and all control rod motion is stopped.

Which one of the following describes the response of reactor power over the next 2 hours without any further operator actions?

A.  Power increases toward the point of adding heat due to the decay of Xe-135.

B.  Power increases toward the point of adding heat due to the decay of Sm-149.

C.  Power decreases toward the shutdown neutron level due to the buildup of Xe-135.

D.  Power decreases toward the shutdown neutron level due to the buildup of Sm-149.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:  K1.14   [3.2/3.3]
QID:            P2260

A nuclear reactor is initially shut down with no xenon in the core.  Over the next four hours, the reactor is made critical and power level is increased to the point of adding heat.  The shift supervisor has directed that power be maintained constant at this level for 12 hours for testing.

To accomplish this objective, control rods will have to be...

A.  inserted periodically for the duration of the 12 hours.

B.  withdrawn periodically for the duration of the 12 hours.

C.  inserted periodically for 4 to 6 hours, then withdrawn periodically.

D.  withdrawn periodically for 4 to 6 hours, then inserted periodically.

ANSWER:  B.

TOPIC:          192006
KNOWLEDGE:  K1.14   [3.2/3.3]
QID:            P2561

A nuclear reactor is initially shut down with no xenon in the core.  A reactor startup is performed and 4 hours later power level is at 25%.  The shift supervisor has directed that reactor power and reactor coolant temperature be maintained constant at this level for 12 hours.

To accomplish this, control rods will have to be...

A.  withdrawn periodically for the duration of the 12 hours.

B.  inserted periodically for the duration of the 12 hours.

C.  withdrawn periodically for 4 to 6 hours, then inserted periodically.

D.  inserted periodically for 4 to 6 hours, then withdrawn periodically.

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:            P2863

A nuclear reactor is operating at 100% power immediately following a one-hour power ascension from steady-state 70% power.  To keep reactor coolant system temperature stable over the next two hours, the operator must _____ control rods or _____ reactor coolant boron concentration.

A   insert; increase

B.  insert; decrease

C.  withdraw; increase

D.  withdraw; decrease

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:            P2963   (B2964)

A nuclear reactor is operating at 60% power immediately after a one-hour power increase from equilibrium 40% power.  To keep RCS T-avg stable over the next two hours, the operator must _____ control rods or _____ reactor coolant boron concentration.

A.  insert; increase

B.  insert; decrease

C.  withdraw; increase

D.  withdraw; decrease

ANSWER:  A.

TOPIC:          192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:            P3063

A nuclear power plant is initially operating at 100% power with equilibrium core xenon-135.  Power is decreased to 75% over a 1-hour period and then stabilized.  The operator then adjusts control rod height as necessary to maintain average reactor coolant temperature constant.

What will be the rod position and directional trend 30 hours after the power change?

A.  Above the initial 75% power position and inserting slowly

B.  Above the initial 75% power position and withdrawing slowly

C.  Below the initial 75% power position and inserting slowly

D.  Below the initial 75% power position and withdrawing slowly

ANSWER:  C.

TOPIC:          192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:            P3563   (B3563)

A nuclear power plant had been operating at 100% power for two months when a reactor trip occurred.  Soon afterward, a  reactor startup was performed.  Twelve hours after the trip, the startup has been paused with reactor power at 2%.

To maintain reactor power and reactor coolant temperature stable over the next hour, the operator must add _____ reactivity because core xenon-135 concentration will be _____.

A.  positive; increasing.

B.  negative; increasing.

C.  positive; decreasing.

D.  negative; decreasing.

ANSWER:  D.

TOPIC:          192006
KNOWLEDGE:   K1.14   [3.2/3.3]
QID:            P3863

A nuclear power plant is initially operating at steady-state 100% reactor power in the middle of a fuel cycle.  The operators then slowly decrease main generator load to 90% while adding boric acid to the RCS.  After the required amount of boric acid is added, reactor power is 90% and average reactor coolant temperature is 582°F.  All control rods remain fully withdrawn and in manual control.

Assuming no other operator actions are taken, which one of the following describes the average reactor coolant temperature after an additional 60 minutes?

A.  Higher than 582°F and increasing slowly.

B.  Higher than 582°F and decreasing slowly.

C.  Lower than 582°F and increasing slowly.

D.  Lower than 582°F and decreasing slowly.

ANSWER:  D.

TOPIC:          192007
KNOWLEDGE:   K1.01   [2.1/2.5]
QID:            P362    (B364)

Which one of the following is <u>not</u> a function performed by burnable poisons in an operating nuclear reactor?

A.  Provide neutron flux shaping.

B.  Provide more uniform power density.

C.  Offset the effects of control rod burnout.

D.  Allow higher fuel enrichment of initial core load.

ANSWER:  C.

TOPIC:          192007
KNOWLEDGE:   K1.01   [2.1/2.5]
QID:            P864

Instead of using a higher concentration of soluble boric acid, burnable poisons are installed in a new nuclear reactor core to...

A.  prevent boron precipitation during normal operation.

B.  establish a more negative moderator temperature coefficient.

C.  allow control rods to be withdrawn farther upon initial criticality.

D.  maintain reactor coolant pH above a minimum acceptable value.

ANSWER:  B.

TOPIC:           192007
KNOWLEDGE:   K1.01   [2.1/2.5]
QID:             P1664

Why are burnable poisons installed in a new nuclear reactor core <u>instead</u> 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.

ANSWER:  B.

TOPIC:           192007
KNOWLEDGE:   K1.04   [3.1/3.4]
QID:             P64

A nuclear reactor is operating near the end of its fuel cycle.  Reactor power and reactor coolant system (RCS) temperature are being allowed to "coast down."

Why is RCS boron dilution <u>no</u> <u>longer</u> used for reactivity control?

A.  The reactivity worth of the boron has increased so much that reactivity changes from RCS boron dilution cannot be safely controlled by the operator.

B.  The reactivity worth of the boron has decreased so much that a very large amount of water must be added to the RCS to make a small positive reactivity addition to the core.

C.  RCS boron concentration has become so high that a very large amount of boron must be added to produce a small increase in boron concentration.

D.  RCS boron concentration has become so low that a very large amount of water must be added to the RCS to produce a small decrease in boron concentration.

ANSWER:  D.

TOPIC:          192007
KNOWLEDGE    K1.04    [3.1/3.4]
QID:            P264    (B564)

Just prior to a refueling outage, a nuclear power plant is operating at 100% power with a reactor coolant boron concentration of 50 ppm.  After the refueling outage, the 100% boron concentration is approximately 1,000 ppm.

Which one of the following is the primary reason for the large increase in full-power reactor coolant boron concentration?

A.  Reactivity from power defect at beginning of core life (BOL) is much greater than at end of core life (EOL).

B.  Differential boron worth at BOL is much less than at EOL.
    [Inverse boron worth at BOL is much greater than at EOL.]

C.  The excess reactivity in the core at BOL is much greater than at EOL.

D.  The integral control rod worth at BOL is much less than at EOL.

ANSWER:  C.

TOPIC:          192007
KNOWLEDGE    K1.04    [3.1/3.4]
QID:            P464

During a six-month period of continuous full power reactor operation, the reactor coolant boron concentration must be decreased steadily to compensate for...

A.  buildup of fission product poisons and decreasing control rod worth.

B.  fuel depletion and buildup of fission product poisons.

C.  decreasing control rod worth and burnable poison burnout.

D.  burnable poison burnout and fuel depletion.

ANSWER:  B.

TOPIC:          192007
KNOWLEDGE:   K1.04   [3.1/3.4]
QID:            P1264   (B1163)

Refer to the drawing of $K_{eff}$ versus core age for a nuclear reactor core following a refueling outage (see figure below).

Which one of the following is responsible for the majority of the decrease in $K_{eff}$ from point 1 to point 2?

A.  Depletion of fuel

B.  Burnout of burnable poisons

C.  Initial heat-up of the reactor

D.  Buildup of fission product poisons

ANSWER:  D.
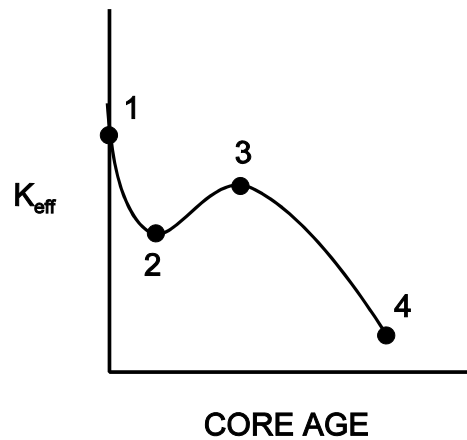
TOPIC:        192007
KNOWLEDGE:   K1.04   [3.1/3.4]
QID:          P1563

Refer to the graph of critical boron concentration versus burnup for a nuclear reactor core 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

ANSWER:  A.
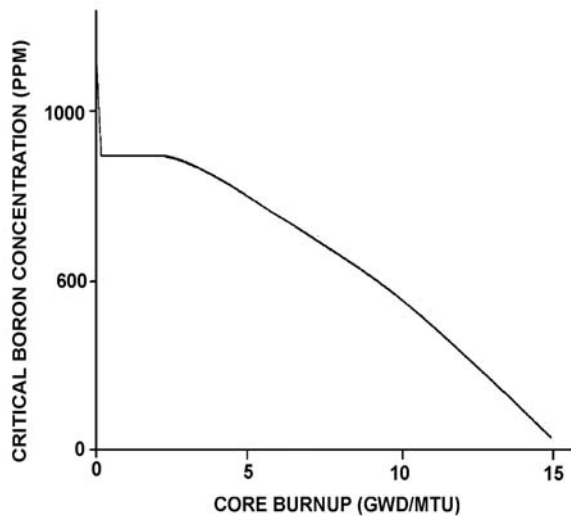
TOPIC:          192007
KNOWLEDGE:   K1.04   [3.1/3.4]
QID:            P1864   (B1364)

Refer to the graph of critical boron concentration versus core burnup for a nuclear reactor core during its first fuel cycle (see figure below).

Which one of the following explains why reactor coolant critical boron concentration becomes relatively constant early in core life?

A.  Buildup of fission product poisons is being offset by burnable poison burnout and fuel depletion.

B.  Burnable poison burnout and fuel depletion are being offset by buildup of fission product poisons.

C.  Fuel depletion is being offset by the buildup of fissionable plutonium and fission product poison buildup.

D.  Fission product poison buildup and fuel depletion are being offset by burnable poison burnout.

ANSWER:  D.
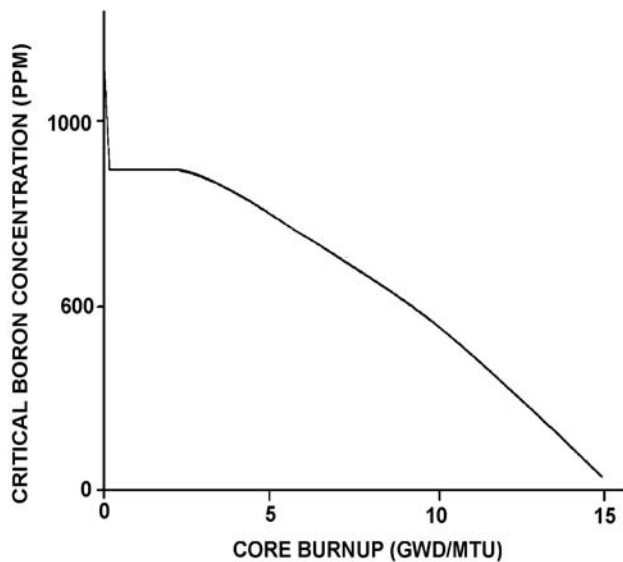
TOPIC:          192007
KNOWLEDGE    K1.04   [3.1/3.4]
QID:            P2763

During continuous full-power nuclear reactor operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically to compensate for fuel depletion.  What other core age-related factor requires a periodic decrease in reactor coolant boron concentration?

A.  Decreasing control rod worth

B.  Buildup of fission product poisons

C.  Burnout of burnable poisons

D.  Decreasing fuel temperature

ANSWER:  B.

TOPIC:          192007
KNOWLEDGE:   K1.04   [3.1/3.4]
QID:            P2964

A nuclear reactor has been operating at 100% power for three months following a refueling outage. If the reactor is operated at 100% power without making RCS boron additions or dilutions for the next month, RCS boron concentration will...

A.  decrease because boron atoms decompose at normal RCS operating temperatures.

B.  decrease because irradiated boron-10 atoms undergo a neutron-alpha reaction.

C.  remain constant because irradiated boron-10 atoms become stable boron-11 atoms.

D.  remain constant because irradiated boron-10 atoms still have large absorption cross sections for thermal neutrons.

ANSWER:  B.

TOPIC:          192007
KNOWLEDGE    K1.04   [3.1/3.4]
QID:            P4832

Just prior to a refueling outage the 100% power reactor coolant boron concentration was 50 ppm. Immediately following the outage the 100% power boron concentration was 1,000 ppm.

Assume that burnable poisons were installed during the outage.  Also assume that control rods were fully withdrawn from the core at 100% power for both cases.

Which one of the following contributes to the need for a much higher 100% power reactor coolant boron concentration at the beginning of a fuel cycle (BOC) compared with the end of a fuel cycle (EOC)?

A.  The negative reactivity from burnable poisons is greater at BOC than at EOC.

B.  The negative reactivity from fission product poisons is smaller at BOC than at EOC.

C.  The positive reactivity from the fuel in the core is smaller at BOC than at EOC.

D.  The positive reactivity from a unit withdrawal of a typical control rod is greater at BOC than at EOC.

ANSWER:  B.

TOPIC:          192007
KNOWLEDGE:   K1.05   [3.0/3.2]
QID:            P1964

Which one of the following describes whether reactor power can be increased from 50% to 100% in a controlled manner faster near the beginning of core life (BOL) or near the end of core life (EOL)? (Assume all control rods are fully withdrawn just prior to beginning the power increase.)

A.  Faster near EOL due to faster changes in boron concentration

B.  Faster near EOL due to greater control rod worth

C.  Faster near BOL due to faster changes in boron concentration

D.  Faster near BOL due to greater control rod worth

ANSWER:  C.

TOPIC:              192007
KNOWLEDGE:   K1.05   [3.0/3.2]
QID:                P2053

Which one of the following correctly compares the rates at which reactor power can be increased from 80% to 100% at the beginning of core life (BOL) and at the end of core life (EOL)?

A.  Slower at EOL due to a lower maximum rate of reactor coolant boron dilution.

B.  Slower at EOL due to lower control rod worth.

C.  Slower at BOL due to a lower maximum rate of reactor coolant boron dilution.

D.  Slower at BOL due to lower control rod worth.

ANSWER:  A.

TOPIC:              192007
KNOWLEDGE:   K1.05   [3.0/3.2]
QID:                P3364

A nuclear reactor has been shut down for 8 hours following a loss of offsite power.  A reactor coolant system (RCS) cooldown on single-phase natural circulation is in progress.

Compared to adding boric acid to the RCS during forced circulation, adding boric acid during natural circulation requires _____ time to achieve complete mixing in the RCS; and, once completely mixed at a given coolant temperature, a 1 ppm increase in RCS boron concentration during natural circulation will cause a/an _____ change in core reactivity.

A.  more; smaller

B.  more; equal

C.  less; smaller

D.  less; equal

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.01   [3.4/3.5]
QID:            P364

Which three of the following parameters should be closely monitored and controlled during the approach to criticality?

   1.  Axial flux difference (axial shape index)
   2.  Reactor startup rate
   3.  Source range (neutron) count rate
   4.  Rod position

A.  1, 2, 3

B.  1, 2, 4

C.  1, 3, 4

D.  2, 3, 4

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.01   [3.4/3.5]
QID:            P565

During a nuclear reactor startup, the first reactivity addition caused the source range count rate to increase from 20 to 40 cps.  The second reactivity addition caused the count rate to increase from 40 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 not enough data given to determine the relationship of reactivity values.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.01   [3.4/3.5]
QID:            P1665

During a nuclear reactor startup, the first positive reactivity addition caused the count rate to increase from 20 to 30 cps.  The second positive reactivity addition caused the count rate to increase from 30 to 60 cps.  Assume $K_{eff}$ was 0.97 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

A.  The first reactivity addition was approximately 50% larger than the second.

B.  The second reactivity addition was approximately 50% larger than the first.

C.  The first and second reactivity additions were approximately the same.

D.  There is not enough information given to determine the relationship of the reactivity values.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.02   [2.8/3.1]
QID:            P3366

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor trip occurred.  Four hours after the trip, with reactor coolant temperature at normal no-load temperature, which one of the following will cause the fission rate in the reactor core to increase?

A.  The operator fully withdraws the shutdown control rods.

B.  Reactor coolant temperature is allowed to increase by 3°F.

C.  Reactor coolant boron concentration is increased by 10 ppm.

D.  An additional two hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER:  A.

TOPIC:           192008
KNOWLEDGE:   K1.02   [2.8/3.1]
QID:             P3464

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor trip occurred.  Four hours after the trip, reactor coolant temperature is being maintained at normal no-load temperature in anticipation of commencing a reactor startup.

At this time, which one of the following will cause the fission rate in the reactor core to decrease?

A.  The operator fully withdraws the shutdown control rods.

B.  Reactor coolant temperature is allowed to decrease by 3°F.

C.  Reactor coolant boron concentration is decreased by 10 ppm.

D.  An additional two hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER:  D.

TOPIC:           192008
KNOWLEDGE:   K1.03   [3.9/4.0]
QID:             P65      (B266)

While withdrawing control rods during an approach to criticality, the stable count rate doubles.  If the same amount  of reactivity that caused the first doubling is added again, stable count rate will _____ and the reactor will be _____.

A.  double; subcritical

B.  more than double; subcritical

C.  double; critical

D.  more than double; critical

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:  K1.03   [3.9/4.0]
QID:            P265

A nuclear reactor startup is in progress and the reactor is slightly subcritical.  Assuming the reactor remains subcritical, a short control rod <u>withdrawal</u> will cause the reactor startup rate indication to increase rapidly in the positive direction, and then...

A.  rapidly decrease and stabilize at a negative 1/3 dpm.

B.  gradually decrease and stabilize at zero.

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

D.  continue a rapid increase until the POAH is reached; then decrease to zero.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:  K1.03   [3.9/4.0]
QID:            P1065  (B1565)

During a nuclear reactor startup, equal increments of positive reactivity are being sequentially added and the count rate is allowed to reach equilibrium after each addition.  Which one of the following statements concerning the equilibrium count rate applies after each successive reactivity addition?

A.  The time required to reach equilibrium count rate is the same.

B.  The time required to reach equilibrium count rate is shorter.

C.  The numerical change in equilibrium count rate increases.

D.  The numerical change in equilibrium count rate is the same.

ANSWER:  C.

TOPIC:        192008
KNOWLEDGE:  K1.03   [3.9/4.0]
QID:          P1166

Which one of the following describes the change in neutron count rate resulting from a short control rod withdrawal with $K_{eff}$ at 0.95 as compared to an identical control rod withdrawal with $K_{eff}$ at 0.99? (Assume reactivity additions are equal, and the reactor remains subcritical.)

A.  The prompt jump in count rate will be the same, and the increase in count rate will be the same.

B.  The prompt jump in count rate will be greater with $K_{eff}$ at 0.99, but the increase in count rate will be the same.

C.  The prompt jump in count rate will be the same, but the increase in count rate will be greater with $K_{eff}$ at 0.99.

D.  The prompt jump in count rate will be greater, and the increase in count rate will be greater with $K_{eff}$ at 0.99.

ANSWER:  D.

TOPIC:        192008
KNOWLEDGE:  K1.03   [3.9/4.0]
QID:          P1766

A nuclear reactor startup is in progress with the reactor currently subcritical.

Which one of the following describes the change in count rate resulting from a short control rod withdrawal with $K_{eff}$ at 0.99 as compared to an identical control rod withdrawal with $K_{eff}$ at 0.95? (Assume reactivity additions are equal, and the reactor remains subcritical.)

A.  Both the prompt jump in count rate and the increase in stable count rate will be the same.

B.  Both the prompt jump in count rate and the increase in stable count rate will be smaller with $K_{eff}$ at 0.95.

C.  The prompt jump in count rate will be smaller with $K_{eff}$ at 0.95, but the increase in stable count rate will be the same.

D.  The prompt jump in count rate will be the same, but the increase in stable count rate will be smaller with $K_{eff}$ at 0.95.

ANSWER:  B.

TOPIC:       192008
KNOWLEDGE:  K1.03  [3.9/4.0]
QID:          P2466  (B2465)

A nuclear reactor startup is being performed by adding <u>equal</u> amounts of positive reactivity and waiting for neutron population to stabilize.  As the reactor approaches criticality, the <u>numerical change</u> in stable neutron population after each reactivity addition _____, and the <u>time required</u> for the neutron population to stabilize after each reactivity addition _____.

A.  increases; remains the same

B.  increases; increases

C.  remains the same; remains the same

D.  remains the same; increases

ANSWER:  B.

TOPIC:       192008
KNOWLEDGE:  K1.03  [3.9/4.0]
QID:          P2467

A reactor startup is in progress.  The reactor is slightly subcritical with a constant startup rate of 0.0 decades per minute (dpm).  A short control rod insertion will cause the reactor startup rate indication to initially decrease (become negative), and then...

A.  gradually become less negative and return to 0.0 dpm.

B.  gradually become more negative until neutron population reaches the source range equilibrium level, and then return to 0.0 dpm.

C.  stabilize until neutron population reaches the source range equilibrium level, and then return to 0.0 dpm.

D.  stabilize at -1/3 dpm until fission neutrons are no longer a significant contributor to the neutron population, and then return to 0.0 dpm.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.03   [3.9/4.0]
QID:            P4534

A nuclear reactor is critical in the source range during a reactor startup with a core effective delayed neutron fraction of 0.007.  The operator then adds positive reactivity to establish a stable 0.5 dpm startup rate.

If the core effective delayed neutron fraction had been 0.005, what would be the approximate stable startup rate after the addition of the same amount of positive reactivity?

A.  0.6

B.  0.66

C.  0.7

D.  0.76

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P266    (B1566)

During a nuclear reactor startup, the operator adds 1.0% $\Delta K/K$ of positive reactivity by withdrawing control rods, thereby increasing equilibrium source range neutron level from 220 cps to 440 cps.

To raise equilibrium source range neutron level to 880 cps, an additional _____ of positive reactivity must be added.

A.  4.0% $\Delta K/K$

B.  2.0% $\Delta K/K$

C.  1.0% $\Delta K/K$

D.  0.5% $\Delta K/K$

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P566

During a nuclear reactor startup, control rods are withdrawn such that 1.05% $\Delta K/K$ of reactivity is added.  Before the withdrawal $K_{eff}$ was 0.97 and count rate was 500 cps.

Which one of the following will be the approximate final steady-state count rate following the rod withdrawal?

A.  750 cps

B.  1000 cps

C.  2000 cps

D.  2250 cps

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P666

During a nuclear reactor startup, control rods are withdrawn such that $K_{eff}$ increases from 0.98 to 0.99.  If the count rate before the rod withdrawal was 500 cps, which one of the following will be the final count rate?

A.   707 cps

B.  1000 cps

C.  1500 cps

D.  2000 cps

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:             P1265   (B1967)

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 4.0 as the first 100 fuel assemblies are loaded.  What is the corresponding final $K_{eff}$?

A.  0.25

B.  0.5

C.  0.75

D.  1.0

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P1770   (B1665)

Refer to the drawing of three 1/M plots labeled A, B, and C (see figure below).

The least conservative approach to criticality is represented by plot _____ and could possibly be the result of recording count rates at _____ time intervals after incremental fuel loading steps compared to the situations represented by the other plots.

A.  A; shorter

B.  A; longer

C.  C; shorter

D.  C; longer

ANSWER:  C.



1/M PLOT
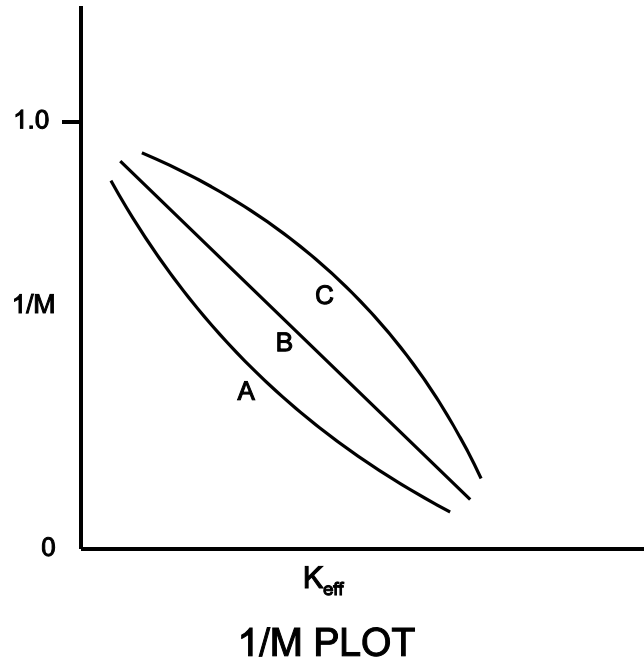
TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P1866  (B2266)

As a nuclear reactor approaches criticality during a reactor startup it takes longer to reach an equilibrium neutron count rate after each control rod withdrawal due to the increased...

A.  length of time required to complete a neutron generation.

B.  number of neutron generations required to reach a stable neutron level.

C.  length of time from neutron birth to absorption.

D.  fraction of delayed neutrons being produced as criticality is approached.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:            P1867

During a nuclear reactor startup, the first reactivity addition caused the count rate to increase from 20 to 40 cps.  The second reactivity addition caused the count rate to increase from 40 to 80 cps. Assume $K_{eff}$ was 0.92 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

A.  The first reactivity addition was approximately twice as large as the second.

B.  The second reactivity addition was approximately twice as large as the first.

C.  The first and second reactivity additions were approximately the same.

D.  There is not enough data given to determine the relationship between reactivity values.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:  K1.04   [3.8/3.8]
QID:            P1972   (B1067)

At one point during a nuclear reactor startup and approach to criticality, count rate is noted to be 780 cps, and $K_{eff}$ is calculated to be 0.92.  Later in the same startup, stable count rate is 4,160 cps.

What is the new $K_{eff}$?

A.  0.945

B.  0.950

C.  0.975

D.  0.985

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:  K1.04   [3.8/3.8]
QID:            P2265   (B366)

During a nuclear reactor startup, source range indication is stable at 100 cps, and $K_{eff}$ is 0.95.  After a number of control rods have been withdrawn, source range indication stabilizes at 270 cps.  Which one of the following is the new $K_{eff}$?  (Assume reactor startup rate is zero before and after the rod withdrawal.)

A.  0.963

B.  0.972

C.  0.981

D.  0.990

ANSWER:  C.

TOPIC:           192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:              P2366   (B2365)

A nuclear reactor startup is in progress with a current $K_{eff}$ of 0.95 and a current stable source range count rate of 120 cps.  Which one of the following stable count rates will occur when $K_{eff}$ becomes 0.97?

A.  200 cps

B.  245 cps

C.  300 cps

D.  375 cps

ANSWER:  A.

TOPIC:           192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:              P2468   (B1766)

A nuclear reactor startup is in progress with a current $K_{eff}$ of 0.95 and a current equilibrium source range count rate of 150 cps.  Which one of the following equilibrium count rates will occur when $K_{eff}$ becomes 0.98?

A.  210 cps

B.  245 cps

C.  300 cps

D.  375 cps

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:  K1.04   [3.8/3.8]
QID:            P2766  (B2765)

During a nuclear reactor startup, source range indication is stable at 120 cps with $K_{eff}$ at 0.95.  After a period of control rod withdrawal, source range indication stabilizes at 600 cps.  Which one of the following is the approximate new $K_{eff}$?

A.  0.96

B.  0.97

C.  0.98

D.  0.99

ANSWER:  D.

TOPIC:           192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:             P3665  (B3665)

Refer to the drawing of a 1/M plot with curves A and B (see figure below).  Assume that each axis has linear units.

Curve A would result if each fuel assembly loaded during the early stages of the refueling caused a relatively _____ fractional change in source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal _____.

A.  small; fuel enrichment

B.  small; reactivity

C.  large; fuel enrichment

D.  large; reactivity

ANSWER:  D.
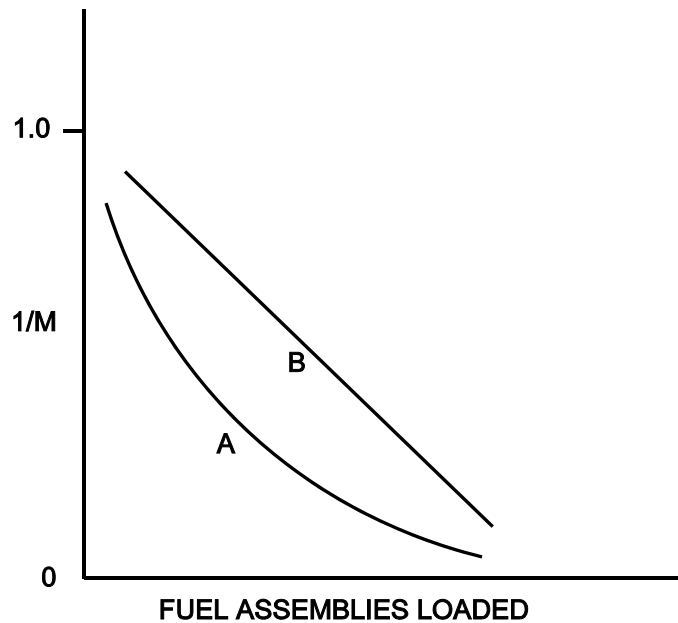
TOPIC:              192008
KNOWLEDGE:   K1.04   [3.8/3.8]
QID:                  P4734

During a nuclear reactor startup, positive reactivity addition X caused the stable source range count rate to increase from 20 to 40 cps. Later in the startup, after several other additions of positive reactivity, positive reactivity addition Y caused the stable source range count rate to increase from 320 cps to 640 cps.

Which one of the following statements describes how the magnitudes of the two positive reactivity additions (X and Y) compare?

A.  Reactivity addition X was several times greater in magnitude than reactivity addition Y.

B.  Reactivity addition X was several times smaller in magnitude than reactivity addition Y.

C.  Reactivity additions X and Y were about equal in magnitude.

D.  There is not enough information given to determine the relationship between the reactivity additions.

ANSWER:  A.

TOPIC:              192008
KNOWLEDGE:   K1.05   [3.8/3.9]
QID:                  P66

In a nuclear reactor with a source, a constant neutron flux over a few minutes is indicative of criticality or...

A.  the point of adding heat.

B.  supercriticality.

C.  subcriticality.

D.  equilibrium subcritical count rate.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.05   [3.8/3.9]
QID:             P267

As criticality is approached during a nuclear reactor startup, equal insertions of positive reactivity will result in a _____ absolute change in equilibrium neutron count rate and a _____ time to reach each new equilibrium neutron flux level.

A.  smaller; shorter

B.  smaller; longer

C.  greater; shorter

D.  greater; longer

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.05   [3.8/3.9]
QID:             P365    (B365)

A nuclear reactor startup is in progress with a stable source range count rate and the reactor is near criticality.  Which one of the following statements describes count rate characteristics during and after a 5-second control rod withdrawal? (Assume the reactor remains subcritical.)

A.  There will be no change in count rate until criticality is achieved.

B.  The count rate will rapidly increase (prompt jump) to a stable higher value.

C.  The count rate will rapidly increase (prompt jump) then gradually increase and stabilize at a higher value.

D.  The count rate will rapidly increase (prompt jump) then gradually decrease and stabilize at the previous value.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.05   [3.8/3.9]
QID:             P3567   (B3566)

A nuclear reactor startup is in progress for a reactor that is in the middle of a fuel cycle.  The reactor is at normal operating temperature and pressure.  The main steam isolation valves are open and the main turbine bypass (also called steam dump) valves are closed.  The reactor is near criticality.

Reactor startup rate (SUR) is stable at zero when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser.  The operator immediately ensures <u>no</u> control rod motion is occurring and takes <u>no</u> further action.  Assume that the steam generator water levels remain stable, the reactor does <u>not</u> trip, and <u>no</u> other reactor protective actions occur.

As a result of the valve failure, SUR will initially become _____; and reactor power will stabilize _____ the point of adding heat.

A.  positive; at

B.  positive; above

C.  negative; at

D.  negative; above

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.06   [2.9/3.1]
QID:             P466

During a nuclear reactor startup as $K_{eff}$ increases toward 1.0, the value of 1/M...

A.  decreases toward zero.

B.  decreases toward 1.0.

C.  increases toward infinity.

D.  increases toward 1.0.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.06   [2.9/3.1]
QID:            P969

The following data were obtained during a nuclear reactor startup:

| Control Rod Units Withdrawn | Source Range Count Rate (cps) |
|:---:|:---:|
| 0 | 20 |
| 10 | 25 |
| 15 | 29 |
| 20 | 33 |
| 25 | 40 |
| 30 | 50 |

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A.  66 to 75 units withdrawn

B.  56 to 65 units withdrawn

C.  46 to 55 units withdrawn

D.  35 to 45 units withdrawn

ANSWER:  C.

TOPIC:            192008
KNOWLEDGE:   K1.06   [2.9/3.1]
QID:              P1167   (B2767)

The following data were obtained during a nuclear reactor startup:

| Control Rod Units Withdrawn | Source Range Count Rate (cps) |
|:---:|:---:|
| 0 | 180 |
| 10 | 210 |
| 15 | 250 |
| 20 | 300 |
| 25 | 360 |
| 30 | 420 |

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A.  35 to 45 units withdrawn

B.  46 to 55 units withdrawn

C.  56 to 65 units withdrawn

D.  66 to 75 units withdrawn

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.06   [2.9/3.1]
QID:               P1667   (B1567)

The following data were obtained at steady-state conditions during a nuclear reactor startup:

| Control Rod Units Withdrawn | Source Range Count Rate (cps) |
|:---:|:---:|
| 0 | 180 |
| 5 | 200 |
| 10 | 225 |
| 15 | 257 |
| 20 | 300 |
| 25 | 360 |
| 30 | 450 |

Assuming uniform differential rod worth, at what approximate control rod position should criticality occur?

A.  Approximately 40 units withdrawn

B.  Approximately 50 units withdrawn

C.  Approximately 60 units withdrawn

D.  Approximately 70 units withdrawn

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:  K1.06  [2.9/3.1]
QID:            P1966  (B1767)

The following data were obtained at steady-state conditions during a nuclear reactor startup:

| Control Rod<br>Units Withdrawn | Source Range<br>Count Rate (cps) |
|:---:|:---:|
| 10 | 360 |
| 15 | 400 |
| 20 | 450 |
| 25 | 514 |
| 30 | 600 |
| 35 | 720 |
| 40 | 900 |

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A.  50 units withdrawn

B.  60 units withdrawn

C.  70 units withdrawn

D.  80 units withdrawn

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:            P67

Near the end of core life, critical rod position has been calculated for a nuclear reactor startup 4 hours after a trip from 100% power equilibrium conditions.  The actual critical rod position will be <u>lower</u> than the predicted critical rod position if...

A.  the startup is delayed until 8 hours after the trip.

B.  the steam dump pressure setpoint is lowered by 100 psi prior to reactor startup.

C.  actual boron concentration is 10 ppm higher than the assumed boron concentration.

D.  one control rod remains fully inserted during the approach to criticality.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:            P268

To predict critical control rod position prior to commencing a nuclear reactor startup, the operator must consider the amount of reactivity added by post-shutdown changes in...

A.  reactor coolant boron concentration, neutron flux level, and burnable poisons.

B.  control rod positions, core xenon-135 concentration, and reactor coolant temperature.

C.  neutron flux level, reactor coolant boron concentration, and control rod positions.

D.  reactor coolant temperature, burnable poisons, and core xenon-135 concentration.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:             P367

Which one of the following is <u>not</u> required to determine the estimated critical boron concentration for a nuclear reactor startup to be performed 48 hours following an inadvertent reactor trip?

A.  Reactor power level just prior to the trip

B.  Steam generator levels just prior to the trip

C.  Xenon reactivity in the core just prior to the trip

D.  Samarium reactivity in the core just prior to the trip

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:             P467

An estimated critical rod position (ECP) has been correctly calculated for a nuclear reactor startup that is to be performed 6 hours after a trip from a 60 day full power run.  Which one of the following events or conditions will result in the actual critical rod position being <u>lower</u> than the ECP?

A.  The startup is delayed for approximately 2 hours.

B.  Steam generator feedwater addition rate is reduced by 5% just prior to criticality.

C.  Steam generator pressures are decreased by 100 psi just prior to criticality.

D.  A new boron sample shows a current boron concentration 20 ppm higher than that used in the ECP calculation.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:               P765

Which one of the following conditions will result in criticality occurring at a lower than estimated control rod position?

A.  Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations

B.  A malfunction resulting in control rod speed being lower than normal speed

C.  Delaying the time of startup from 10 days to 14 days following a trip from 100% power equilibrium conditions.

D.  Misadjusting the steam dump (turbine bypass) controller such that steam pressure is maintained 50 psig higher than the required no-load setting.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:               P970

An estimated critical rod position (ECP) has been calculated for a nuclear reactor startup to be performed 15 hours after a trip from 100% power equilibrium conditions.  Which one of the following conditions would cause the actual critical rod position to be <u>higher</u> than the predicted critical rod position?

A.  A 90% value for reactor power was used for power defect determination in the ECP calculation.

B.  Reactor criticality is achieved approximately 2 hours earlier than anticipated.

C.  Steam generator pressures are decreased by 100 psi just prior to criticality.

D.  Current boron concentration is 10 ppm lower than the value used in the ECP calculation.

ANSWER:  B.

TOPIC:       192008
KNOWLEDGE:  K1.07  [3.5/3.6]
QID:         P1266

A nuclear reactor is subcritical with a startup in progress.  Which one of the following conditions will result in a critical rod position that is lower than the estimated critical rod position?

A.  A malfunction resulting in control rod speed being faster than normal speed

B.  A malfunction resulting in control rod speed being slower than normal speed

C.  Delaying the time of startup from 3 hours to 5 hours following a trip from 100% power equilibrium conditions

D.  An inadvertent dilution of reactor coolant system boron concentration

ANSWER:  D.

TOPIC:       192008
KNOWLEDGE:  K1.07  [3.5/3.6]
QID:         P1365

Control rods are being withdrawn during a nuclear reactor startup at the end of core life.  Which one of the following will result in reactor criticality at a rod height above the estimated critical rod position?

A.  Steam generator pressure increases by 50 psia.

B.  Steam generator level increases by 10%.

C.  Pressurizer pressure increases by 50 psia.

D.  Pressurizer level increases by 10%.

ANSWER:  A.

TOPIC:            192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:              P1565

A nuclear reactor startup is in progress following a reactor trip from steady-state 100% power at the end of core life.  Which one of the following conditions will result in criticality occurring at a higher than estimated critical rod position?

A.  Misadjusting the steam dump (turbine bypass) controller such that steam generator pressure is maintained 50 psig higher than the required no-load setting

B.  Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations

C.  A malfunction resulting in control rod speed being 10%  slower than normal speed

D.  Delaying the time of startup from 10 days to 14 days following the trip

ANSWER:  A.


TOPIC:            192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:              P1666

An estimated critical rod position (ECP) has been calculated for a nuclear reactor startup to be performed 15 hours after a reactor trip that ended three months operation at 100% power.

Which one of the following conditions will result in criticality occurring at a lower than estimated critical rod position?

A.  Adjusting reactor coolant system boron concentration to 50 ppm higher than assumed for startup calculations

B.  A malfunction resulting in control rod speed being slower than normal speed

C.  Moving the time of startup from 15 hours to 12 hours following the trip

D.  Using a pretrip reactor power of 90% to determine power defect

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.07   [3.5/3.6]
QID:            P1765

A reactor trip has occurred from 100% reactor power and equilibrium xenon-135 conditions near the end of a fuel cycle.  An estimated critical rod position (ECP) has been calculated using the following assumptions:

Criticality occurs 24 hours after trip.
Reactor coolant temperature is 550°F.
Reactor coolant boron concentration is 400 ppm.

Which one of the following will result in criticality occurring at a control rod position that is higher than the calculated ECP?

A.  Decreasing reactor coolant system boron concentration to 350 ppm

B.  A malfunction resulting in control rod speed being 20% higher than normal speed

C.  Moving the time of criticality to 30 hours after the trip

D.  Misadjusting the steam dump (turbine bypass) controller such that reactor coolant temperature is being maintained at 553°F

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.09   [3.2/3.3]
QID:            P68     (B123)

With $K_{eff}$ = 0.985, how much reactivity must be added to make a nuclear reactor <u>exactly</u> critical?

A.  1.54% ΔK/K

B.  1.52% ΔK/K

C.  1.50% ΔK/K

D.  1.48% ΔK/K

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.09   [3.2/3.3]
QID:            P469

A nuclear reactor is subcritical by 1.0 %ΔK/K when the operator dilutes the reactor coolant system by 30 ppm boron.  Assuming boron worth is -0.025% ΔK/K per ppm and that no other reactivity changes occur, the reactor is...

A.  subcritical.

B.  critical.

C.  supercritical.

D.  prompt critical.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.09   [3.2/3.3]
QID:            P2267   (B867)

When a nuclear reactor is exactly critical, reactivity is...

A.  infinity.

B.  undefined.

C.  0.0 ΔK/K.

D.  1.0 ΔK/K.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:  K1.10   [3.3/3.4]
QID:            P69      (B269)

If, during a nuclear reactor startup, the startup rate is constant and positive without any further reactivity addition, then the reactor is...

A.  exactly critical.

B.  supercritical.

C.  subcritical.

D.  prompt critical.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:  K1.10   [3.3/3.4]
QID:            P125

A nuclear reactor is initially critical at 10,000 cps when a steam generator atmospheric relief valve fails open.  Assume end of core life conditions, no reactor trip, and no operator actions are taken.

When the reactor stabilizes, the reactor coolant average temperature ($T_{ave}$) will be _____ than the initial $T_{ave}$ and reactor power will be _____ the point of adding heat.

A.  greater; at

B.  greater; above

C.  less; at

D.  less; above

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P136

A nuclear reactor startup is being performed following a one-month shutdown period.  If the reactor is taken critical and then stabilized at 10,000 cps in the source/startup range, over the next 10 minutes the count rate will...

A.  remain constant.

B.  decrease linearly.

C.  decrease geometrically.

D.  decrease exponentially.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P1870   (B2168)

A nuclear reactor startup is in progress following a one-month shutdown.  Upon reaching criticality, the operator establishes a positive 80-second period and stops control rod motion.

After an additional five minutes, reactor power will be _____ and reactor period will be _____.  (Assume reactor power remains below the point of adding heat.)

A.  constant; constant

B.  constant; increasing

C.  increasing; constant

D.  increasing; increasing

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:              P2667   (B2668)

A nuclear reactor is critical at $10^{-6}$% power.  Control rods are <u>withdrawn</u> for 5 seconds and then stopped, resulting in a stable startup rate (SUR) of positive 0.2 decades per minute (dpm).

If control rods had been <u>inserted</u> (instead of withdrawn) for 5 seconds with the reactor initially critical at $10^{-6}$% power, the stable SUR would have been:  (Assume equal absolute values of reactivity are added in both cases.)

A.  faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in smaller delayed neutron fractions.

B.  faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases are less limited by delayed neutrons.

C.  slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in larger delayed neutron fractions.

D.  slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases are more limited by delayed neutrons.

ANSWER:  D.

TOPIC:        192008
KNOWLEDGE:  K1.10  [3.3/3.4]
QID:         P3467  (B3451)

A nuclear reactor core is exactly critical well below the point of adding heat during a nuclear power plant startup. A small amount of positive reactivity is then added to the core, and a stable positive startup rate (SUR) is established.

With the stable positive SUR, the following is observed:

| Time | Power Level |
|------|-------------|
| 0 sec | $3.16 \times 10^{-7}$% |
| 90 sec | $1.0 \times 10^{-5}$% |

Which one of the following will be the reactor power at time = 120 seconds?

A.  $3.16 \times 10^{-5}$%

B.  $5.0 \times 10^{-5}$%

C.  $6.32 \times 10^{-5}$%

D.  $1.0 \times 10^{-4}$%

ANSWER:  A.

TOPIC:              192008
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:                  P5334   (B5334)

Given:

- Nuclear 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

ANSWER:  B.

TOPIC:              192008
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:                  P5535   (B5534)

A nuclear reactor is currently operating in the source range with a stable period of 90 seconds. The core effective delayed neutron fraction ($\overline{\beta}_{eff}$) is 0.006. How much additional positive reactivity must be added to establish a stable period of 60 seconds?

A.   0.00026 $\Delta$K/K

B.   0.00034 $\Delta$K/K

C.   0.00068 $\Delta$K/K

D.   0.00086 $\Delta$K/K

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.11   [3.8/3.8]
QID:             P868

Which one of the following indicates that a nuclear reactor has achieved criticality during a normal reactor startup?

A.  Constant positive startup rate during rod withdrawal

B.  Increasing positive startup rate during rod withdrawal

C.  Constant positive startup rate with no rod motion

D.  Increasing positive startup rate with no rod motion

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.11   [3.8/3.8]
QID:             P2968   (B2966)

A nuclear reactor startup is in progress.  Control rod withdrawal was stopped several minutes ago to assess criticality.  Which one of the following is a combination of indications in which each listed indication supports a declaration that the reactor has reached criticality?

A.  Startup rate is stable at 0.0 dpm; source range count rate is stable.

B.  Startup rate is stable at 0.2 dpm; source range count rate is stable.

C.  Startup rate is stable at 0.0 dpm; source range count rate is slowly increasing.

D.  Startup rate is stable at 0.2 dpm; source range count rate is slowly increasing.

ANSWER:  D.

TOPIC:       192008
KNOWLEDGE:  K1.12  [3.5/3.6]
QID:           P767

A nuclear reactor has just achieved criticality at $10^{-8}$% reactor power during a reactor startup from xenon-free conditions.  The operator establishes a 0.5 decade per minute startup rate to increase power.  Over a period of 10 minutes, startup rate decreases to zero and then becomes increasingly negative.

Which one of the following is a possible cause for these indications?

A.  Fuel depletion

B.  Burnable poison burnout

C.  Reactor power reaching the point of adding heat

D.  Inadvertent boration of the reactor coolant system

ANSWER:  D.

TOPIC:       192008
KNOWLEDGE:  K1.12  [3.5/3.6]
QID:           P1366

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

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

A.  Inadvertent boration of the RCS

B.  Xenon buildup in the core

C.  Gradual cooling of the RCS

D.  Fission-induced heating of the fuel

ANSWER:  A.

TOPIC:        192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID:          P670    (B670)

After taking critical data during a nuclear reactor startup, the operator establishes a stable 1 DPM startup rate to increase power to the point of adding heat (POAH). How much negative reactivity feedback must be added at the POAH to stop the power increase?

    Assume:   $\overline{\beta}_{eff}$ = 0.00579
                $l^*$    = 1.0 x $10^{-5}$ seconds
                $\lambda_{eff}$ = 0.1 seconds$^{-1}$

A.   0.16% ΔK/K

B.   0.19% ΔK/K

C.   0.23% ΔK/K

D.   0.29% ΔK/K

ANSWER: A.

TOPIC:        192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID:          P768

The point of adding heat is defined as that power level where the nuclear reactor is producing enough heat...

A.   for Doppler coefficient to produce a positive reactivity feedback.

B.   for void coefficient to produce a negative reactivity feedback.

C.   to cause a measurable temperature increase in the fuel and coolant.

D.   to support main turbine operations.

ANSWER: C.

TOPIC:          192008
KNOWLEDGE:  K1.13   [3.4/3.6]
QID:             P2370  (B2369)

After taking critical data during a reactor startup, the operator establishes a positive 48-second reactor period to increase power to the point of adding heat (POAH).  Which one of the following is the approximate amount of reactivity needed to stabilize power at the POAH?  (Assume $\overline{\beta}_{eff}$ = 0.00579.)

A.  -0.010% $\Delta K/K$

B.  -0.012% $\Delta K/K$

C.  -0.10% $\Delta K/K$

D.  -0.12% $\Delta K/K$

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:  K1.13   [3.4/3.6]
QID:             P2470

A nuclear reactor startup is in progress following a one-month shutdown.  Upon reaching criticality, the operator establishes a stable positive 1.0 decade per minute (dpm) startup rate and stops rod motion.

After an additional 30 seconds, reactor power will be _____ and startup rate will be _____.  (Assume reactor power remains below the point of adding heat.)

A.  increasing; increasing

B.  increasing; constant

C.  constant; increasing

D.  constant; constant

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.13   [3.4/3.6]
QID:            P2668   (B26 71)

A nuclear reactor is critical during a xenon-free reactor startup.  Reactor power is increasing in the intermediate range with a stable 0.5 dpm startup rate (SUR).

Assuming <u>no</u> operator action is taken that affects reactivity, SUR will remain constant until...

A.  reactor coolant temperature begins to increase, then SUR will increase.

B.  core xenon-135 production becomes significant, then SUR will increase.

C.  delayed neutron production rate exceeds prompt neutron production rate, then SUR will decrease.

D.  fuel temperature begins to increase, then SUR will decrease.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.13   [3.4/3.6]
QID:            P3068   (B3068)

After taking critical data during a nuclear reactor startup, the operator establishes a stable 0.75 dpm startup rate to increase power to the point of adding heat (POAH).  Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff} = 0.0066$.)

A.  -0.10 %ΔK/K

B.  -0.12 %ΔK/K

C.  -0.15 %ΔK/K

D.  -0.28 %ΔK/K

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.13   [3.4/3.6]
QID:            P3935   (B3934)

After taking critical data during a reactor startup, the operator establishes a stable 0.52 dpm startup rate to increase power to the point of adding heat (POAH).  Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff}$ = 0.006.)

A.  -0.01 %ΔK/K

B.  -0.06 %ΔK/K

C.  -0.10 %ΔK/K

D.  -0.60 %ΔK/K

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P568

During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required intermediate range (IR) level.  The critical data was taken again at the proper IR level with the same reactor coolant temperature and boron concentration.

The critical rod position taken at the proper IR level _____ the critical rod position taken two decades below the proper IR level.

A.  cannot be compared to

B.  is greater than

C.  is the same as

D.  is less than

ANSWER:  C.

TOPIC:            192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:               P669

During a xenon-free nuclear reactor startup, critical data were inadvertently taken one decade above the required intermediate range (IR) level.  The critical data were taken again at the proper IR level with the same reactor coolant temperatures and boron concentration.

The critical rod position taken at the proper IR level is _____ the critical rod position taken one decade above the proper IR level.

A.  less than

B.  the same as

C.  greater than

D.  unrelated to

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:               P972    (B133)

A nuclear reactor is critical several decades below the point of adding heat (POAH) when a small amount of <u>positive</u> reactivity is added to the core.  If the exact same amount of <u>negative</u> reactivity is then added to the core prior to reaching the POAH, reactor power will stabilize...

A.  higher than the initial power level but below the POAH.

B.  lower than the initial power level.

C.  at the initial power level.

D.  at the POAH.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P1267

A nuclear reactor has just achieved criticality during a xenon-free reactor startup and power is being increased to take critical data.  Instead of stabilizing power at $10^{-5}$% per the startup procedure, the operator inadvertently stabilizes power at $10^{-4}$%.

Assuming reactor coolant system (RCS) temperature and RCS boron concentration do not change, the critical rod height at $10^{-4}$% power will be _____ the critical rod height at $10^{-5}$% power.  (Neglect any effects of source neutrons.)

A.  less than

B.  equal to

C.  greater than

D.  independent of

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P1268

A nuclear reactor is exactly critical two decades below the point of adding heat when -0.01% $\Delta K/K$ of reactivity is added to the core.  If +0.01% $\Delta K/K$ is then added to the core 2 minutes later, reactor power will stabilize at...

A.  the point of adding heat.

B.  the initial power level.

C.  somewhat lower than the initial power level.

D.  the subcritical multiplication equilibrium level.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P1669

A nuclear reactor is critical at $10^{-5}$% power and critical data is being taken when a steam generator relief valve fails open.  The reactor is at middle of core life and control rods are in manual.

Assuming no operator actions and no reactor trip, when the reactor stabilizes, average coolant temperature will be _____ initial coolant temperature and final reactor power will be _____ the point of adding heat.

A.  equal to; greater than

B.  equal to; equal to

C.  less than; greater than

D.  less than; equal to

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P2269

A nuclear reactor is critical at the point of adding heat (POAH) when a small amount of <u>negative</u> reactivity is added to the core.  If the same amount of <u>positive</u> reactivity is added to the core approximately 5 minutes later, reactor power will...

A.  increase and stabilize at the POAH.

B.  quickly stabilize at a power level below the POAH.

C.  continue to decrease on a negative 80 second period until the shutdown equilibrium neutron level is reached.

D.  continue to decrease with an unknown period until the shutdown equilibrium neutron level is reached.

ANSWER:  B.

TOPIC:              192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:                  P2568   (B2568)

A nuclear reactor is currently at $10^{-3}$% power with a positive 60 second reactor period.  An amount of <u>negative</u> reactivity is added to the core that places the reactor on a negative 40 second reactor period.

If the same amount of <u>positive</u> reactivity is added to the core approximately 5 minutes later, reactor power will...

A.  increase and stabilize at the point of adding heat.

B.  increase and stabilize at $10^{-3}$%.

C.  continue to decrease on a negative 40 second period until the equilibrium source neutron level is reached.

D.  continue to decrease with an unknown period until the equilibrium source neutron level is reached.

ANSWER:  A.

TOPIC:              192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:                  P3668   (B3668)

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

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

A.  stabilize at a positive value.

B.  turn and slowly increase.

C.  stabilize at zero.

D.  continue to slowly decrease.

ANSWER:  A.

TOPIC:            192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:              P4033

Refer to the drawing that shows two graphs (see figure below).  The axes on each graph have linear scales.

A nuclear reactor is initially critical in the source range.  At time = 0 seconds, a constant rate addition of positive reactivity commences.  Assume 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

ANSWER:  A.
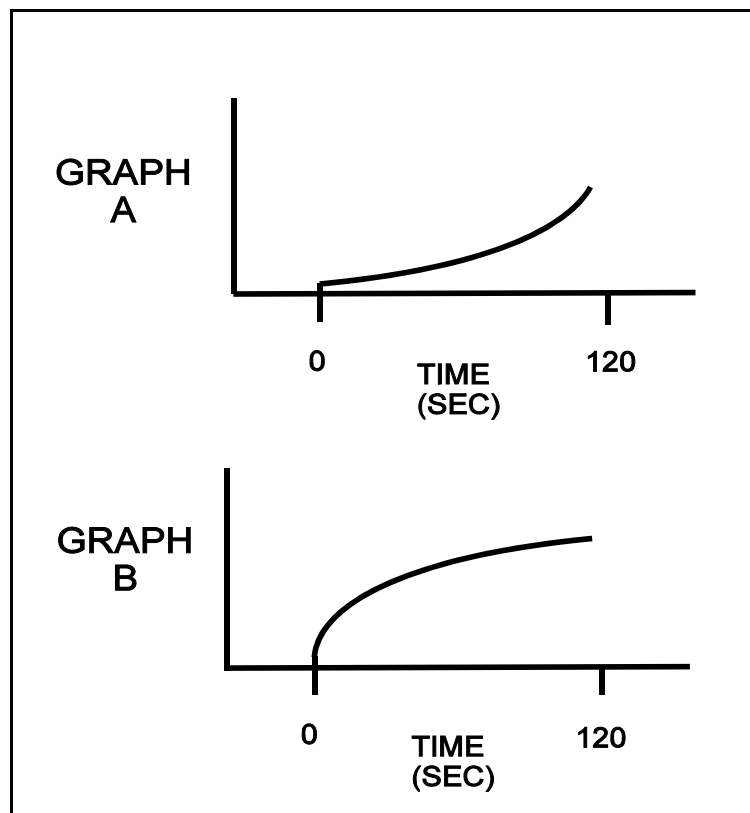
TOPIC:          192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:            P4434

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

Which one of the following events, occurring at time = 0 seconds, would cause the reactor response shown on the graph?

A.  A step addition of positive reactivity to a reactor that is initially stable in the power range and remains in the power range for the duration of the 120-second interval shown.

B.  A constant rate of positive reactivity addition to a reactor that is initially stable in the power range and remains in the power range for the duration of the 120-second interval shown.

C.  A step addition of positive reactivity to a reactor that is initially critical in the source range and remains below the point of adding heat for the duration of the 120-second interval shown.

D.  A constant rate of positive reactivity addition to a reactor that is initially critical in the source range and remains below the point of adding heat for the duration of the 120-second interval shown.

ANSWER:  D.
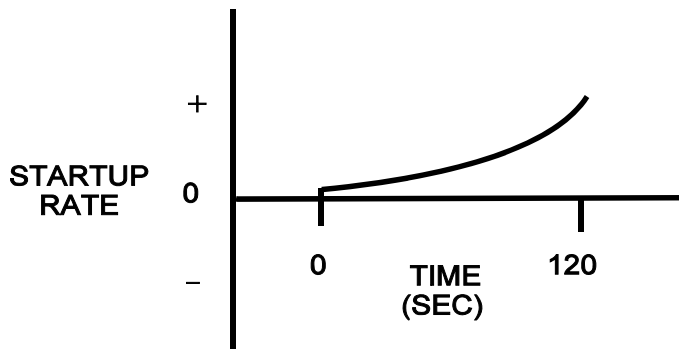
TOPIC:              192008
KNOWLEDGE:   K1.14   [3.1/3.1]
QID:                  P4636

During a reactor startup, source range count rate is observed to double every 30 seconds.  Which one of the following is the approximate startup rate in decades per minute (dpm)?

A.  0.6 dpm

B.  0.9 dpm

C.  1.4 dpm

D.  2.0 dpm

ANSWER:  A.

TOPIC:              192008
KNOWLEDGE:   K1.15   [3.4/3.4]
QID:                  P569

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

ANSWER:  D.

TOPIC:           192008
KNOWLEDGE:  K1.17   [3.3/3.4]
QID:             P70

Given a critical nuclear reactor operating below the point of adding heat (POAH), what reactivity effects are associated with reaching the POAH?

A.  There are no reactivity effects because the reactor is critical.

B.  The increase in fuel temperature will begin to create a positive reactivity effect.

C.  The decrease in fuel temperature will begin to create a negative reactivity effect.

D.  The increase in fuel temperature will begin to create a negative reactivity effect.

ANSWER:  D.

TOPIC:           192008
KNOWLEDGE:  K1.17   [3.3/3.4]
QID:             P471

A nuclear reactor is operating just above the point of adding heat.  To raise reactor power to a higher stable power level, the operator must increase...

A.  steam generator levels.

B.  steam demand.

C.  $T_{ave}$.

D.  reactor coolant system boron concentration.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:              P1070

A nuclear reactor is critical at a stable power level below the point of adding heat (POAH) when a small amount of positive reactivity is added.  Which one of the following reactivity coefficient(s) will stabilize reactor power at the POAH?

A.  Moderator temperature only

B.  Fuel temperature only

C.  Moderator temperature and fuel temperature

D.  Fuel temperature and voids

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:              P1172

A nuclear reactor near the end of core life is at $5 \times 10^{-2}$% power with a 0.3 DPM startup rate.  With no operator action, what will be the approximate reactor power 10 minutes later?  (Assume <u>no</u> protective system actuation.)

A.  100%

B.  50%

C.  10%

D.  1% (point of adding heat)

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:            P1367

A nuclear reactor startup is in progress near the end of a fuel cycle.  Reactor power is 5 x $10^{-3}$% and increasing slowly with a stable 0.3 dpm startup rate.  Assuming no operator action, no reactor trip, and no steam release, what will reactor power be after 10 minutes?

A.  Below the point of adding heat (POAH).

B.  At the POAH.

C.  Above the POAH but less than 50%.

D.  Greater than 50%.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:            P1465

A nuclear reactor required 3 hours to increase power from 70% to 100% at the end of core life using only reactor coolant system (RCS) boron dilution at the maximum rate to control RCS temperature.

Following a refueling, the same power change performed under the same conditions will require a _____ period of time because the rate at which RCS boron concentration can be decreased is _____ at the beginning at core life.

A.  longer; lower

B.  shorter; lower

C.  longer; higher

D.  shorter; higher

ANSWER:  D.

TOPIC:   192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID:    P1470 (B1371)

With a nuclear reactor on a constant period, which one of the following power changes requires the <u>longest</u> time to occur?

A. 1% power to 4% power

B. 5% power to 15% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: A.

TOPIC:   192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID:    P1567 (B1570)

With a nuclear reactor on a constant period of 30 minutes, which one of the following power changes requires the <u>least</u> time to occur?

A. 1% power to 6% power

B. 10% power to 20% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: D.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:             P2069   (B2072)

With a nuclear reactor on a constant period of 180 seconds, which one of the following power changes requires the <u>longest</u> amount of time to occur?

A.   3% power to 5% power

B.   5% power to 15% power

C.   15% power to 30% power

D.   30% power to 60% power

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:             P2168

A nuclear reactor is stable at the point of adding heat (POAH) with the average reactor coolant temperature at 550°F during a startup.  Control rods are then withdrawn a few inches to increase steam generator steaming rate.

When the reactor stabilizes, reactor power will be _____ the POAH, and average reactor coolant temperature will be _____ 550°F.

A.  greater than; equal to

B.  greater than; greater than

C.  equal to; equal to

D.  equal to; greater than

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.17   [3.3/3.4]
QID:              P2770   (B2770)

With a nuclear reactor on a constant period of 180 seconds, which one of the following power changes requires the shortest amount of time to occur?

A.   3% power to 5% power

B.   5% power to 15% power

C.   15% power to 30% power

D.   30% power to 60% power

ANSWER:  A.

TOPIC:            192008
KNOWLEDGE:   K1.18   [3.6/3.5]
QID:              P270

A nuclear power plant is operating at equilibrium 50% of rated power level.  Control rods are manually withdrawn for 5 seconds.  Which one of the following plant parameter changes will be observed when the plant stabilizes?

A.  Reactor coolant temperature will be higher.

B.  Reactor coolant system pressure will be lower.

C.  Reactor power will be higher.

D.  Pressurizer level will be lower.

ANSWER:  A.

TOPIC:            192008
KNOWLEDGE:   K1.18   [3.6/3.5]
QID:               P869

A nuclear power plant is operating at 100% power near the end of a fuel cycle with all control systems in manual.  The reactor operator inadvertently adds 100 gallons of boric acid (4% by weight) to the reactor coolant system (RCS).

Which one of the following will occur as a result of the boric acid addition?  (Assume a constant main generator output.)

A.  Pressurizer level will decrease and stabilize at a lower value.

B.  RCS pressure will increase and stabilize at a higher value.

C.  Reactor power will decrease and stabilize at a lower value.

D.  Average RCS temperature will increase and stabilize at a higher value.

ANSWER:  A.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P1071

A nuclear power plant was operating with the following steady-state initial conditions:

    Power level           = 100%
    Coolant boron         = 620 ppm
    Coolant temperature   = 587°F

After a load decrease, steady-state conditions were as follows:

    Power level           = 80%
    Coolant boron         = 650 ppm
    Coolant temperature   = 577°F

Given the following, how much reactivity was added by control rod movement during the load decrease? (Disregard any fission product poison reactivity change.)

    Differential boron worth           = -1.0 x 10$^{-2}$% ΔK/K/ppm
    Total power coefficient            = -1.5 x 10$^{-2}$% ΔK/K/%
    Moderator temperature coefficient  = -2.0 x 10$^{-2}$% ΔK/K/°F

A.  -0.0% ΔK/K

B.  -0.2% ΔK/K

C.  -0.6% ΔK/K

D.  -0.8% ΔK/K

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.18   [3.6/3.5]
QID:            P1871

A nuclear power plant is operating with the following stable initial conditions:

    Power level          = 100%
    Coolant boron        = 630 ppm
    Coolant temperature  = 582°F

After a load decrease, stable conditions are as follows:

    Power level          = 80%
    Coolant boron        = 640 ppm
    Coolant temperature  = 577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease?  (Assume fission product poison reactivity does not change.)

    Total power coefficient           = -1.5 x $10^{-2}$% Δk/k/%
    Moderator temperature coefficient = -2.0 x $10^{-2}$% Δk/k/°F
    Differential boron worth          = -1.5 x $10^{-2}$% Δk/k/ppm

A.  +0.15% Δk/k

B.  +0.25% Δk/k

C.  -0.15% Δk/k

D.  -0.25% Δk/k

ANSWER:  C.

TOPIC:         192008
KNOWLEDGE:   K1.18   [3.6/3.5]
QID:           P1968

A nuclear power plant is operating with the following initial conditions:

    Power level            = 80%
    Coolant boron          = 630 ppm
    Coolant temperature   = 582°F

After a normal load decrease, conditions are as follows:

    Power level            = 50%
    Coolant boron          = 650 ppm
    Coolant temperature   = 572°F

Given the following values, how much reactivity was added by control rod movement during the load decrease?  (Assume fission product poison reactivity does <u>not</u> change.)

    Total power coefficient              = -1.5 x 10$^{-2}$% ΔK/K/%
    Moderator temperature coefficient   = -2.0 x 10$^{-2}$% ΔK/K/°F
    Differential boron worth             = -1.5 x 10$^{-2}$% ΔK/K/ppm

A.  -0.5% ΔK/K

B.  -0.15% ΔK/K

C.  -0.25% ΔK/K

D.  -0.35% ΔK/K

ANSWER:  B.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P2070

A nuclear power plant is operating with the following initial conditions:

Power level = 100%
Coolant boron = 620 ppm
Average coolant temperature = 587°F

After a load decrease, conditions are as follows:

Power level = 80%
Coolant boron = 630 ppm
Average coolant temperature = 577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

Total power coefficient = -1.5 x $10^{-2}$% ΔK/K/%
Moderator temperature coefficient = -2.0 x $10^{-2}$% ΔK/K/°F
Differential boron worth = -1.0 x $10^{-2}$% ΔK/K/ppm

A. -0.2% ΔK/K

B. +0.2% ΔK/K

C. -0.4% ΔK/K

D. +0.4% ΔK/K

ANSWER: A.

TOPIC:            192008
KNOWLEDGE:   K1.18   [3.6/3.5]
QID:               P3269

One week after a refueling outage, a nuclear power plant is operating at 80% of rated power with control rods fully withdrawn.  During the outage, the entire core was replaced by new fuel assemblies and new burnable poison assemblies were installed at various locations in the core.

Assume reactor power and control rod position do <u>not</u> change.  If <u>no</u> operator action is taken, how and why will reactor coolant average temperature change during the next week?

A.  Decrease slowly due to fuel burnup only.

B.  Decrease slowly due to fuel burnup <u>and</u> fission product poison buildup.

C.  Increase slowly due to burnable poison burnout only.

D.  Increase slowly due to burnable poison burnout <u>and</u> fission product poison decay.

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.19   [3.5/3.6]
QID:               P570

How do the following parameters change during a normal ramp of reactor power from 15% to 75%?

|  | Main Turbine First Stage Pressure | Reactor Coolant System Boron Concentration |
|---|---|---|
| A. | Increases | Decreases |
| B. | Decreases | Decreases |
| C. | Increases | Increases |
| D. | Decreases | Increases |

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.19   [3.5/3.6]
QID:            P1672   (B1671)

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

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.19   [3.5/3.6]
QID:            P2272

A nuclear power plant is operating at 100% power near the end of core life.  The greatest contribution to core heat production is being provided by the fission of...

A.  U-235 and U-238.

B.  U-235 and Pu-239.

C.  U-238 and Pu-239.

D.  U-238 and Pu-241.

ANSWER:  B.

TOPIC:           192008
KNOWLEDGE:   K1.19   [3.5/3.6]
QID:             P2868

A refueling outage has just been completed in which the entire core was offloaded and replaced with new fuel.  A reactor startup has been performed and 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

ANSWER:  A.

TOPIC:           192008
KNOWLEDGE:   K1.20   [3.8/3.9]
QID:             P271

A nuclear reactor is critical at $2 \times 10^{-8}$% power.  The operator withdraws rods as necessary to immediately establish and maintain a 0.10 Dpm startup rate.  How long will it take for the reactor to reach $7 \times 10^{-8}$% power?

A.  2.4 minutes

B.  5.4 minutes

C.  7.4 minutes

D.  10.4 minutes

ANSWER:  B.

TOPIC:              192008
KNOWLEDGE:   K1.20   [3.8/3.9]
QID:                 P571

A nuclear reactor startup is in progress and criticality has just been achieved.  After recording critical rod height, the operator withdraws control rods for 20 seconds to establish a stable positive 0.5 dpm startup rate.  One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds.  (Assume the positive and negative reactivity insertion rates are the same.)

During the control rod insertion, the startup rate will become...

A.  negative during the entire period of control rod insertion.

B.  negative shortly after the control rods pass through the critical rod height.

C.  negative just as the control rods pass through the critical rod height.

D.  negative shortly before the control rods pass through the critical rod height.

ANSWER:  D.

TOPIC:              192008
KNOWLEDGE:   K1.20   [3.8/3.9]
QID:                 P2869

A nuclear reactor is critical at $3 \times 10^{-8}$% power.  The operator withdraws rods as necessary to immediately establish and maintain a stable, positive 0.10 Dpm startup rate.  How long will it take for the reactor to reach $7 \times 10^{-8}$% power?

A.  3.7 minutes

B.  5.4 minutes

C.  6.7 minutes

D.  8.4 minutes

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.20   [3.8/3.9]
QID:              P2970

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 0.5 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.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:              P272

A nuclear power plant has been operating at 75% of rated power for several weeks.  A partial steam line break occurs and 3% total steam flow is escaping.  Assuming no operator or automatic actions, stable reactor power will _____ and stable reactor coolant temperature will _____.

A.  increase; increase

B.  not change; increase

C.  increase; decrease

D.  not change; decrease

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P368

A nuclear reactor is critical at a stable power level below the point of adding heat (POAH).  An unisolable steam line break occurs and 3% of rated steam flow is escaping.

Assuming no reactor trip, which one of the following describes the response of the reactor? (Assume a negative moderator temperature coefficient.)

A.  $T_{ave}$ will decrease.  The reactor will go subcritical.

B.  $T_{ave}$ will remain the same.  The reactor will go to 3% power.

C.  $T_{ave}$ will decrease.  The reactor will go to 3% power.

D.  $T_{ave}$ will decrease.  Power will not change because the reactor was below the POAH.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P1370

A nuclear power plant has been operating at 80% of rated power for several weeks.  A partial steam line break occurs and 2% total steam flow is escaping.  Turbine load and control rod position remain the same.

Assuming no operator or automatic actions, when the plant stabilizes, reactor power will be _____ and average reactor coolant temperature will be _____.

A.  higher; higher

B.  unchanged; higher

C.  higher; lower

D.  unchanged; lower

ANSWER:  C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P1570

A nuclear power plant is operating at 85% of rated power and 580°F average reactor coolant temperature ($T_{ave}$) at the end of core life. A failure of the turbine control system opens the turbine control valves to admit 10% more steam flow to the main turbine. No operator actions occur and no protective system actuations occur. Rod control is in manual.

Following the transient, reactor power will stabilize _____ 85% and $T_{ave}$ will stabilize _____ 580°F.

A. above; above

B. above; below

C. below; above

D. below; below

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P2372

A nuclear power plant is operating at 90% of rated power at the end of core life with manual rod control when a turbine control system malfunction opens the turbine control valves an additional 5 percent. Reactor power will initially...

A. increase because the rate of neutron absorption in the moderator initially decreases.

B. increase because the rate of neutron absorption at U-238 resonant energies initially decreases.

C. decrease because the rate of neutron absorption in the moderator initially increases.

D. decrease because the rate of neutron absorption at U-238 resonant energies initially increases.

ANSWER: B.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P2671

A nuclear power plant is operating at 100% power near the end of core life when the main turbine trips.  If the reactor does <u>not</u> immediately trip, which one of the following will act first to change reactor power?

A.  Positive reactivity addition from the Doppler coefficient will cause reactor power to initially increase.

B.  Positive reactivity addition from the moderator temperature coefficient will cause reactor power to initially increase.

C.  Negative reactivity addition from the Doppler coefficient will cause reactor power to initially decrease.

D.  Negative reactivity addition from the moderator temperature coefficient will cause reactor power to initially decrease.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P2771

A nuclear power plant is operating at 80% of rated power and 580°F average reactor coolant temperature ($T_{ave}$) at the end of core life with manual rod control.  A turbine control system malfunction partially closes the turbine control valves resulting in 5% less steam flow to the main turbine.  No operator actions occur and no protective system actuations occur.

Following the transient, reactor power will stabilize _____ 80% and $T_{ave}$ will stabilize _____ 580°F.

A.  at; above

B.  at; below

C.  below; above

D.  below; below

ANSWER:  C.

TOPIC:            192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:              P3171   (B3169)

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction closes the turbine steam inlet valves an additional 5 percent.  Which one of the following is responsible for the initial reactor power decrease?

A.  The rate of neutron absorption by core Xe-135 initially increases.

B.  The rate of neutron absorption in the moderator initially increases.

C.  The rate of neutron absorption at U-238 resonance energies initially increases.

D.  The rate of neutron absorption by the boron in the reactor coolant initially increases.

ANSWER:  C.

TOPIC:            192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:              P3484

A multi-loop nuclear power plant is operating at 50% power with manual rod control when the main steam isolation valve (MSIV) for one steam generator inadvertently closes.  Assume that no reactor trip or other protective action occurs, and no operator action is taken.

Immediately after the MSIV closure, the cold leg temperature (Tc) in the reactor coolant loop with the closed MSIV will _____; and the Tc in a loop with an open MSIV will immediately _____.

A.  increase; increase

B.  increase; decrease

C.  decrease; increase

D.  decrease; decrease

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P4035

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction opens the turbine steam inlet valves an additional 5 percent.  Which one of the following is responsible for the <u>initial</u> reactor power increase?

A.  The rate of neutron absorption by core Xe-135 initially decreases.

B.  The rate of neutron absorption in the moderator initially decreases.

C.  The rate of neutron absorption at U-238 resonance energies initially decreases.

D.  The rate of neutron absorption by the boron in the reactor coolant initially decreases.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.21   [3.6/3.8]
QID:            P4735

A nuclear power plant is initially operating at steady-state 100% reactor power with the main generator producing 1,100 MW.  A power grid disturbance occurs and appropriate operator actions are taken. The plant is stabilized with the following current conditions:

•   Main generator output is 385 MW.
•   Steam dump/bypass system is discharging 15% of rated steam flow to the main condenser.
•   All reactor coolant system parameters are in their normal ranges.

What is the approximate current reactor power level?

A.  15%

B.  35%

C.  50%

D.  65%

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.22   [2.6/3.8]
QID:            P72

The major reason boron is used in a nuclear reactor is to permit...

A.  a reduction in the shutdown margin.

B.  an increase in the amount of control rods installed.

C.  an increase in core life.

D.  a reduction in the effect of resonance capture.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.22   [2.6/3.8]
QID:            P671

The use of boron as a burnable poison in a nuclear reactor core...

A.  increases the amount of fuel required to produce the same amount of heat.

B.  allows the plant to operate longer on a smaller amount of fuel.

C.  allows more fuel to be loaded and prolongs core life.

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

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.22   [2.6/3.8]
QID:            P1072

A high boron concentration is necessary at the beginning of core life to...

A.  compensate for excess reactivity in the fuel.

B.  ensure a negative moderator temperature coefficient exists.

C.  flatten the axial and radial neutron flux distributions.

D.  maximize control rod worth until fission product poisons accumulate.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.22   [2.6/3.8]
QID:            P2570

During a core refueling, fuel assemblies with higher enrichments of U-235 were installed to prolong the fuel cycle from 12 months to 16 months.  What is a possible consequence of offsetting all the excess positive reactivity of the new fuel with a higher concentration of boron in the reactor coolant?

A.  Boron will precipitate out of the reactor coolant during a cooldown.

B.  An RCS temperature decrease will result in a negative reactivity addition.

C.  Power changes requiring dilution of RCS boron will take longer.

D.  The differential boron worth will become positive.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P71     (B72)

Shortly after a reactor trip, reactor power indicates 0.5% where a stable negative startup rate is attained.  Reactor power will be reduced to 0.05% in approximately _____ seconds.

A.   90

B.  180

C.  270

D.  360

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P572    (B2272)

A nuclear power plant has been operating at 100% power for several weeks when a reactor trip occurs.  How much time will be required for core heat production to decrease to 1% following the trip?

A.  1 to 8 days

B.  1 to 8 hours

C.  1 to 8 minutes

D.  1 to 8 seconds

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P770    (B771)

Which one of the following is responsible for the negative 80-second stable reactor period experienced shortly after a reactor scram/trip?

A.  The longest-lived fission product poisons

B.  The shortest-lived fission product poisons

C.  The longest-lived delayed neutron precursors

D.  The shortest-lived delayed neutron precursors

ANSWER:  C.

TOPIC:            192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P1965  (B1369)

Shortly after a reactor trip, when reactor power indicates $10^{-3}$%, a stable negative period is attained. Reactor power will decrease to $10^{-4}$% in approximately _____ seconds.

A.  380

B.  280

C.  180

D.  80

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:            P2171   (B1770)

Following a reactor trip, reactor power indicates 0.1% when the typical stable post-trip reactor period is observed.  Which one of the following is the approximate time required for reactor power to decrease to 0.05%?

A.  24 seconds

B.  55 seconds

C.  173 seconds

D.  240 seconds

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:            P2672   (B131)

Which one of the following approximates the decay heat produced in a nuclear reactor at 1 second and at 1 hour, respectively, following a reactor trip from extended operation at 100% power?

| | ONE SECOND | ONE HOUR |
|---|---|---|
| A. | 15.0% | 1.0% |
| B. | 7.0% | 1.0% |
| C. | 1.0% | 0.1% |
| D. | 0.5% | 0.1% |

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:            P2768  (B2769)

Nuclear reactors A and B are identical and have been operated at 100% 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.

Which reactor, if any, will have the longest reactor period five minutes after the trip?

A.  Reactor A due to the greater shutdown reactivity.

B.  Reactor B due to the smaller shutdown reactivity.

C.  Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D.  Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:            P2969

Nuclear reactors A and B are identical and have been operated at 100% 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.

Which reactor, if any, will have the longer reactor period five minutes after the trip?

A.  Reactor A because its delayed neutron fraction will be smaller.

B.  Reactor B because its delayed neutron fraction will be larger.

C.  Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D.  Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P3271   (B3271)

Nuclear reactors A and B are identical and have been operated at 100% 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.

After five minutes, when compared to reactor B, the core fission rate in reactor A will be _____, and the reactor period in reactor A will be _____.

A.  the same; shorter

B.  the same; the same

C.  lower; shorter

D.  lower; the same

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.23   [2.9/3.1]
QID:             P3468   (B3472)

A nuclear reactor is critical just below the point of adding heat when an inadvertent reactor trip occurs.  All control rods fully insert except for one rod, which remains fully withdrawn.  Five minutes after the reactor trip, with reactor startup rate (SUR) stable at approximately -1/3 dpm, the remaining withdrawn control rod suddenly drops (fully inserts).

Which one of the following describes the reactor response to the drop of the last control rod?

A.  SUR will remain stable at approximately -1/3 dpm.

B.  SUR will immediately become more negative, and then return to and stabilize at approximately -1/3 dpm.

C.  SUR will immediately become more negative, and then turn and stabilize at a value more negative than -1/3 dpm.

D.  SUR will immediately become more negative, and then turn and stabilize at a value less negative than -1/3 dpm.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.24   [3.5/3.6]
QID:              P672    (B1969)

A nuclear reactor is exactly critical below the point of adding heat when a single control rod fully inserts into the core.  Assuming no operator or automatic action, reactor power will slowly decrease to...

A.  zero.

B.  an equilibrium value equal to the source neutron strength.

C.  an equilibrium value greater than the source neutron strength.

D.  a slightly lower value, then slowly return to the initial value.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.24   [3.5/3.6]
QID:              P1472

A nuclear reactor is exactly critical just below the point of adding heat when a single control rod drops into the core.  Assuming no operator or automatic actions occur, when the plant stabilizes, reactor power will be _____ and average reactor coolant temperature will be _____.

A.  the same; the same

B.  the same; lower

C.  lower; the same

D.  lower; lower

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.24   [3.5/3.6]
QID:            P5136

A nuclear reactor is initially critical in the source range during a reactor startup when the control rods are inserted a small amount.  Reactor startup rate stabilizes at -0.15 dpm.  Assuming startup rate remains constant, how long will it take for source range count rate to decrease by one-half?

A.  0.3 minutes

B.  2.0 minutes

C.  3.3 minutes

D.  5.0 minutes

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.25   [2.9/3.1]
QID:            P772

Which one of the following is the reason for inserting control rods in a predetermined sequence during a normal reactor shutdown?

A.  To prevent uneven fuel burnup

B.  To prevent an excessive reactor coolant system cooldown rate

C.  To prevent abnormally high local power peaks

D.  To prevent divergent xenon oscillations

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.25   [2.9/3.1]
QID:            P2971

Which one of the following describes the process for inserting control rods during a normal reactor shutdown?

A.  Control rods are inserted in reverse order one bank at a time to maintain acceptable power distribution.

B.  Control rods are inserted in reverse order one bank at a time to maintain a rapid shutdown capability from the remainder of the control rods.

C.  Control rods are inserted in reverse order in a bank overlapping sequence to maintain a relatively constant differential control rod worth.

D.  Control rods are inserted in reverse order in a bank overlapping sequence to limit the amount of positive reactivity added during a rod ejection accident.

ANSWER:  C.

TOPIC:          192008
KNOWLEDGE:   K1.26   [3.1/3.2]
QID:            P369

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.

ANSWER:  A.

TOPIC:          192008
KNOWLEDGE:   K1.26   [3.1/3.2]
QID:             P370    (B372)

After one month of operation at 100% reactor power, the fraction of thermal power being produced from the decay of fission products in the operating nuclear reactor is...

A.  greater than 10%.

B.  greater than 5% but less than 10%.

C.  greater than 1% but less than 5%.

D.  less than 1%.

ANSWER:  B.

TOPIC:          192008
KNOWLEDGE:   K1.27   [3.1/3.4]
QID:             P132

The magnitude of decay heat generation is determined primarily by...

A.  core burnup.

B.  power history.

C.  final power at shutdown.

D.  control rod worth at shutdown.

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.27   [3.1/3.4]
QID:              P1272   (B1372)

Following a reactor shutdown from three-months operation at full power, core heat production will continue for a period of time.  The rate of core heat production will be dependent upon the...

A.  amount of fuel that has been depleted.

B.  amount of time that has elapsed since $K_{eff}$ decreased below 1.0.

C.  amount of time required for the reactor pressure vessel to cool down.

D.  rate at which the photoneutron source strength decays following shutdown.

ANSWER:  B.

TOPIC:            192008
KNOWLEDGE:   K1.27   [3.1/3.4]
QID:              P1372

A nuclear power plant had been operating at 100% power for six months when a steam line rupture occurred that resulted in a reactor trip and all steam generators (S/Gs) blowing down (emptying) after approximately 1 hour.  The S/G blowdown caused reactor coolant system (RCS) temperature to decrease to 400°F at which time an RCS heatup began.

Given the following information, what was be the average RCS heatup rate during the 5 minutes immediately after all S/Gs became empty?

| | |
|---|---|
| Reactor rated thermal power: | 3,400 MWt |
| Decay heat: | 1.0% rated thermal power |
| Reactor coolant pumps heat input to the RCS: | 15 MWt |
| RCS total heat loss: | Negligible |
| RCS $c_p$: | 1.1 Btu/lbm-°F |
| RCS inventory (less pressurizer): | 475,000 lbm |

A.  8 to 15°F/hour

B.  50 to 75°F/hour

C.  100 to 150°F/hour

D.  300 to 350°F/hour

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:   K1.27   [3.1/3.4]
QID:            P2572

A nuclear power plant had been operating at 100% power for six months when a steam line rupture occurred that resulted in a reactor trip and all steam generators (S/Gs) blowing down (emptying) after approximately 1 hour.  The S/G blowdown caused reactor coolant system (RCS) temperature to decrease to 400°F.

Given the following information, what was be the average RCS heatup rate during the 5 minutes immediately after all S/Gs became empty?

| | |
|---|---|
| Reactor rated thermal power: | 2,400 MWt |
| Decay heat: | 1.0% rated thermal power |
| Reactor coolant pumps heat input to the RCS: | 13 MWt |
| RCS total heat loss: | 2.4 MWt |
| RCS $c_p$: | 1.1 Btu/lbm-°F |
| RCS inventory (less pressurizer): | 325,000 lbm |

A.  8 to 15°F/hour

B.  25 to 50°F/hour

C.  80 to 150°F/hour

D.  300 to 400°F/hour

ANSWER:  D.

TOPIC:          192008
KNOWLEDGE:  K1.27   [3.1/3.4]
QID:            P2872  (B2872)


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

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

    Reactor rated thermal power:          2,800 MWt
    Decay heat rate:                      0.2% rated thermal power
    RCS ambient heat loss rate:           2.4 MWt
    RCS $c_p$:                            1.1 Btu/lbm-°F
    RCS inventory (less pressurizer):     325,000 lbm

A.  Less than 25°F/hour

B.  26 to 50°F/hour

C.  51 to 75°F/hour

D.  More than 76°F/hour

ANSWER:  B.




TOPIC:          192008
KNOWLEDGE:  K1.27   [3.1/3.4]
QID:            P2972  (B2972)


A nuclear power plant has been operating for one hour at 50% of rated power following six months of operation at steady-state 100% power.  What  percentage of rated thermal power is currently being generated by reactor decay heat?

A.  1% to 2%

B.  3% to 5%

C.  6% to 8%

D.  9% to 11%

ANSWER:  B.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P4336 (B4336)

A nuclear power plant has been operating at rated power for six months when a reactor trip occurs. Which one of the following describes the source(s) of core heat generation 30 minutes after the reactor trip?

A. Fission product decay is the <u>only</u> significant source of core heat generation.

B. Delayed neutron-induced fission is the <u>only</u> significant source of core heat generation.

C. Fission product decay and delayed neutron-induced fission are <u>both</u> significant sources and produce approximately equal rates of core heat generation.

D. Fission product decay and delayed neutron-induced fission are <u>both</u> insignificant sources and generate core heat at rates that are less than the rate of ambient heat loss from the core.

ANSWER: A.

TOPIC:           193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:             P73

An atmospheric pressure of 15 psia approximately equals...

A.  30.0 psig.

B.  29.4 psig.

C.  14.7 psig.

D.   0.0 psig.

ANSWER:  D.

TOPIC:           193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:             P273

A pressure gauge on a condenser reads 27 inches of mercury (Hg) vacuum.  What is the absolute pressure corresponding to this vacuum?  (Assume an atmospheric pressure of 15 psia.)

A.  14.0 psia

B.  13.5 psia

C.   1.5 psia

D.   1.0 psia

ANSWER:  C.

TOPIC:　　　　193001
KNOWLEDGE:　K1.01　[2.5/2.7]
QID:　　　　　P473

Assuming a standard atmospheric pressure of 15 psia, 5 inches of mercury (Hg) vacuum is equivalent to...

A.  2.5 psia.

B.  5.0 psia.

C.  10.0 psia.

D.  12.5 psia.

ANSWER:  D.

TOPIC:　　　　193001
KNOWLEDGE:　K1.01　[2.5/2.7]
QID:　　　　　P873

If a main steam line pressure gauge reads 900 psig, what is the absolute pressure?

A.  870 psia

B.  885 psia

C.  915 psia

D.  930 psia

ANSWER:  C.

TOPIC:           193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:           P1173

Which one of the following is equivalent to 5 psia?

A.  20 psig

B.  10 psig

C.  10 inches of mercury (Hg) vacuum

D.  20 inches of mercury (Hg) vacuum

ANSWER:  D.

TOPIC:           193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:           P1273

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

A.  8 psia, 20 inches Hg absolute, 2 psig

B.  8 psia, 2 psig, 20 inches Hg absolute

C.  20 inches Hg absolute, 2 psig, 8 psia

D.  20 inches Hg absolute, 8 psia, 2 psig

ANSWER:  A.

TOPIC:          193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:            P1573

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

A.  2 psig, 20 inches Hg absolute, 8 psia

B.  2 psig, 8 psia, 20 inches Hg absolute

C.  8 psia, 20 inches Hg absolute, 2 psig

D.  8 psia, 2 psig, 20 inches Hg absolute

ANSWER:  A.

TOPIC:          193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:            P1773

Which one of the following is approximately equivalent to 2 psig?

A.  11 psia

B.  13 psia

C.  15 psia

D.  17 psia

ANSWER:  D.

TOPIC:              193001
KNOWLEDGE:   K1.01    [2.5/2.7]
QID:                P2073

Which one of the following is arranged from the lowest pressure to the highest 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

ANSWER:  D.

TOPIC:              193001
KNOWLEDGE:   K1.01    [2.5/2.7]
QID:                P2173

Which one of the following is the approximate condenser vacuum when condenser pressure is 16 inches Hg absolute?

A.  4 inches Hg vacuum

B.  8 inches Hg vacuum

C.  12 inches Hg vacuum

D.  14 inches Hg vacuum

ANSWER:  D.

TOPIC:          193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:            P2273

Which one of the following is arranged 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

ANSWER:  B.

TOPIC:          193001
KNOWLEDGE:   K1.01   [2.5/2.7]
QID:            P2773

Which one of the following is arranged 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

ANSWER:  B.

TOPIC:            193001
KNOWLEDGE:   K1.03    [2.6/2.6]
QID:               P374    (B373)

Refer to the drawing of four tank differential pressure (D/P) level detectors (see figure below).  The tanks are identical and are being maintained at 17 psia and the same constant water level.  They are surrounded by atmospheric pressure.

Which one of the level detectors is sensing the greatest D/P?

A.  1

B.  2

C.  3

D.  4

ANSWER:  B.
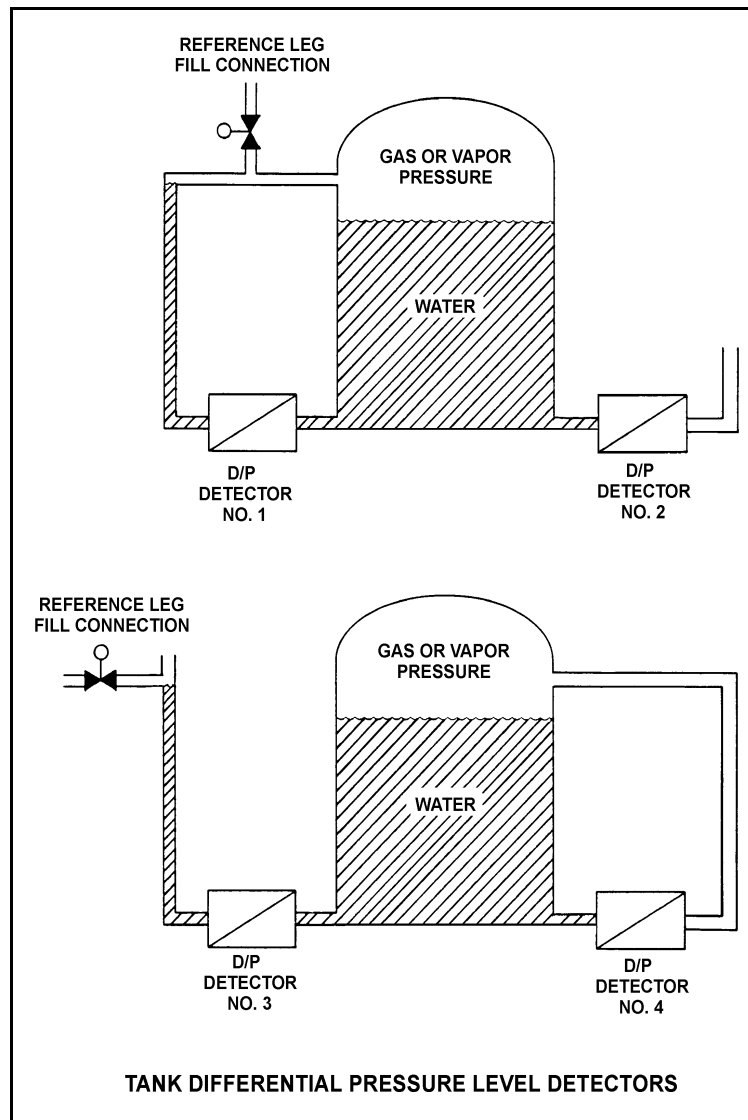
TOPIC:             193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:                P573    (B1973)

A water storage tank is enclosed to prevent vapors from escaping to the environment.  The tank is also pressurized to prevent boiling.  A differential pressure detector with a dry reference leg is used to measure the tank level.

To achieve the greatest accuracy of measurement, the low pressure side of the detector should sense which one of the following?

A.  The pressure at the bottom 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 vapor space at the top of the tank

ANSWER:  D.

TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P709    (B710)

Refer to the drawing of four differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are being maintained at 17 psia and 70% water level (calibration conditions).  They are located in a building that is currently at atmospheric pressure.

If the building ventilation system creates a vacuum in the building, which level detectors will provide the <u>lowest</u> level indications?

A.  1 and 3

B.  1 and 4

C.  2 and 3

D.  2 and 4

ANSWER:  B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS
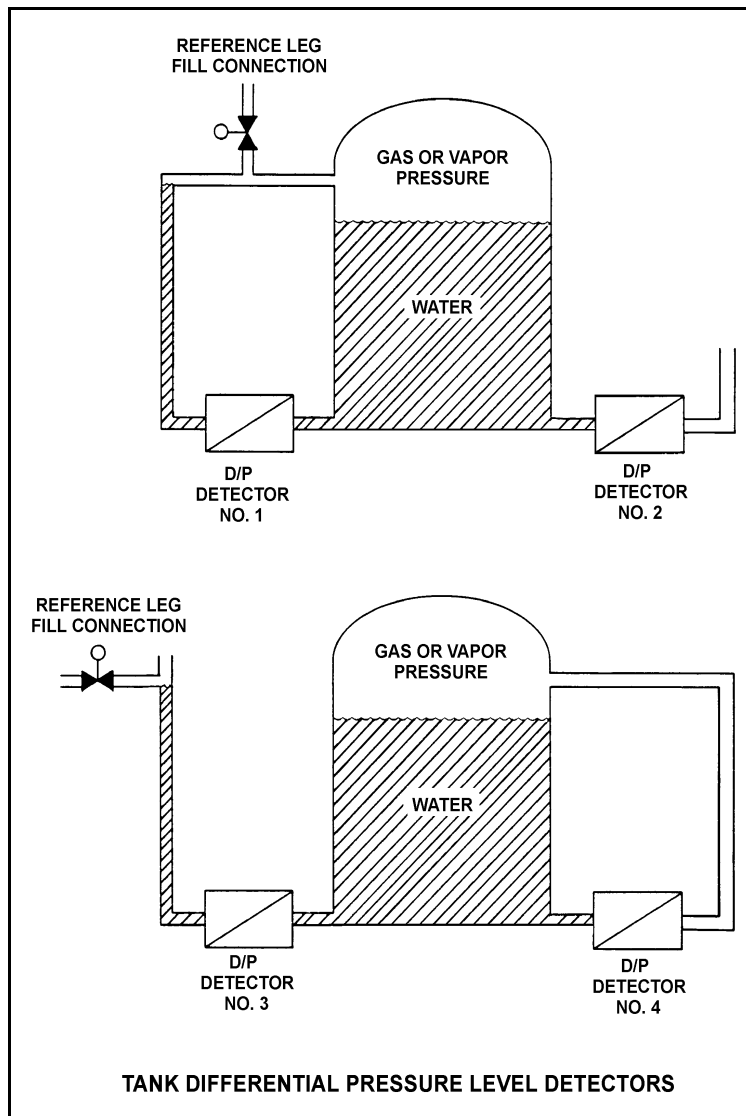
TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:             P1673   (B1174)

Refer to the drawing of four identical tank differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are currently at 2 psig overpressure, the same constant water level, and a temperature of 60°F.  They are surrounded by atmospheric pressure.  All level detectors have been calibrated and are producing the same level indication.

If a leak in the top of each tank causes a complete loss of overpressure, which level detector(s) will produce the lowest level indication?

A.  No. 1 only

B.  No. 2 only

C.  No. 1 and 4

D.  No. 2 and 3

ANSWER:  D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS
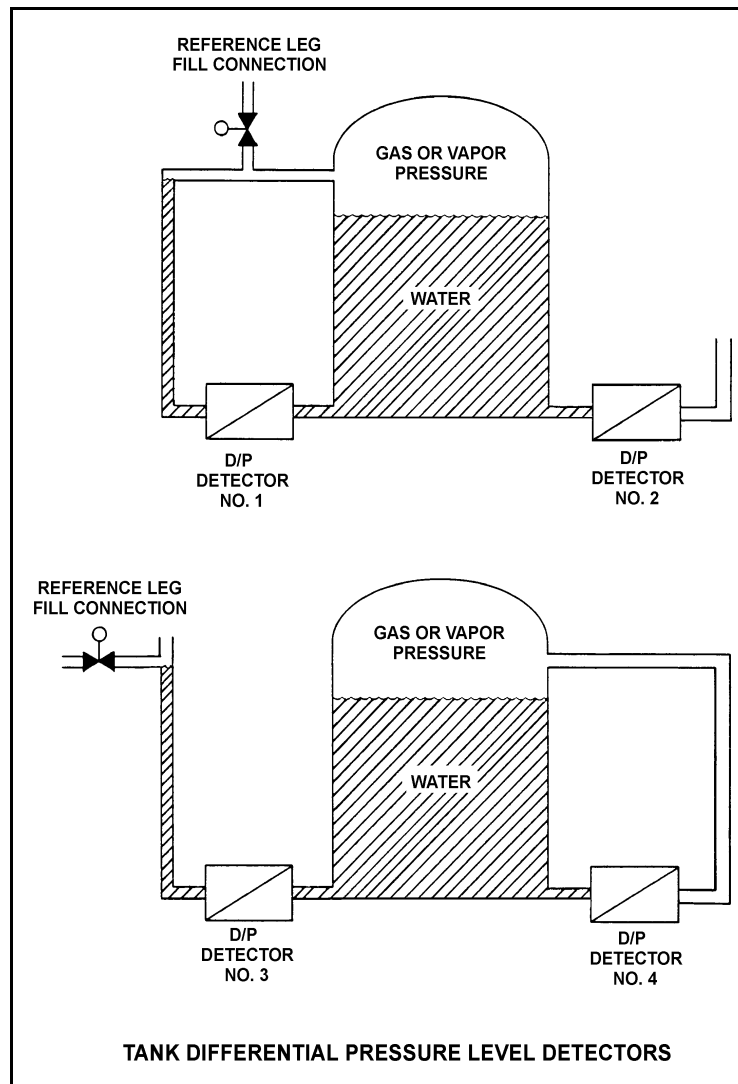
TOPIC: 193001
KNOWLEDGE: K1.03 [2.6/2.6]
QID: P2373 (B2373)

Refer to the drawing of four identical tank differential pressure level detectors (see figure below).

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

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

A. 1 and 3

B. 2 and 4

C. 1 and 4

D. 2 and 3

ANSWER: C



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS
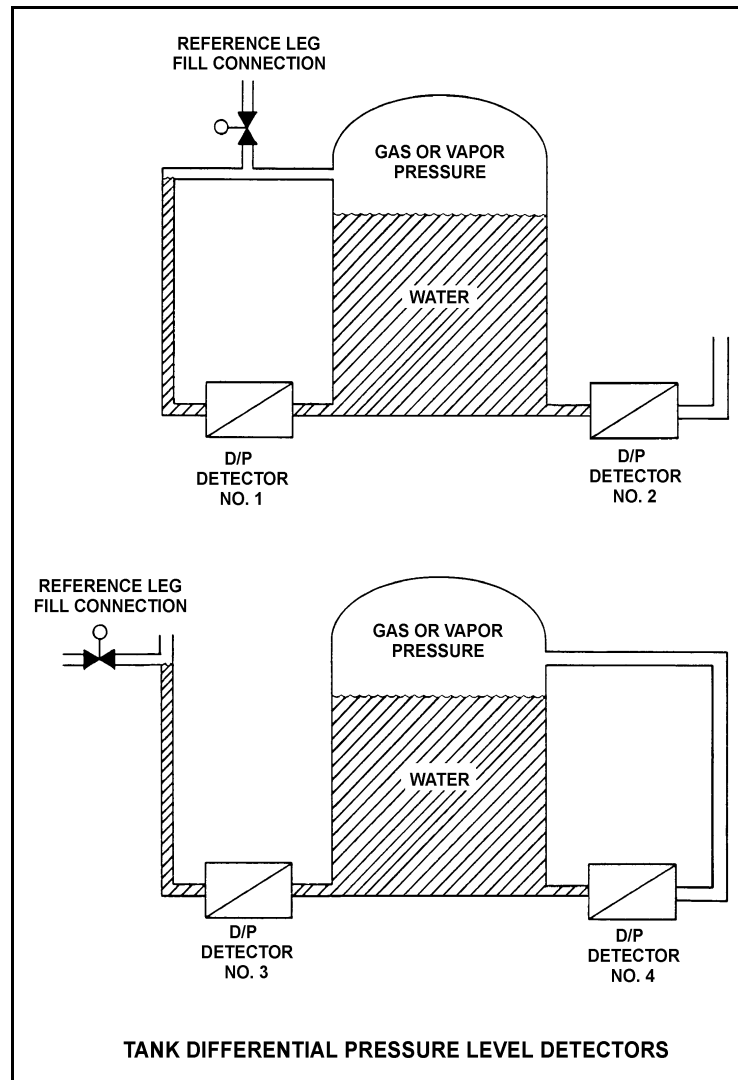
TOPIC:            193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:              P2574   (B2573)

Refer to the drawing of four identical tank differential pressure level detectors (see figure on next page).

The tanks are identical and they are presently at 2 psig overpressure, 60°F, and the same constant water level.  They are located within a sealed containment structure that is being maintained at atmospheric pressure.  All level detectors have been calibrated and are producing the same level indication.  A ventilation malfunction causes containment structure pressure to decrease to 13 psia.

Which level detectors will produce the highest indication?

A.  1 and 2

B.  3 and 4

C.  1 and 4

D.  2 and 3

ANSWER:  D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS
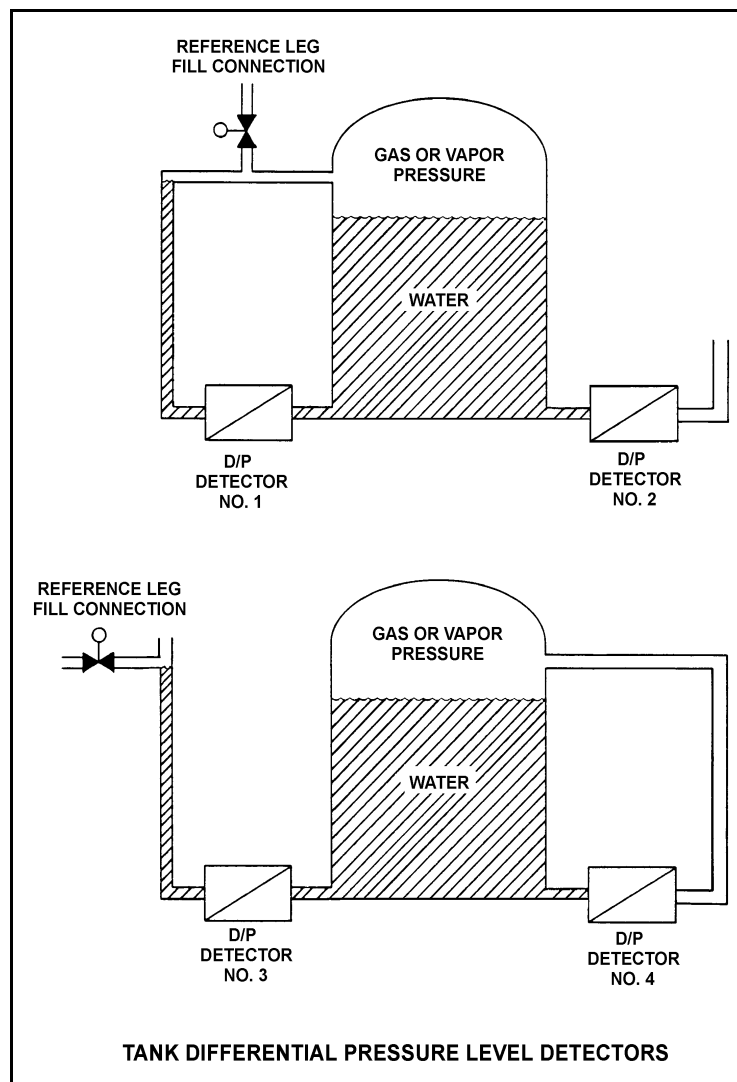
TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P2673   (B73)

Refer to the drawing of a differential pressure manometer (see figure below).

A differential pressure manometer is installed across an orifice in a ventilation duct.  With the ventilation conditions as shown, the pressure at P1 is _____ than P2, and airflow is from _____.

A.  greater; left to right

B.  greater; right to left

C.  less; left to right

D.  less; right to left

ANSWER:  A.



DIFFERENTIAL PRESSURE MANOMETER
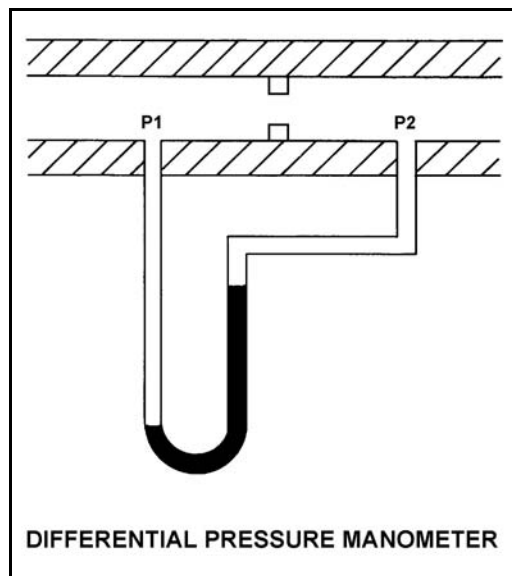
TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P2873   (B1073)

Refer to the drawing of four differential pressure level detectors (see figure below).

The tanks are identical and are being maintained at 30 psia with a water level of 20 feet.  They are surrounded by standard atmospheric pressure.  The water temperatures in the tanks and reference legs are the same.

If each detector experiences a ruptured diaphragm, which detector(s) will cause indicated tank level to decrease?  (Assume actual tank water level remains constant.)

A.  No. 1 only

B.  No. 2 only

C.  No. 1, 2,  and 3

D.  No. 2, 3,  and 4

ANSWER:  D.
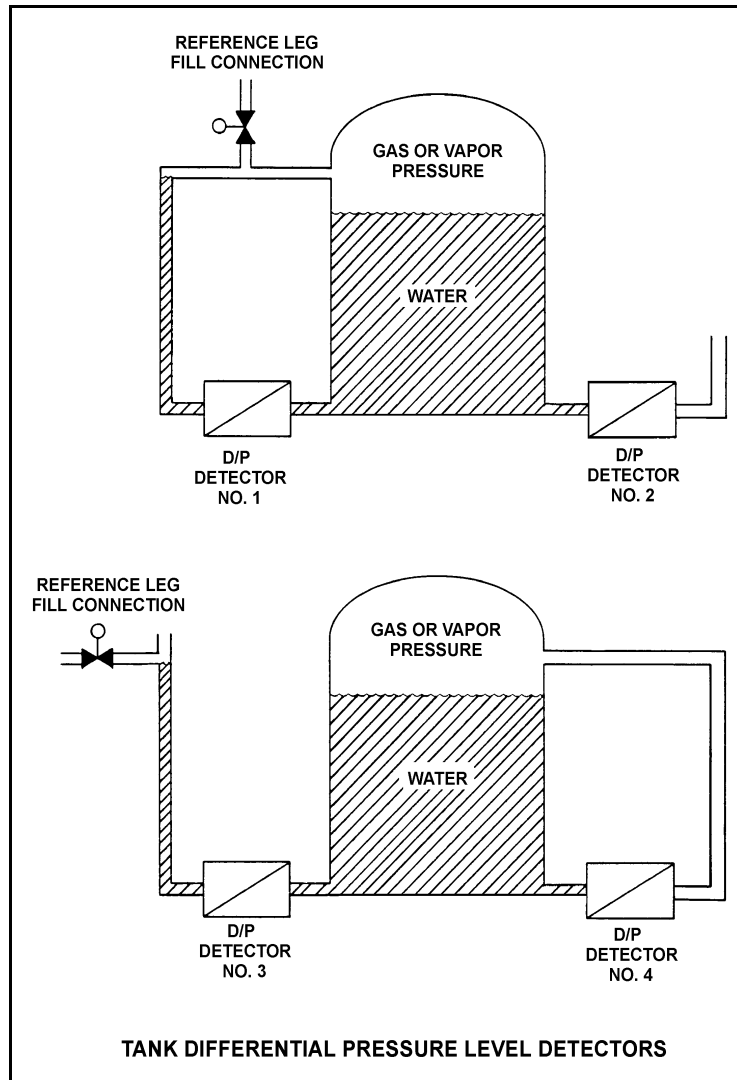
TOPIC:         193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:           P2973   (B673)

Refer to the drawing of a differential pressure manometer (see figure below).

A differential pressure manometer containing water is installed across an orifice in a ventilation duct to determine the direction of airflow.  P1 and P2 are pressures sensed in the ventilation duct.
With the conditions shown in the drawing, P1 pressure is _____ than P2 pressure, and airflow is to the _____.

A.  less; left

B.  less; right

C.  greater; left

D.  greater; right

ANSWER:  A.



DIFFERENTIAL PRESSURE MANOMETER
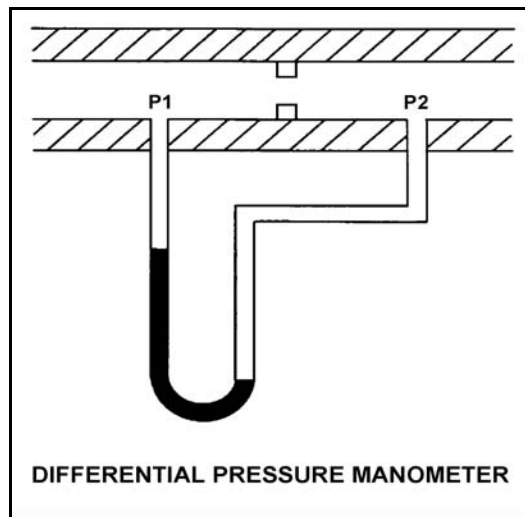
TOPIC:           193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:             P3173   (B3173)

A water storage tank is vented to atmosphere.  The tank is located at sea level and contains 100,000 gallons of 80°F water.  A pressure gauge at the bottom of the tank reads 5.6 psig.  What is the approximate water level in the tank?

A.  13 feet

B.  17 feet

C.  21 feet

D.  25 feet

ANSWER:  A.

TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P3673   (B3673)

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

If the tank contains 30 feet of water at 60°F, what is the approximate D/P sensed by the detector?

A.  2 psid

B.  13 psid

C.  20 psid

D.  28 psid

ANSWER:  B.

TANK OPEN
TO ATMOSPHERE

WATER

D/P
DETECTOR

TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR
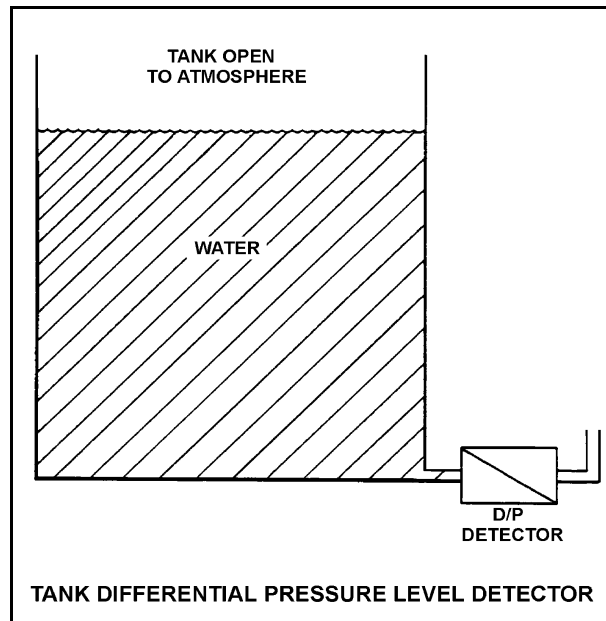
TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P3873   (B3873)

A water storage tank is vented to atmosphere.  The tank is located at sea level and contains 100,000 gallons of water at 80°F.  A pressure gauge at the bottom of the tank reads 7.3 psig.  What is the approximate water level in the tank?

A.  13 feet

B.  17 feet

C.  21 feet

D.  25 feet

ANSWER:  B.

TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P4537   (B4537)

A water storage tank is vented to atmosphere.  The tank is located at sea level and contains 100,000 gallons of water at 80°F.  A pressure gauge at the bottom of the tank reads 9.0 psig.  What is the approximate water level in the tank?

A.  13 feet

B.  17 feet

C.  21 feet

D.  25 feet

ANSWER:  C.

TOPIC:          193001
KNOWLEDGE:   K1.03   [2.6/2.6]
QID:            P4837   (B4837)

Refer to the drawing of four identical tank differential pressure (D/P) level detectors with different piping configurations (see figure below).

The tanks are identical and are presently at 2 psig overpressure, the same constant water level, and a temperature of 60°F.  They are surrounded by atmospheric pressure.  All level detectors have been calibrated and are producing the same level indication.  A leak in the top of each tank causes a complete loss of overpressure in both tanks.

Which level detector(s) will produce the highest level indication?

A.  No. 1 only

B.  No. 2 only

C.  No. 1 and 4

D.  No. 2 and 3

ANSWER:  C.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS
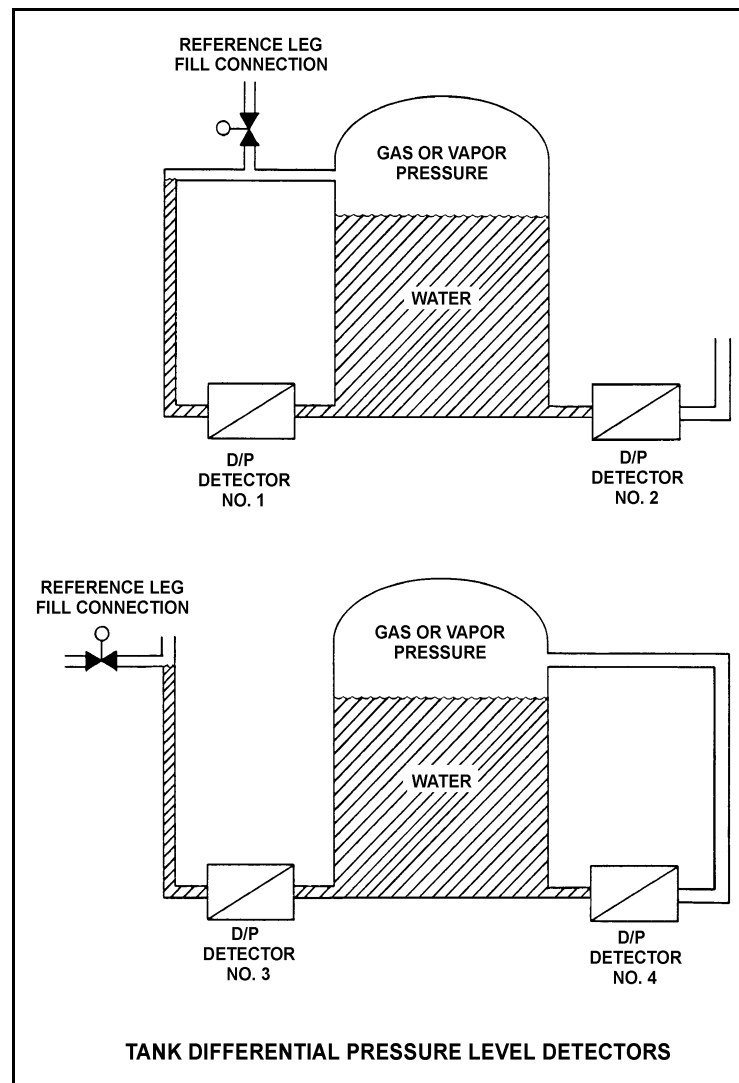
There are no test items available for topic 193002.

TOPIC:          193003
KNOWLEDGE:  K1.02   [2.4/2.5]
QID:            P1774

Two identical pressurizers are connected to the same location on two identical reactor coolant systems operating at 1,000 psia.  Pressurizer A volume contains 50% saturated water and 50% saturated steam.  Pressurizer B volume contains 50% subcooled water (300°F) and 50% nitrogen.

Which one of the following explains which pressurizer will maintain the highest pressure following a sudden 10% liquid outsurge from each pressurizer?

A.  Pressurizer A due to vaporizing of saturated water as pressure begins to decrease

B.  Pressurizer A due to the expansion characteristics of saturated steam being better than the expansion characteristics of nitrogen

C.  Pressurizer B due to the subcooled water resulting in a smaller amount of energy being lost upon the outsurge

D.  Pressurizer B due to the expansion characteristics of nitrogen being better than the expansion characteristics of saturated steam

ANSWER:  A.

TOPIC: 193003
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P1973

Two identical pressurizers are connected to the same location on two identical reactor coolant systems operating at 1,000 psia. Pressurizer A volume contains 50% subcooled water (300°F) and 50% nitrogen. Pressurizer B volume contains 50% saturated water and 50% saturated steam. Which one of the following explains which pressurizer will maintain the highest pressure during a sudden 10% liquid outsurge from each pressurizer?

A. Pressurizer A due to the subcooled water resulting in a smaller amount of energy being lost during the outsurge.

B. Pressurizer A due to the expansion characteristics of nitrogen being better than the expansion characteristics of saturated steam.

C. Pressurizer B due to vaporizing of saturated water as pressure begins to decrease.

D. Pressurizer B due to the expansion characteristics of saturated steam being better than the expansion characteristics of nitrogen.

ANSWER: C.

TOPIC: 193003
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P3874

A nuclear reactor is operating normally at 100% power. Reactor coolant enters the reactor vessel at a temperature of 556°F and a total flow rate of 320,000 gpm. The reactor coolant leaves the reactor vessel at 612°F.

What is the approximate flow rate of the reactor coolant leaving the reactor vessel?

A. 320,000 to 329,000 gpm

B. 330,000 to 339,000 gpm

C. 340,000 to 349,000 gpm

D. 350,000 to 359,000 gpm

ANSWER: D.

TOPIC: 193003
KNOWLEDGE: K1.08 [2.8/2.8]
QID: P674 (B1074)

A liquid is saturated with 0% quality. Assuming pressure remains constant, the addition of a small amount of heat will...

A. raise the liquid temperature above the boiling point.

B. result in a subcooled liquid.

C. result in vaporization of the liquid.

D. result in a superheated liquid.

ANSWER: C.

TOPIC: 193003
KNOWLEDGE: K1.08 [2.8/2.8]
QID: P774

A pressurizer is operating in a saturated condition at 636°F. If a sudden pressurizer level decrease of 10% occurs, pressurizer pressure will _____ and pressurizer temperature will _____.

A. remain the same; decrease

B. remain the same; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: C.

TOPIC:         193003
KNOWLEDGE:  K1.08  [2.8/2.8]
QID:           P874    (B875)

Consider a water/steam mixture with a current quality of 99%. If pressure remains constant and heat is removed from the mixture, the temperature of the mixture will _____ and the quality of the mixture will _____. (Assume the mixture remains saturated.)

A. decrease; remain the same

B. decrease; decrease

C. remain the same; remain the same

D. remain the same; decrease

ANSWER: D.

TOPIC:         193003
KNOWLEDGE:  K1.08  [2.8/2.8]
QID:           P1075

A nuclear power plant is shut down with the following pressurizer conditions:

    Pressurizer liquid temperature:    588°F
    Pressurizer vapor temperature:    607°F
    Pressurizer pressure:           1,410 psia

If the pressurizer is vented until pressure equals 1,200 psia, pressurizer liquid temperature will...

A. increase due to condensation of vapor.

B. increase due to evaporation of liquid.

C. decrease due to condensation of vapor.

D. decrease due to evaporation of liquid.

ANSWER: D.

TOPIC:           193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:             P1174

Which one of the following describes the temperature of a saturated liquid?

A.  Below the boiling point

B.  At the boiling point

C.  Above the boiling point

D.  Unrelated to the boiling point

ANSWER:  B.

TOPIC:           193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:             P1374   (B1874)

Consider a water/steam mixture with a current quality of 95%.  If pressure remains constant and heat is added to the mixture, the temperature of the mixture will _____ and the quality of the mixture will _____.   (Assume the mixture remains saturated.)

A.  increase; remain the same

B.  increase; increase

C.  remain the same; remain the same

D.  remain the same; increase

ANSWER:  D.

TOPIC:         193003
KNOWLEDGE:  K1.08  [2.8/2.8]
QID:           P1474  (B1974)

If 1 pound-mass of liquid water is in a saturated condition at a constant pressure, the addition of 1 Btu will...

A.  raise the temperature of the water by 1°F.

B.  vaporize a portion of the water.

C.  increase the density of the water.

D.  result in 1°F of superheat.

ANSWER:  B.

TOPIC:         193003
KNOWLEDGE:  K1.08  [2.8/2.8]
QID:           P1574  (B1574)

Consider a steam-water mixture with a current quality of 79%. If pressure remains constant and heat is added to the mixture, the temperature of the mixture will _____ and the quality of the mixture will _____. (Assume the mixture remains saturated.)

A.  increase; increase

B.  increase; remain the same

C.  remain the same; increase

D.  remain the same; remain the same

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:            P1575

A nuclear power plant is shut down with the pressurizer in a saturated condition as follows:

    Pressurizer liquid temperature    = 588°F
    Pressurizer vapor temperature    = 588°F
    Pressurizer pressure               = 1,410 psia

Pressurizer spray is initiated to lower pressurizer pressure to 1350 psia.  When pressurizer pressure stabilizes at 1350 psia, liquid temperature will be _____ and vapor temperature will be _____.

A.  the same; the same

B.  the same; lower

C.  lower; the same

D.  lower; lower

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:            P1974   (B3574)

A steam-water mixture is initially saturated with a quality of 50%, when a small amount of heat is added.  Assuming pressure remains constant and the mixture remains saturated, mixture steam quality will _____ and mixture temperature will _____.

A.  increase; increase

B.  increase; remain the same

C.  remain the same; increase

D.  remain the same; remain the same

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:  K1.08   [2.8/2.8]
QID:             P1976  (B2874)

Which one of the following is the approximate steam quality of a steam-water mixture at 467°F with an enthalpy of 1,000 BTU/lbm?

A.  25%

B.  27%

C.  73%

D.  75%

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:  K1.08   [2.8/2.8]
QID:             P2174

Consider a pressurizer containing a saturated water/steam mixture at 636°F with a quality of 50%. If an outsurge removes 10% of the liquid volume from the pressurizer, the temperature of the mixture will _____ and the quality of the mixture will _____.  (Assume the mixture remains saturated.)

A.  decrease; decrease

B.  decrease; increase

C.  remain the same; decrease

D.  remain the same; increase

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:            P2374   (B2375)

Which one of the following describes the effect of removing heat from a steam-water mixture that is in a saturated condition?  (Assume the mixture remains saturated.)

A.  Temperature will increase.

B.  Temperature will decrease.

C.  Quality will increase.

D.  Quality will decrease.

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:            P2474

A nuclear power plant is shut down with the pressurizer in a saturated condition as follows:

    Pressurizer liquid temperature     = 588°F
    Pressurizer vapor temperature     = 588°F
    Pressurizer pressure                   = 1,410 psia

Pressurizer heaters are energized to raise pressurizer pressure to 1,450 psia.  When pressurizer pressure stabilizes at 1,450 psia, liquid temperature will be _____ and vapor temperature will be _____.

A.  the same; the same

B.  the same; higher

C.  higher; the same

D.  higher; higher

ANSWER:  D.

TOPIC:           193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:              P2874   (B3374)

An open container holds one pound-mass of liquid water at saturated conditions and atmospheric pressure.  The addition of 4 BTUs will...

A.  raise the temperature of the water by 4°F.

B.  vaporize a portion of the water.

C.  increase the density of the water.

D.  result in 4°F of superheat.

ANSWER:  B.

TOPIC:           193003
KNOWLEDGE:   K1.08   [2.8/2.8]
QID:              P2974   (B2975)

Consider a pressurizer containing a saturated water/vapor mixture at 500°F.  The mixture is currently stable with no net heat gain or loss occurring.  Water and steam each occupy 50% of the pressurizer volume.

If a leak near the bottom of the pressurizer results in a loss of 10% of the liquid volume from the pressurizer, the temperature of the mixture will _____, and the overall quality of the mixture will _____.  (Assume the mixture remains saturated.)

A.  decrease; increase

B.  decrease; decrease

C.  remain the same; increase

D.  remain the same; decrease

ANSWER:  A.

TOPIC:            193003
KNOWLEDGE:   K1.12   [2.8/2.3]
QID:              P3375   (B3378)

Given the following:

- A saturated steam-water mixture with an inlet quality of 60% is flowing through a moisture separator.
- The moisture separator is 100% efficient for removing moisture.

How much <u>moisture</u> will be removed by the moisture separator from 50 lbm of the steam-water mixture?

A.  10 lbm

B.  20 lbm

C.  30 lbm

D.  40 lbm

ANSWER:  B.

TOPIC:           193003
KNOWLEDGE:   K1.12   [2.8/2.3]
QID:             P3774   (B3778)

Given the following:

- A saturated steam-water mixture with an inlet quality of 40% is flowing through a moisture separator.
- The moisture separator is 100% efficient for removing water.

How much water will be removed by the moisture separator from 50 lbm of the steam-water mixture?

A.  10 lbm

B.  20 lbm

C.  30 lbm

D.  40 lbm

ANSWER:  C.

TOPIC:           193003
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:             P574

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

A.  saturated vapor.

B.  superheated vapor.

C.  dry saturated vapor.

D.  wet saturated vapor.

ANSWER:  B.

TOPIC:             193003
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:               P1674

A reactor trip occurred 10 minutes ago due to a loss of coolant accident.  Emergency coolant injection is in progress and pressurizer level is increasing.  Current pressurizer conditions are as follows:

    Pressurizer liquid temperature     = 540°F
    Pressurizer vapor temperature      = 607°F
    Pressurizer pressure                     = 1,410 psia
    Pressurizer level                          = 60%

Given these conditions, the pressurizer liquid is _____ and the pressurizer vapor is _____.

A.  saturated; saturated

B.  saturated; superheated

C.  subcooled; saturated

D.  subcooled; superheated

ANSWER:  D.

TOPIC:             193003
KNOWLEDGE:   K1.14   [2.4/2.5]
QID:               P2074   (B2074)

Consider a saturated water/steam mixture at 500°F with a quality of 90%.  If the pressure of the mixture is decreased with no heat gain or loss, the temperature of the mixture will _____ and the quality of the mixture will _____.   (Assume the mixture remains saturated.)

A.  decrease; decrease

B.  decrease; increase

C.  remain the same; decrease

D.  remain the same; increase

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:  K1.16   [2.6/2.7]
QID:               P2975   (B2973)

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.

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:  K1.17   [3.0/3.2]
QID:               P575

A nuclear reactor is shut down with reactor coolant system (RCS) pressure at 1,500 psia and core decay heat is being removed via the steam generators (S/Gs).  What pressure must be maintained in the S/Gs to obtain a 110°F subcooling margin in the RCS loop cold legs? (Assume a negligible temperature difference across the S/G tubes.)

A.  580 psia

B.  600 psia

C.  620 psia

D.  640 psia

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:   K1.17   [3.0/3.2]
QID:            P675

Which one of the following steam generator (S/G) pressures will come closest to producing a 50°F reactor coolant system (RCS) subcooling margin with RCS pressure at 1000 psia?  (Assume a negligible delta-T across the S/G tubes.)

A.  550 psia

B.  600 psia

C.  650 psia

D.  700 psia

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.17   [3.0/3.2]
QID:            P775

Which one of the following changes will result in <u>increased</u> subcooling of the condensate water in the condenser hotwell?

A.  Isolate one bay of the condenser circulating water system

B.  Increase circulating water temperature

C.  Decrease circulating water flow

D.  Decrease the main turbine steam flow rate

ANSWER:  D.

TOPIC:           193003
KNOWLEDGE:  K1.24   [2.8/3.1]
QID:              P1475

A nuclear power plant has been operating at 100% power (3400 MWt) for six months when a main steamline break results in a reactor trip.  The break is isolated and all steam generators (S/Gs) stop depressurizing at 700 psia.  The reactor coolant system (RCS) cooldown stops at 503°F and a heatup begins.  Current plant conditions are as follows:

| | |
|---|---|
| Total mass of water in the RCS and S/Gs: | 800,000 lbm |
| Specific heat of RCS and S/G feedwater: | 1.2 Btu/lbm-°F |
| Reactor coolant pump heat input to RCS: | 15 MWt |
| Decay heat generation rate: | 3% |
| RCS pressure: | 1,600 psia |
| Feedwater flow to S/Gs: | Isolated |

The above parameters do not change once the break is isolated.  The RCS and S/Gs remain in thermal equilibrium during the heatup.  The S/Gs remain saturated and the only S/G heat removal path is via the safety valve.

Approximately how long from break isolation will it take for S/G pressure to reach the safety valve setpoint of 1,100 psia?

A.  2 minutes

B.  8 minutes

C.  16 minutes

D.  30 minutes

ANSWER:  B.

TOPIC:            193003
KNOWLEDGE:   K1.24   [2.8/3.1]
QID:              P1675   (B1175)

Which one of the following is the approximate temperature of a water-steam mixture that has an enthalpy of 1,150 Btu/lbm and a quality of 95%?

A.  220°F

B.  270°F

C.  360°F

D.  440°F

ANSWER:  C.

TOPIC:            193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:              P75

Which one of the following is the approximate reactor coolant system subcooling margin when reactor coolant temperature is 280°F and pressurizer pressure is 400 psig?

A.  165°F

B.  168°F

C.  265°F

D.  268°F

ANSWER:  B.

TOPIC:           193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P141

Given the following reactor coolant system (RCS) parameters, determine the approximate RCS subcooling margin.

    RCS pressure                  = 2,235 psig
    RCS hot leg temperature  = 610°F

A.  25°F

B.  31°F

C.  38°F

D.  43°F

ANSWER:  D.

TOPIC:           193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P275    (B275)

The saturation pressure for water at 328°F is approximately...

A.  85 psig.

B.  100 psig.

C.  115 psig.

D.  130 psig.

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P376

If a wet vapor is at 130°F and has a quality of 90%, its specific enthalpy is approximately...

A.  1,015 Btu/lbm.

B.  1,093 Btu/lbm.

C.  1,118 Btu/lbm.

D.  1,216 Btu/lbm.

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P385

Given the following nuclear power plant conditions:

   Core Thermal Power   = 3,400 MWt
   RCS $T_{ave}$            = 573.5°F
   S/G $T_{stm}$            = 513.5°F

A nuclear power plant is shut down for maintenance, during which 5.0% of the total steam generator (S/G) tubes are plugged.  Upon completion of the maintenance, the plant is returned to 3,400 MWt with RCS mass flow rate and RCS temperatures unchanged.

Which one of the following is the approximate new S/G steam pressure with the plant at 3,400 MWt?

A.  711 psia

B.  734 psia

C.  747 psia

D.  762 psia

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P474

Main condenser hotwell condensate is 4°F subcooled at a temperature of 112°F.  What is the condenser pressure?

A.  1.78 psia

B.  1.51 psia

C.  1.35 psia

D.  1.20 psia

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P1275

If steam pressure is 230 psia at a temperature of 900°F, what is the approximate amount of superheat?

A.  368°F

B.  393°F

C.  506°F

D.  535°F

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P1775   (B1776)

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

A.  889 Btu

B.  1,119 Btu

C.  2,666 Btu

D.  3,358 Btu

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P1875

Saturated steam undergoes an ideal expansion process in an ideal turbine from 1,000 psia to 28 inches Hg vacuum.  Approximately how much specific work is being performed by the turbine?

A.  1,193 Btu/lbm

B.  805 Btu/lbm

C.  418 Btu/lbm

D.  388 Btu/lbm

ANSWER:  C.

TOPIC:            193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:              P2275   (B2275)

$1.0 \times 10^6$ lbm/hr saturated steam at 30% steam quality is leaving a main turbine and entering a condenser at 2.0 psia.  Condensate is entering the hotwell at 118°F.

Which one of the following is the approximate condenser heat transfer rate?

A.  $3.1 \times 10^8$ Btu/hr

B.  $5.8 \times 10^8$ Btu/hr

C.  $7.2 \times 10^8$ Btu/hr

D.  $9.9 \times 10^8$ Btu/hr

ANSWER:  A.

TOPIC:            193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:              P2375   (B2374)

Which one of the following is the approximate amount of heat required to convert 2.0 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A.  1,119 Btu

B.  1,187 Btu

C.  2,238 Btu

D.  2,374 Btu

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P2475   (B2475)

A steam line is carrying steam at 500 psia and 507°F.  Approximately how much ambient heat loss is required before moisture formation occurs in the steam line?

A.  31 Btu/lbm

B.  45 Btu/lbm

C.  58 Btu/lbm

D.  71 Btu/lbm

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P2575   (B2575)

Which one of the following is the approximate amount of heat required to convert 2.0 lbm of water at 100°F and 100 psia to a superheated vapor at 400°F and 100 psia?

A.  1,119 Btu

B.  1,159 Btu

C.  2,238 Btu

D.  2,318 Btu

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P2675   (B2675)

What is the specific heat (Btu/lbm-°F) of water at 300°F and 100 psia?

A.  1.03 Btu/lbm-°F

B.  1.11 Btu/lbm-°F

C.  1.17 Btu/lbm-°F

D.  1.25 Btu/lbm-°F

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P2775   (B2776)

With a nuclear power plant operating near rated power, air inleakage into the main condenser causes main condenser pressure to increase from 1.0 psia to 2.0 psia.

Given the following:

•   Initial main condenser condensate depression was 4°F.
•   After the plant stabilizes, with main condenser pressure at 2.0 psia, main condenser condensate depression is 2°F.

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

A.  2 Btu/lbm

B.  4 Btu/lbm

C.  8 Btu/lbm

D.  16 Btu/lbm

ANSWER:  A.

TOPIC:              193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:                  P2875

Given the following:

- A nuclear power plant is operating near rated power.
- The main turbine is comprised of a single unit with <u>no</u> 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

ANSWER:  A.

TOPIC:              193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:                  P3074   (B3075)

The temperature of a saturated steam-water mixture is 467°F.

Which one of the following additional parameter values, when paired with the temperature, provides <u>insufficient</u> data to determine the approximate steam quality of the mixture?

A.  Pressure at 499.96 psia

B.  Enthalpy at 977.33 Btu/lbm

C.  Entropy at 1.17 Btu/lbm -°R

D.  Specific volume at 0.817 ft³/lbm

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:  K1.25  [3.3/3.4]
QID:               P3175  (B3175)

A steam line is carrying saturated steam vapor at 500 psia and 467°F.  Approximately how much specific heat addition to the steam vapor is necessary to achieve 60°F of superheat?

A.  31 Btu/lbm

B.  45 Btu/lbm

C.  58 Btu/lbm

D.  71 Btu/lbm

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:  K1.25  [3.3/3.4]
QID:               P3275  (B3274)

An ideal main turbine generator (MTG) is producing 1000 MW of electrical power while being supplied with 100% quality steam at 920 psig.  Steam supply pressure is then gradually increased to 980 psig at the same quality.  Assume turbine control valve position and condenser vacuum remain the same.

Which one of the following describes why the MTG output increases as steam pressure increases?

A.  Each lbm of steam entering the turbine has a higher specific heat.

B.  Each lbm of steam entering the turbine has a higher specific enthalpy.

C.  Each lbm of steam passing through the turbine expands to fill a greater volume.

D.  Each lbm of steam passing through the turbine performs increased work in the turbine.

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:  K1.25   [3.3/3.4]
QID:            P3475   (B3475)

Which one of the following is the approximate amount of heat required to convert 2 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A.  560 Btu

B.  1,120 Btu

C.  2,238 Btu

D.  3,356 Btu

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:  K1.25   [3.3/3.4]
QID:            P3575

The following stable nuclear power plant conditions existed just prior to a plant shutdown for maintenance:

    Power    = 100%
    RCS $T_{ave}$ = 572°F
    SG $T_{stm}$  = 534°F

During the shutdown, 5% of the total steam generator (SG) tubes were plugged.  Which one of the following will be the approximate SG steam pressure when the plant is returned to 100% power? (Assume RCS mass flow rate and RCS $T_{ave}$ are the same as their pre-shutdown 100% power values.)

A.  813 psia

B.  841 psia

C.  870 psia

D.  900 psia

ANSWER:  D.

TOPIC:           193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P3775   (B3774)

A 100 ft$^3$ vessel contains a saturated water-steam mixture at 1,000 psia.  The water portion occupies 30 ft$^3$ and the steam portion occupies the remaining 70 ft$^3$.  What is the approximate total mass of the mixture in the vessel?

A.  1,547 lbm

B.  2,612 lbm

C.  3,310 lbm

D.  4,245 lbm

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P3875

A nuclear power plant has been operating at full power for six months when a sustained station blackout occurs, resulting in a reactor trip and a complete loss of forced reactor coolant circulation. All means of reactor coolant injection are unavailable.  Reactor coolant system (RCS) pressure is being maintained at approximately 2,100 psia by operation of the pressurizer relief valves.

The following conditions exist five minutes after the reactor trip:

    RCS pressure:                                    2,100 psia
    Core exit thermocouple (CET) temperature:   550°F

Assuming that core uncovery occurs within the next few hours, which one of the following describes the future response of the CET temperature indication?

A.  CET indication will remain stable at approximately 550°F until the core becomes uncovered; then, CET indication will become erratic.

B.  CET indication will remain stable at approximately 550°F until the core becomes uncovered; then, CET indication will increase to approximately 643°F where it will become erratic.

C.  CET indication will steadily increase to approximately 643°F and stabilize; then, as the core begins to uncover, CET indication will increase further until it becomes erratic.

D.  CET indication will steadily increase until it becomes erratic.

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P3939   (B3938)

Main steam is being used to reheat high-pressure (HP) turbine exhaust in a moisture separator reheater (MSR).

Given:

- The HP turbine exhaust enters the MSR reheater section as saturated steam (100% quality).
- The exhaust enters and exits the reheater section at 280 psia and a flow rate of 1.0E6 lbm/hr.
- The main steam heat transfer rate in the reheater section is 42.1E6 Btu/hr.

Which one of the following is the approximate temperature of the HP turbine exhaust leaving the reheater section of the MSR?

A.  450°F

B.  475°F

C.  500°F

D.  525°F

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P4139   (B4138)

Saturated steam at 50% steam quality is leaving a main turbine at a flow rate of $1.0 \times 10^6$ lbm/hr and entering a condenser at 1.6 psia.  Condensate is entering the hotwell at 112°F.

Which one of the following is the approximate condenser heat transfer rate?

A.  $3.1 \times 10^8$ Btu/hr

B.  $3.8 \times 10^8$ Btu/hr

C.  $4.5 \times 10^8$ Btu/hr

D.  $5.2 \times 10^8$ Btu/hr

ANSWER:  D.

TOPIC:            193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:              P4339  (B4338)

A nuclear power plant is operating at full rated power.  The main turbine has one high pressure (HP) unit and one low pressure (LP)  unit.

Main steam enters the HP unit of the main turbine with the following parameters:

    Pressure:       1,000 psia
    Quality:        100%

The exhaust steam exits the HP unit at 200 psia, then goes through a moisture separator/reheater, and enters the LP units with the following parameters:

    Pressure:       200 psia
    Temperature:  500°F

The main condenser pressure is 1.0 psia.  Assume that each unit of the main turbine is 100% efficient.

The higher enthalpy steam is being supplied to the _____ unit of the main turbine; and the greater moisture content is found in the exhaust of the _____ unit.

A.  LP; LP

B.  LP; HP

C.  HP; LP

D.  HP; HP

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P4739   (B4738)

Consider a 100 lbm quantity of a steam-water mixture at standard atmospheric pressure.  The mixture has a quality of 70 percent.  Assume that pressure remains constant and there is no heat loss from the mixture.

Which one of the following is the approximate heat addition needed to increase the quality of the mixture to 100 percent?

A.  5,400 Btu

B.  12,600 Btu

C.  29,100 Btu

D.  67,900 Btu

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P4839   (B4838)

An open vessel contains one pound-mass of water at 204°F and standard atmospheric pressure.  If 16.0 Btu of heat is added to the water, the water temperature will rise by about _____; and approximately _____ of the water mass will become vapor.

A.  8°F; 1 percent

B.  8°F; 10 percent

C.  16°F; 1 percent

D.  16°F; 10 percent

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P4939   (B4938)

Water enters an ideal convergent-divergent nozzle with the following parameters:

    Pressure       = 300 psia
    Temperature   = 102°F
    Velocity       = 50 ft/sec

The velocity of the water at the throat of the nozzle is 200 ft/sec.

Given that nozzles convert enthalpy to kinetic energy, and assuming no heat transfer to or from the nozzle, what is the approximate pressure of the water at the throat of the nozzle?

A.  296 psia

B.  150 psia

C.  75 psia

D.  50 psia

ANSWER:  D.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:            P5039   (B5038)

An open vessel contains one pound-mass of water at 206°F and standard atmospheric pressure. Which one of the following will be caused by the addition of 12.0 Btu to the water?

A.  The water temperature will rise by about 6°F and none of the water will vaporize.

B.  The water temperature will rise by about 6°F and some of the water will vaporize.

C.  The water temperature will rise by about 12°F and none of the water will vaporize.

D.  The water temperature will rise by about 12°F and some of the water will vaporize.

ANSWER:  B.

TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P5139   (B5138)

A feedwater pump discharges into a 16-inch diameter discharge line.  Given the following:

    Pump discharge pressure:  950 psia
    Feedwater temperature:     300°F
    Feedwater velocity:          15.2 ft/sec

What is the feedwater pump discharge flow rate in pounds-mass per hour (lbm/hr)?

A.  1.1 x $10^6$ lbm/hr

B.  4.4 x $10^6$ lbm/hr

C.  1.8 x $10^7$ lbm/hr

D.  5.3 x $10^7$ lbm/hr

ANSWER:  B.


TOPIC:          193003
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:             P5239   (B5238)

Saturated steam enters a frictionless convergent-divergent nozzle with the following parameters:

    Pressure = 850 psia
    Velocity = 10 ft/sec

The steam at the throat of the nozzle has a subsonic velocity of 950 ft/sec.

Given that nozzles convert enthalpy to kinetic energy, and assuming no heat transfer to or from the nozzle, what is the enthalpy of the steam at the throat of the nozzle?

A.  1,162 Btu/lbm

B.  1,171 Btu/lbm

C.  1,180 Btu/lbm

D.  1,189 Btu/lbm

ANSWER:  C.

TOPIC:          193003
KNOWLEDGE:   K1.25
QID:            P5439   (B5438)

An ideal auxiliary steam turbine exhausts to the atmosphere.  The steam turbine is supplied with saturated steam at 900 psia.  Which one of the following is the maximum specific work (Btu/lbm) that can be extracted from the steam by the steam turbine?

A.  283 Btu/lbm

B.  670 Btu/lbm

C.  913 Btu/lbm

D.  1,196 Btu/lbm

ANSWER:  A.

TOPIC:          193003
KNOWLEDGE:   K1.25
QID:            P5639

An ideal steam turbine exhausts to a steam condenser at 1.0 psia.  The turbine is driven by saturated steam at 600 psia.  What is the work (Btu/hr) of the steam turbine if the turbine steam flow rate is 200,000 lbm/hr?

A.  7.9 x $10^6$ Btu/hr

B.  1.6 x $10^7$ Btu/hr

C.  7.9 x $10^7$ Btu/hr

D.  1.6 x $10^8$ Btu/hr

ANSWER:  C.

TOPIC:            193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:               P74      (B2277)

Condensate depression is the process of...

A.  removing condensate from turbine exhaust steam.

B.  spraying condensate into turbine exhaust steam.

C.  heating turbine exhaust steam above its saturation temperature.

D.  cooling turbine exhaust steam below its saturation temperature.

ANSWER:  D.

TOPIC:            193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:               P274

Excessive heat removal from the low pressure turbine exhaust steam in the main condenser will result in...

A.  thermal shock.

B.  loss of condenser vacuum.

C.  condensate depression.

D.  fluid compression.

ANSWER:  C.

TOPIC:              193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:                 P477    (B277)

Main condenser pressure is 1.0 psia.  During the cooling process in the condenser, the temperature of the low pressure turbine exhaust decreases to 100°F, at which time it is a...

A.  saturated liquid.

B.  saturated vapor.

C.  subcooled liquid.

D.  superheated vapor.

ANSWER:  C.

TOPIC:              193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:                 P576    (B2676)

Which one of the following explains why condensate subcooling is necessary in a nuclear power plant steam cycle?

A.  To provide a better condenser vacuum.

B.  To maximize overall secondary efficiency.

C.  To provide net positive suction head for the condensate pumps.

D.  To minimize turbine blade and condenser tube erosion by entrained moisture.

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:            P876    (B1876)

Which one of the following is the approximate condensate subcooling in a steam condenser operating at 26 inches Hg vacuum with a condensate temperature of 100°F?

A.  2°F

B.  19°F

C.  25°F

D.  53°F

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:            P1076

Which one of the following is an advantage of condensate depression in the main condenser?

A.  Increased secondary cycle efficiency

B.  Increased feedwater temperature entering the steam generators

C.  Increased net positive suction head available to condensate pumps

D.  Increased inventory in the main condenser hotwell

ANSWER:  C.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P1176   (B2176)

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

A.  increase; increase

B.  increase; decrease

C.  decrease; increase

D.  decrease; decrease

ANSWER:  D.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P1376

Which one of the following is the condensate depression in a condenser operating at 2.0 psia with a condensate temperature of 115°F?

A.  9°F

B.  11°F

C.  13°F

D.  15°F

ANSWER:  B.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:            P1576   (B2976)

What is the approximate condensate depression in a condenser operating at 28 inches Hg vacuum with a condensate temperature of 100°F?

A. Less than 2°F

B. 3°F to 5°F

C. 6°F to  8°F

D. 9°F to 11°F

ANSWER:  A.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:            P1977

Condensate is collecting in a main condenser hotwell at 90°F with a condenser pressure of 28 inches Hg vacuum.  Which one of the following will improve steam cycle efficiency?

A. Main condenser cooling water flow rate decreases by 5% with no change in condenser vacuum.

B. Main condenser cooling water inlet temperature decreases by 10°F with no change in condenser vacuum.

C. Main condenser vacuum decreases to 27 inches Hg due to buildup of noncondensible gases.

D. Steam flow through the turbine decreases by 10% with no change in condenser vacuum.

ANSWER:  A.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P2276   (B78)

The thermodynamic cycle efficiency of a nuclear power plant can be increased by...

A.  decreasing power from 100% to 25%.

B.  removing a high-pressure feed water heater from service.

C.  lowering condenser vacuum from 29 inches to 25 inches.

D.  decreasing the amount of condensate depression (subcooling).

ANSWER:  D.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P2476   (B2077)

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 thermal efficiency will increase because the work output of the turbine will increase.

B.  Overall steam cycle thermal efficiency will increase because condensate depression will decrease.

C.  Overall steam cycle thermal efficiency will decrease because the work output of the turbine will decrease.

D.  Overall steam cycle thermal efficiency will decrease because condensate depression will increase.

ANSWER:  C.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P2576   (B2576)

A nuclear power plant is operating at 80% of rated power with 5°F of condensate depression in the main condenser.  If the condensate depression decreases to 2°F, steam cycle efficiency will _____ and the probability of condensate pump cavitation will _____.

A.  decrease; decrease

B.  decrease; increase

C.  increase; decrease

D.  increase; increase

ANSWER:  D.

TOPIC:           193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P2976

What is the approximate value of condensate depression in a condenser operating at 27 inches Hg vacuum with a condensate temperature of 100°F?

A.  2°F

B.  4°F

C.  8°F

D.  16°F

ANSWER:  D.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P3576  (B1484)

A main condenser is operating at 28 inches of Hg vacuum with a condensate outlet temperature of 92°F.  Which one of the following is the approximate amount of condensate depression?

A.  6°F

B.  10°F

C.  13°F

D.  17°F

ANSWER:  B.

TOPIC:          193004
KNOWLEDGE:   K1.11   [2.4/2.5]
QID:             P3876  (B3877)

Main turbine exhaust enters a main condenser and condenses at 126°F.  The condensate is cooled to 100°F before entering the main condenser hotwell.  Assuming main condenser vacuum does not change, which one of the following would improve the thermodynamic efficiency of the steam cycle?

A.  Decrease main condenser hotwell level by 5%.

B.  Increase main condenser hotwell level by 5%.

C.  Decrease condenser cooling water flow rate by 5%.

D.  Increase condenser cooling water flow rate by 5%.

ANSWER:  C.

TOPIC:            193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:               P76

A nuclear power plant is maintained at 2,000 psia with a pressurizer temperature of 636°F.  A pressurizer relief safety valve is leaking to a collection tank which is being held at 10 psig.  Which one of the following is the approximate temperature of the fluid downstream of the relief valve?

A.  280°F

B.  240°F

C.  190°F

D.  170°F

ANSWER:  B.

TOPIC:            193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:               P148

A pressurizer power-operated relief valve is stuck partially open with the fluid being discharged into a pressurizer relief tank.  The pressurizer pressure is 2200 psia and the relief tank pressure is 5 psig.

Which one of the following is the condition of the fluid downstream of the relief valve?

A.  Superheated steam

B.  Subcooled liquid

C.  Dry saturated steam

D.  Wet vapor

ANSWER:  D.

TOPIC:           193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:              P150

As steam goes through a throttling process in the main steam header to atmospheric leak, in which of the following parameters will there be an increase?

A.  Enthalpy

B.  Pressure

C.  Specific volume

D.  Temperature

ANSWER:  C.

TOPIC:           193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:              P276

A reactor coolant system is being maintained at 1000 psia.  A pressurizer safety/relief valve is slowly discharging to a collection tank, which is maintained at 5 psig.

Assuming 100% quality steam in the pressurizer vapor space, what is the approximate enthalpy of the fluid entering the tank?

A.  1,210 Btu/lbm

B.  1,193 Btu/lbm

C.  1,178 Btu/lbm

D.  1,156 Btu/lbm

ANSWER:  B.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P377

What is the approximate temperature and phase of the fluid downstream of the pressurizer relief valve if it sticks partially open with 2,200 psia in the pressurizer and a 50 psia backpressure?

A.  281°F, saturated

B.  281°F, superheated

C.  332°F, saturated

D.  332°F, superheated

ANSWER:  A.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P677

An operator is involved in a routine nuclear power plant shutdown with a steam bubble (100% quality) in the pressurizer.  Pressurizer pressure is 415 psig and pressurizer pressure and level are slowly decreasing.  The operator suspects a pressurizer power-operated relief valve (PORV) is partially open but the position indicating lights are not working.

Which one of the following will be the approximate PORV tailpipe temperature if the PORV is partially open?  (Assume downstream pressure is atmospheric and no heat is lost from the tailpipe.)

A.  212°F

B.  280°F

C.  330°F

D.  450°F

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P877

A nuclear reactor is operating at 100% power.  As steam escapes via a main steam header-to-atmosphere leak, which of the following parameters will increase in the leaking steam?

A.  Enthalpy

B.  Pressure

C.  Specific volume

D.  Temperature

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P1277

A heatup and pressurization of the reactor coolant system (RCS) is in progress following a maintenance shutdown.  RCS pressure is 800 psia with a steam bubble in the pressurizer.  Pressurizer power-operated relief valve (PORV) tailpipe temperature has been steadily rising.  Assume 97.5% quality saturated steam in the pressurizer vapor space, PORV downstream pressure is 30 psia, and PORV leakage is an ideal throttling process.

Which one of the following is the approximate PORV tailpipe temperature if a PORV is leaking by?

A.  262°F

B.  282°F

C.  302°F

D.  322°F

ANSWER:  B.

TOPIC:            193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:              P1477

A nuclear power plant is operating at 100% power with steam generator pressure at 900 psia.  A steam generator safety valve is leaking 100% saturated steam to atmosphere.

Which one of the following is the approximate temperature of the escaping steam once it reaches atmospheric pressure?

A.  532°F

B.  370°F

C.  308°F

D.  212°F

ANSWER:  C.

TOPIC:            193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:              P1577

A heatup and pressurization of the reactor coolant system (RCS) is in progress following a maintenance shutdown.  RCS pressure is 800 psia with a steam bubble in the pressurizer.  Pressurizer power-operated relief valve (PORV) tailpipe temperature has been steadily rising.  The pressurizer vapor space contains 96.0% quality saturated steam and PORV downstream pressure is 20 psia.

Assuming PORV leakage is an ideal throttling process, which one of the following will be the approximate PORV tailpipe temperature if a PORV is leaking by?

A.  228°F

B.  260°F

C.  284°F

D.  320°F

ANSWER:  B.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P1677

A nuclear power plant is being maintained at 2,220 psig.  A pressurizer safety/relief valve is leaking saturated steam (100% quality) to a collection tank which is being held at 20 psig.

Neglecting heat losses to ambient, which one of the following is the approximate temperature of the fluid downstream of the relief valve?

A.  162°F

B.  228°F

C.  259°F

D.  320°F

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P1777

Which one of the following is essentially a constant-enthalpy process?

A.  Throttling of main steam through main turbine steam inlet valves

B.  Condensation of turbine exhaust in a main condenser

C.  Expansion of main steam through the stages of an ideal turbine

D.  Steam flowing through an ideal convergent nozzle

ANSWER:  A.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P2077   (B2075)

A nuclear power plant is operating with the following main steam parameters at a main turbine steam inlet valve:

    Pressure:   900 psia
    Quality:    98%

The main turbine steam chest pressure is 400 psia.  Which one of the following is the quality of the steam in the steam chest?

A.  97%

B.  98%

C.  99%

D.  100%

ANSWER:  A.

TOPIC:              193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:                   P2377

A heatup and pressurization of the reactor coolant system (RCS) is in progress following a maintenance shutdown.  RCS pressure is 800 psia with a steam bubble in the pressurizer.  Pressurizer power-operated relief valve (PORV) tailpipe temperature has been steadily rising.  The pressurizer vapor space contains 96.0% quality saturated steam and PORV downstream pressure is 20 psia.

Assuming PORV leakage is an ideal throttling process, which one of the following will be the approximate PORV tailpipe temperature and phase of escaping fluid if a PORV is leaking by?

A.  254°F, saturated

B.  254°F, superheated

C.  228°F, saturated

D.  228°F, superheated

ANSWER:  B.

TOPIC:           193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:             P2876

Refer to the drawing of two 1,000 ft³ pressure vessels with relief protection (see figure below).

Both vessels are in saturated conditions at 281°F and approximately 35 psig.  Vessel A is completely filled with saturated water.  Vessel B contains one-half saturated steam (100% quality) volume and one-half saturated water (0% quality) volume.  Both vessels are protected by identical relief valves.

If both relief valves begin to leak at a rate of 0.1% of design flow, the higher temperature fluid will initially be leaving the relief valve of vessel _____.  And, if 100 lbm of fluid is released through both relief valves, the larger pressure decrease will occur in vessel _____.

A.  A; A

B.  A; B

C.  B; A

D.  B; B

ANSWER:  D.



PRESSURE VESSELS WITH RELIEF PROTECTION

*Thermodynamic Processes*
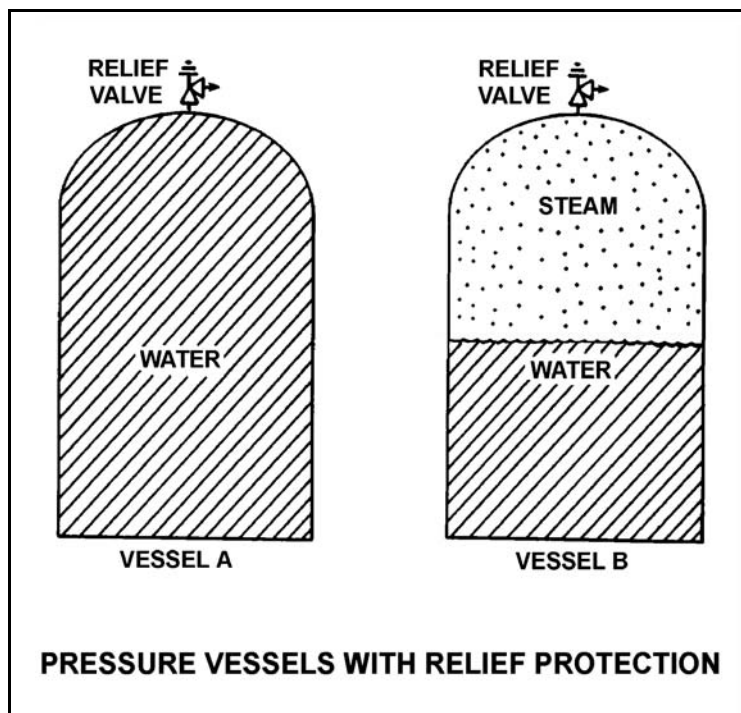
TOPIC:         193004
KNOWLEDGE:  K1.15  [2.8/2.8]
QID:            P3077  (B3074)

A nuclear power plant is operating at 100% rated power.  Steam is escaping to atmosphere through a flange leak in a steam supply line to the low pressure section of the main turbine.

Given:

- Steam line pressure is 300 psia.
- Steam line temperature is 440°F.

What is the approximate temperature of the steam as it reaches atmospheric pressure?

A.  212°F

B.  268°F

C.  322°F

D.  358°F

ANSWER:  D.

TOPIC:           193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:             P3277

A nuclear power plant is operating at 100% rated power.  Steam is escaping to atmosphere through a flange leak in a steam supply line to the low pressure section of the main turbine.

Given:

*   Steam line pressure is 280 psia.
*   Steam line temperature is 450ºF.

What is the approximate temperature of the steam as it reaches atmospheric pressure?

A.  212ºF

B.  268ºF

C.  322ºF

D.  378ºF

ANSWER:  D.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P3477

A pressurizer safety valve is leaking by, allowing the 100% quality steam in the pressurizer to flow to the pressurizer relief tank (PRT).  The reactor has been shut down, and a plant cooldown and depressurization are in progress.  PRT pressure is being maintained constant at 20 psig.

Which one of the following describes how safety valve tailpipe temperature will be affected as pressurizer pressure slowly decreases from 1,500 psia to 500 psia?  (Assume there is <u>no</u> ambient heat loss from the tailpipe.)

A.  Increases, because the entropy of the pressurizer steam will be increasing.

B.  Increases, because the enthalpy of the pressurizer steam will be increasing.

C.  Decreases, because the mass flow rate of the leaking steam will be decreasing.

D.  Decreases, because the temperature of the pressurizer steam will be decreasing.

ANSWER:  B.

TOPIC:              193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:                 P3577   (B3575)

Saturated steam (100% quality) at 1000 psia is being supplied to the inlet of a partially-open steam throttle valve on a main turbine.  Pressure in the steam chest downstream of the throttle valve is 150 psia.  Assume a typical throttling process with <u>no</u> heat gain or loss to/from the steam.

When compared to the conditions at the inlet to the throttle valve, which one of the following describes the conditions in the steam chest for specific enthalpy and entropy?

|      | Steam Chest<br>Specific Enthalpy | Steam Chest<br>Specific Entropy |
|------|-----------------------|----------------------|
| A.   | About the same        | About the same       |
| B.   | About the same        | Significantly higher |
| C.   | Significantly lower    | About the same       |
| D.   | Significantly lower    | Significantly higher |

ANSWER:  B.

TOPIC:              193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:                 P3677   (B3675)

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

A.  212°F

B.  268°F

C.  322°F

D.  358°F

ANSWER:  C.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P4040

A heatup and pressurization of a reactor coolant system (RCS) is in progress following a maintenance shutdown.  RCS pressure is 1,000 psia with a steam bubble in the pressurizer.  Pressurizer power-operated relief valve (PORV) tailpipe temperature has been steadily rising.  The pressurizer vapor space contains 100.0% quality saturated steam and PORV downstream pressure is 40 psia.

Assuming PORV leakage is an ideal throttling process, which one of the following will be the approximate PORV tailpipe temperature and phase of escaping fluid if a PORV is leaking by?

A.  267°F, saturated

B.  267°F, superheated

C.  312°F, saturated

D.  312°F, superheated

ANSWER:  D.

TOPIC:          193004
KNOWLEDGE:  K1.15   [2.8/2.8]
QID:            P5340   (B5338)

A nuclear power plant is operating with the following main steam parameters at a main turbine steam inlet valve:

    Pressure:  900 psia
    Quality:   99%

The main turbine steam chest pressure is 300 psia.  Which one of the following is the quality of the steam in the steam chest?

A.  100%

B.  98%

C.  88%

D.  87%

ANSWER:  B.

TOPIC:          193004
KNOWLEDGE:   K1.15   [2.8/2.8]
QID:            P5640

A pressurizer safety valve is leaking by, allowing the 100% quality steam from the pressurizer to enter the discharge pipe, which remains at a constant pressure of 30 psig.  Initial safety valve discharge pipe temperature is elevated but stable.  Assume <u>no</u> heat loss from the safety valve discharge pipe.

Upon discovery of the leak, the reactor is shut down and a plant cooldown and depressurization are commenced.  As pressurizer pressure slowly decreases from 2,000 psig to 1,800 psig, the safety valve discharge pipe temperature will...

A.  decrease, because the entropy of the safety valve discharge will be decreasing.

B.  decrease, because the enthalpy of the safety valve discharge will be decreasing.

C.  increase, because the safety valve discharge will become more superheated as pressurizer pressure decreases.

D.  remain the same, because the safety valve discharge will remain a saturated steam-water mixture at 30 psig.

ANSWER:  D.

TOPIC:             193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:               P77

Overall nuclear power plant thermal efficiency will <u>decrease</u> if...

A.  additional moisture is removed from the steam entering the turbine.

B.  the temperature of the feedwater entering the steam generator is increased.

C.  the amount of condensate depression (subcooling) in the main condenser is decreased.

D.  the temperature of the steam at the turbine exhaust is increased.

ANSWER:  D.

TOPIC:             193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:               P277

Which one of the following will cause overall nuclear power plant thermal efficiency to <u>increase</u>?

A.  Increasing total steam generator blowdown from 30 gpm to 40 gpm.

B.  Changing steam quality from 99.7% to 99.9%.

C.  Bypassing a feedwater heater during normal plant operations.

D.  Increasing condenser pressure from 1 psia to 2 psia.

ANSWER:  B.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P378    (B3578)

Steam turbines X and Y are identical 100% efficient turbines that exhaust to a condenser at 1.0 psia. Saturated steam at 250 psia enters turbine X.  Superheated steam at 250 psia and 500°F enters turbine Y.

Which one of the following lists the percentage of moisture at the exhaust of turbines X and Y?

|     | Turbine X | Turbine Y |
| --- | --- | --- |
| A. | 24.5% | 20.5% |
| B. | 26.3% | 13.0% |
| C. | 24.5% | 13.0% |
| D. | 26.3% | 20.5% |

ANSWER:  A.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P379

Which one of the following actions will <u>decrease</u> overall nuclear power plant thermal efficiency?

A.  Reducing turbine inlet steam moisture content

B.  Reducing condensate depression

C.  Increasing turbine exhaust pressure

D.  Increasing temperature of feedwater entering the steam generators

ANSWER:  C.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P478

To achieve maximum overall nuclear power plant thermal efficiency, feed water should enter the steam generator (S/G) _____ and the pressure difference between the S/G and the condenser should be as _____ as possible.

A.  as subcooled as practical; great

B.  as subcooled as practical; small

C.  close to saturation; great

D.  close to saturation; small

ANSWER:  C.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P878

Feed water heating increases overall nuclear power plant thermal efficiency because...

A.  the average temperature at which heat is transferred in the steam generators is increased.

B.  less steam flow passes through the turbine, thereby increasing turbine efficiency.

C.  increased feed water temperature lowers the temperature at which heat is rejected in the condenser.

D.  less power is required by the feed water pumps to pump the warmer feed water.

ANSWER:  A.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P978

Which one of the following changes will cause an <u>increase</u> in overall nuclear power plant thermal efficiency?

A.  Decreasing the temperature of the water entering the steam generators

B.  Decreasing the superheat of the steam entering the low pressure turbines

C.  Decreasing the circulating water flow rate through the main condenser

D.  Decreasing the concentration of noncondensible gases in the main condenser

ANSWER:  D.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P1078

A nuclear power plant is operating at full power with $0°F$ of condensate subcooling.  If main condenser cooling water inlet temperature <u>increases</u> by $3°F$, the overall nuclear power plant thermal efficiency will...

A.  decrease due to a degraded main condenser vacuum.

B.  increase due to an improved main condenser vacuum.

C.  decrease due to increased main condenser heat rejection.

D.  increase due to decreased main condenser heat rejection.

ANSWER:  A.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P1378

Which one of the following actions will result in a <u>decrease</u> in overall nuclear power plant thermal efficiency?

A.  Increasing steam quality by adding additional heat to the steam prior to entering the turbine

B.  Increasing the temperature of the feed water entering the steam generator

C.  Decreasing the amount of condensate depression in the main condenser

D.  Decreasing the amount of turbine steam extracted for feed water heating

ANSWER:  D.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P1478

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

ANSWER:  D.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P1678

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 500 psia.  Turbine Y is driven by saturated steam (100% quality) at 700 psia.

The greatest amount of specific work is being performed by turbine _____; the greatest moisture content exists in the exhaust of turbine _____.

A.  X; X

B.  X; Y

C.  Y; X

D.  Y; Y

ANSWER:  D.

TOPIC:          193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:            P1878   (B1879)

A nuclear power plant is operating at 85% of rated thermal power when the extraction steam to a high-pressure feedwater heater is <u>isolated</u>.  After the transient, the operator returns reactor power to 85% and stabilizes the plant.  Compared to conditions just prior to the transient, current main turbine generator output (MWe) is...

A.  higher because increased steam flow causes the turbine generator to pick up load.

B.  lower because decreased steam flow causes the turbine generator to reject load.

C.  higher because plant efficiency has increased.

D.  lower because plant efficiency has decreased.

ANSWER:  D.

TOPIC:            193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P1980   (B1679)

A nuclear power plant is initially operating at 85% reactor power when extraction steam to a high-pressure feedwater heater is isolated.  Main generator load is returned to its initial value.  When the plant stabilizes, reactor power will be _____ than 85% and overall plant thermal efficiency will be _____.

A.  greater; lower

B.  greater; higher

C.  less; lower

D.  less; higher

ANSWER:  A.

TOPIC:            193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P2078

A nuclear power plant is operating at 90% of rated power.  Main condenser pressure is 1.7 psia and hotwell condensate temperature is 120°F.

If main condenser cooling water flow rate is reduced by 5%, overall steam cycle efficiency will...

A.  increase because condensate depression will decrease.

B.  decrease because condensate depression will increase.

C.  increase because the work output of the main turbine will increase.

D.  decrease because the work output of the main turbine will decrease.

ANSWER:  D.

TOPIC:              193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:                   P2178   (B2178)

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

A.  remain the same; increase

B.  remain the same; decrease

C.  decrease; increase

D.  decrease; decrease

ANSWER:  C.

TOPIC:              193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:                   P2278

If the moisture content of the steam supplied to a main turbine increases, (assume <u>no</u> change in steam pressure, condenser pressure, or control valve position) turbine work will...

A.  decrease, because the enthalpy of the steam being supplied to the turbine has decreased.

B.  decrease, because moist steam results in more windage losses in the turbine.

C.  increase, because the enthalpy of the steam being supplied to the turbine has increased.

D.  increase, because moist steam results in less windage losses in the turbine.

ANSWER:  A.

TOPIC:           193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P2478

Turbine X is an ideal steam turbine that exhausts to a condenser at 1.0 psia.  Turbine X is driven by saturated steam (100% quality) at 500 psia.  Which one of the following lists the approximate specific work output of turbine X and the moisture content of the steam exiting turbine X?

|   | Specific Work | Moisture Content |
|---|---------------|------------------|
| A. | 388 Btu/lbm | 72% |
| B. | 388 Btu/lbm | 28% |
| C. | 817 Btu/lbm | 72% |
| D. | 817 Btu/lbm | 28% |

ANSWER:  B.

TOPIC:           193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:              P2678   (B1978)

If the moisture content of the steam supplied to a main turbine decreases, the overall steam cycle efficiency will increase because the...

A.  operating temperature of the turbine blades has increased.

B.  reheat capacity of the turbine extraction steam has increased.

C.  mass flow rate of the steam through the turbine has increased.

D.  enthalpy of the steam being supplied to the turbine has increased.

ANSWER:  D.

TOPIC:           193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:             P2778  (B2774)

The theoretical maximum efficiency of a steam cycle is given by the equation:

$$Eff_{thmax} = (1 - T_{out}/T_{in}) \times 100\%,$$

where $T_{out}$ is the absolute temperature for heat rejection and $T_{in}$ is the absolute temperature for heat addition.  (Fahrenheit temperature is converted to absolute temperature by adding $460°$.)

A nuclear power plant is operating with a stable steam generator pressure of 900 psia.  What is the approximate theoretical maximum steam cycle efficiency this plant can achieve by establishing its main condenser vacuum at 1.0 psia?

A.  35%

B.  43%

C.  57%

D.  65%

ANSWER:  B.

TOPIC:           193005
KNOWLEDGE:   K1.03   [2.5/2.6]
QID:             P3078  (B3077)

Which one of the following will be caused by a <u>decrease</u> in main condenser vacuum (higher absolute pressure) on a nuclear power plant operating at full power?  (Assume main steam flow rate and condenser circulating water flow rate are unchanged.)

A.  Decrease in the condensate temperature

B.  Decrease in the ideal steam cycle efficiency

C.  Decrease in the condensate pump required NPSH

D.  Decrease in the mass of noncondensible gas in the condenser

ANSWER:  B.

TOPIC: 193005
KNOWLEDGE: K1.03 [2.5/2.6]
QID: P3378 (B2478)

A nuclear power plant was initially operating normally at 90% reactor power when heating steam (supplied from main turbine extraction steam) to the feedwater heaters was isolated. The plant was stabilized and reactor power was returned to 90%.

As compared to the initial main generator output (MW), the current generator output is...

A. lower, because the steam cycle is less efficient.

B. higher, because the steam cycle is less efficient.

C. lower, because more steam heat energy is available to the main turbine.

D. higher, because more steam heat energy is available to the main turbine.

ANSWER: A.

TOPIC: 193005
KNOWLEDGE: K1.03 [2.5/2.6]
QID: P4441

Consider the thermal efficiency of a nuclear power plant operating at rated power.

If the pressure at which saturated steam is produced in the steam generators is increased, thermal efficiency will _____; and if the temperature of the feedwater entering the steam generators is increased, thermal efficiency will _____.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: A.

TOPIC:          193006
KNOWLEDGE:   K1.04   [3.4/3.6]
QID:            P78

The possibility of water hammer in a liquid system is <u>minimized</u> by...

A.  maintaining temperature above the saturation temperature.

B.  starting centrifugal pumps with the casing vent valve fully open.

C.  starting positive displacement pumps with the discharge valve closed.

D.  venting systems prior to starting centrifugal pumps.

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.04   [3.4/3.6]
QID:            P278

Which one of the following methods will increase the possibility and/or severity of water hammer?

A.  Opening and closing system valves slowly

B.  Venting fluid systems prior to starting a pump

C.  Starting a centrifugal pump with the discharge valve fully open

D.  Starting a centrifugal pump with the discharge valve fully closed

ANSWER:  C.

TOPIC:        193006
KNOWLEDGE:  K1.04  [3.4/3.6]
QID:          P679   (B279)

A sudden stop of fluid flow in a piping system, due to rapid closure of an isolation valve, will most likely result in...

A.  check valve slamming.

B.  pump runout.

C.  water hammer.

D.  pressurized thermal shock.

ANSWER:  C.

TOPIC:        193006
KNOWLEDGE:  K1.04  [3.4/3.6]
QID:          P879

One reason for keeping condensate out of the steam lines is to...

A.  minimize corrosion buildup.

B.  reduce heat losses.

C.  eliminate steam traps.

D.  prevent water/steam hammer.

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.04   [3.4/3.6]
QID:             P1079

The possibility of water hammer will be increased by...

A.  maintaining the discharge line filled with liquid on an automatically starting pump.

B.  condensation in a steam line just prior to initiating flow.

C.  warming steam lines prior to initiating steam flow.

D.  slowly closing the discharge valve on an operating pump.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.04   [3.4/3.6]
QID:             P1279

To minimize the possibility of water hammer when initiating flow in a system, the operator should...

A.  vent the system prior to initiating flow.

B.  vent the system only after flow has been initiated.

C.  fully open the pump discharge valve prior to starting a pump.

D.  rapidly open the pump discharge valve after a pump is running.

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:  K1.04   [3.4/3.6]
QID:              P1879  (B2779)

Which one of the following describes why large steam lines are gradually warmed instead of suddenly admitting full steam flow?

A.  To minimize the possibility of stress corrosion cracking of the steam lines.

B.  To minimize the total thermal expansion of the steam lines.

C.  To minimize the potential for water hammer in the steam lines.

D.  To minimize the heat loss from the steam lines.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.04   [3.4/3.6]
QID:              P2079  (B2081)

Which one of the following will minimize the possibility of water hammer?

A.  Draining the discharge line of a centrifugal pump after shutdown

B.  Draining condensate out of steam lines before and after initiating flow

C.  Starting a centrifugal pump with its discharge valve fully open

D.  Starting a positive displacement pump with its discharge valve partially closed

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.04   [3.4/3.6]
QID:             P2279  (B2679)

Which one of the following operating practices <u>minimizes</u> the possibility of water hammer?

A.  Change valve position as rapidly as possible.

B.  Start a centrifugal pump with the discharge valve throttled.

C.  Start a positive displacement pump with the discharge valve closed.

D.  Vent a system only after initiating system flow.

ANSWER:  B.

TOPIC:         193006
KNOWLEDGE:   K1.04   [3.4/3.6]
QID:          P4042   (B4041)

Refer to the drawing of two lengths of 6-inch diameter pipe, each containing an identical automatic isolation valve. The actual pipe lengths are proportional to their symbols in the drawing

Water at 65°F is flowing at 1,000 gpm through each pipe.  If the isolation valves instantly close, valve A and its associated piping will experience a maximum pressure that is _____ the maximum pressure experienced by valve B and its associated piping.  The pressure spike will dissipate quicker in the _____ length of pipe.

A.  equal to; shorter

B.  equal to; longer

C.  less than; shorter

D.  less than; longer

ANSWER:  A.
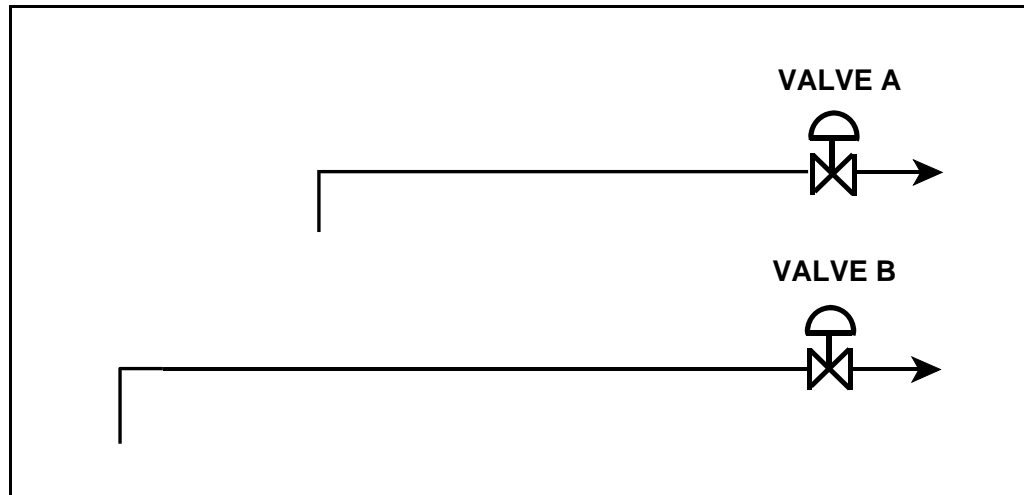
TOPIC:              193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:                  P380     (B383)

An 85 gpm leak has developed in a cooling water system that is operating at 100 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 50 psig?

A.  60.1 gpm

B.  51.7 gpm

C.  42.5 gpm

D.  33.3 gpm

ANSWER:  A.

TOPIC:              193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:                  P579

Mass flow rate equals volumetric flow rate (V) times...

A.  specific volume.

B.  density.

C.  specific gravity.

D.  velocity.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P680    (B681)

A 55 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 50 psig?

A.  27.5 gpm

B.  31.8 gpm

C.  38.9 gpm

D.  43.4 gpm

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P1382

A 75 gpm leak to atmosphere has developed from a cooling water system that is operating at 80 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 40 psig?

A.  37.5 gpm

B.  43.5 gpm

C.  53 gpm

D.  59 gpm

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P1580   (B1979)

A 60 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A.  15.0 gpm

B.  30.0 gpm

C.  42.4 gpm

D.  53.1 gpm

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P1679   (B2981)

A 100 gpm leak to atmosphere has developed from a cooling water system that is operating at 60 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 20 psig?

A.  33.3 gpm

B.  53.0 gpm

C.  57.7 gpm

D.  70.7 gpm

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.05   [2.9/3.0]
QID:            P1779  (B1783)

A 100 gpm leak to atmosphere has developed from a cooling water system that is operating at 45 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 30 psig?

A.  25 gpm

B.  50 gpm

C.  67 gpm

D.  82 gpm

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.05   [2.9/3.0]
QID:            P1986

A 47 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A.  23.5 gpm

B.  33.2 gpm

C.  36.5 gpm

D.  37.3 gpm

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.05   [2.9/3.0]
QID:            P2080  (B2080)


An 80 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?


A.  69 gpm


B.  60 gpm


C.  51 gpm


D.  40 gpm


ANSWER:  A.


TOPIC:          193006
KNOWLEDGE:  K1.05   [2.9/3.0]
QID:            P2379  (B2381)


A 60 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 100 psig?


A.  27 gpm


B.  35 gpm


C.  40 gpm


D.  49 gpm


ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P2779  (B2781)

An 80 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A.  20 gpm

B.  40 gpm

C.  49 gpm

D.  57 gpm

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P2980

An 80 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 100 psig?

A.  36 gpm

B.  53 gpm

C.  56 gpm

D.  65 gpm

ANSWER:  D.

TOPIC:            193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:              P3080   (B3181)

A 75 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig.  Which one of the following will be the approximate leak rate when system pressure has decreased to 80 psig?

A.  26.5 gpm

B.  38.9 gpm

C.  56.4 gpm

D.  67.1 gpm

ANSWER:  D.

TOPIC:            193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:              P3780

Which one of the following describes the relationship between the main steam mass flow rate leaving a steam generator and the main feedwater mass flow rate entering the same steam generator at steady-state power operation?  (Assume no other addition/removal of steam generator inventory.)

A.  The mass flow rates will be the same only if downcomer level is constant.

B.  The mass flow rates will be the same only if the reactor is operating near rated power.

C.  The main steam mass flow rate is smaller than the main feedwater mass flow rate by the amount of moisture removed by the steam generator moisture separators.

D.  The main steam mass flow rate is greater than the main feedwater mass flow rate by the amount of moisture removed by the steam generator moisture separators.

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:              P5342  (B5342)

A heat exchanger has the following <u>initial</u> cooling water inlet temperature and differential pressure (ΔP) parameters:

    Inlet Temperature   = 70°F
    Heat Exchanger ΔP = 10 psi

Six hours later, the <u>current</u> heat exchanger cooling water parameters are:

    Inlet Temperature   = 85°F
    Heat Exchanger ΔP = 10 psi

In comparison to the initial cooling water mass flow rate, the current mass flow rate is...

A.  lower because the density of the cooling water has decreased.

B.  higher because the velocity of the cooling water has increased.

C.  the same because the changes in cooling water velocity and density offset.

D.  the same because the heat exchanger cooling water ΔP is the same.

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:              P580

Reactor coolant system (RCS) hot leg temperature is 568°F and RCS pressure is decreasing due to a small leak.  Which one of the following pressure ranges includes the pressure at which two-phase flow will <u>first</u> occur in the hot leg?

A.  1,250 to 1,201 psig

B.  1,200 to 1,151 psig

C.  1,150 to 1,101 psig

D.  1,100 to 1,051 psig

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P1180

Reactor coolant system (RCS) hot leg temperature is constant at 538°F while RCS pressure is decreasing due to a small reactor coolant leak.  Which one of the following RCS pressure ranges includes the pressure at which two-phase flow will <u>first</u> occur in the hot leg?

A.  1,100 to 1,151 psig

B.  1,050 to 1,001 psig

C.  1,000 to 951 psig

D.  950 to 901 psig

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P1480

Reactor coolant system (RCS) hot leg temperature is 520°F and RCS pressure is decreasing due to a small leak.  Which one of the following pressure ranges includes the pressure at which two-phase flow will <u>first</u> occur in the hot leg?

A.  950 to 901 psig

B.  900 to 851 psig

C.  850 to 801 psig

D.  800 to 751 psig

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.06   [2.8/2.9]
QID:              P2581

Reactor coolant system (RCS) hot leg temperature is 552°F and RCS pressure is decreasing due to a small leak.  Which one of the following pressure ranges includes the pressure at which two-phase flow will first occur in the hot leg?

A.  1,100 to 1,051 psig

B.  1,050 to 1,001 psig

C.  1,000 to 951 psig

D.  950 to 901 psig

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.07   [2.7/2.7]
QID:              P581

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.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.08   [2.8/1.8]
QID:             P279    (B143)

A centrifugal water pump is being returned to service after maintenance.  However, the operator fails to vent the pump.

Compared to normal operations, after the pump is started, the operator will see _____ flow rate and _____ discharge head.

A.  higher; lower

B.  higher; higher

C.  lower; lower

D.  lower; higher

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.08   [2.8/2.8]
QID:            P3481

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

Centrifugal pump A is circulating water at 100°F.  Which one of the following will cause the centrifugal pump to operate closer to a condition in which gas/vapor binding can occur?

A.  Surge tank level is raised by 5%.

B.  Service water flow rate is decreased by 5%.

C.  The pump discharge valve is used to decrease cooling water system flow rate by 5%.

D.  Makeup water containing a high concentration of total dissolved solids is added to the cooling water system.

ANSWER:  B.
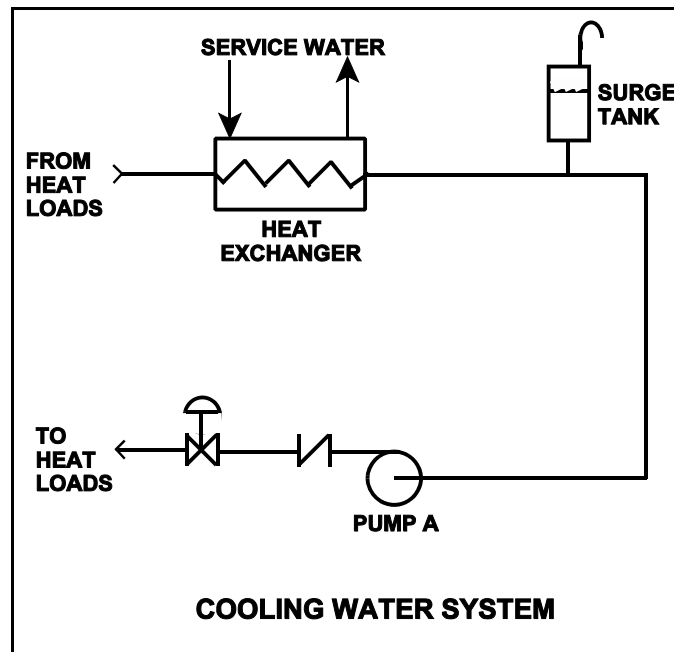
TOPIC:          193006
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P80     (B79)

The piping system pressure change caused by suddenly stopping fluid flow is referred to as...

A.  cavitation.

B.  shutoff head.

C.  water hammer.

D.  flow head.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P381    (B380)

The <u>major</u> concern with starting a main feedwater pump with downstream fluid in a saturated condition is...

A.  cavitation.

B.  water hammer.

C.  thermal shock.

D.  positive reactivity addition.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P2480  (B1180)

Which one of the following will increase the possibility of water hammer?

A.  Opening and closing system valves very slowly

B.  Venting liquid systems only after initiating system flow

C.  Starting centrifugal pumps with the discharge valve closed

D.  Starting positive displacement pumps with the discharge valve open

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.10   [3.3/3.4]
QID:            P2880  (B1135)

The primary reason for slowly opening the discharge valves of large motor-driven centrifugal cooling water pumps after starting the pumps is to minimize the...

A.  net positive suction head requirements.

B.  potential for a water hammer.

C.  motor running current requirements.

D.  potential for pump cavitation.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.11   [3.1/3.3]
QID:            P79

Cavitation in an operating pump may be caused by...

A.  lowering the pump suction temperature.

B.  throttling the pump suction valve.

C.  increasing the pump backpressure.

D.  increasing the pump suction pressure.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.11   [3.1/3.3]
QID:            P149

Cavitation of a centrifugal pump in an open system is indicated by _____ discharge pressure and _____ flow rate.

A.  low; low

B.  high; high

C.  low; high

D.  high; low

ANSWER:  A.

TOPIC:              193006
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:                 P382     (B80)

Which one of the following is most likely to cause cavitation of an operating centrifugal pump?

A.  Lowering the suction temperature.

B.  Throttling the pump suction valve.

C.  Throttling the pump discharge valve.

D.  Decreasing the pump speed.

ANSWER:  B.

TOPIC:              193006
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:                 P481

While on surveillance rounds, an operator notices that a centrifugal pump is making a great deal of noise (like marbles rattling inside the pump casing) and the discharge pressure is fluctuating.

This set of conditions indicates pump...

A.  runout.

B.  cavitation.

C.  bearing deterioration.

D.  packing deterioration.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.11   [3.1/3.3]
QID:            P882

Cavitation in an operating centrifugal pump may be caused by...

A.  decreasing the pump suction temperature.

B.  throttling down on the pump suction valve.

C.  throttling down on the pump discharge valve.

D.  decreasing the pump speed.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.11   [3.1/3.3]
QID:            P1181

Which one of the following contains indications of pump cavitation?

A.  Abnormally low discharge pressure and flow rate

B.  Abnormally high discharge pressure and flow rate

C.  Abnormally low discharge pressure and abnormally high flow rate

D.  Abnormally high discharge pressure and abnormally low flow rate

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P1381

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

A.  impeller; casing

B.  impeller; discharge piping

C.  volute; casing

D.  volute; discharge piping

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:   K1.11   [3.1/3.3]
QID:            P2680   (B280)

Cavitation is the formation of vapor bubbles in the _____ pressure area of a pump followed by the _____ of these bubbles within the pump casing.

A.  low; expansion

B.  low; collapse

C.  high; expansion

D.  high; collapse

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.11   [3.1/3.3]
QID:              P2981   (B1880)

Which of the following completes the following statement?

Pump cavitation occurs when vapor bubbles are formed at the eye of a pump impeller...

A.  because the localized flow velocity exceeds sonic velocity for the existing fluid temperature.

B.  because the localized pressure exceeds the vapor pressure for the existing fluid temperature.

C.  and enter a high pressure region of the pump where they collapse causing damaging pressure pulsations.

D.  and are discharged from the pump where they expand into larger bubbles causing damaging pressure pulsations.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.12   [2.5/2.6]
QID:              P81

In an operating cooling water system with a constant water velocity, if water temperature decreases, indicated volumetric flow rate (gpm) will...

A.  remain the same, because the density of the water has not changed.

B.  increase, because the density of the water has increased.

C.  remain the same, because the water velocity has not changed.

D.  increase, because the viscosity of the water has increased.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:            P281

Flow instruments used to measure the mass flow rate of saturated steam are often density compensated because, for a steam pressure increase at a constant volumetric flow rate, steam density will _____ and the actual mass flow rate will _____.

A.  decrease; increase

B.  increase; decrease

C.  increase; increase

D.  decrease; decrease

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:            P982

A density-compensated flow instrument is being used to measure mass flow rate in a steam system. If the pressure of the steam decreases, <u>indicated</u> mass flow rate will:  (Assume volumetric flow rate is constant.)

A.  increase for all steam conditions.

B.  decrease for all steam conditions.

C.  increase, but only if the steam is saturated (not superheated).

D.  decrease, but only if the steam is saturated (not superheated).

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:             P1083

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.  increase due to the velocity increase of the steam.

B.  increase due to the increased density of the steam.

C.  decrease due to the velocity decrease of the steam.

D.  decrease due to the decreased density of the steam.

ANSWER:  A.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:             P1182

A cooling water system is supplying $1.0 \times 10^6$ lbm/hour of flow at a temperature of 100°F.  Assuming volumetric flow rate does not change, which one of the following is the mass flow rate that will be supplied by the system if cooling water temperature increases to 140°F?

A.  $7.5 \times 10^5$ lbm/hr

B.  $8.3 \times 10^5$ lbm/hr

C.  $9.0 \times 10^5$ lbm/hr

D.  $9.9 \times 10^5$ lbm/hr

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:            P1780

A reactor coolant system is supplying $1.0 \times 10^8$ lbm/hour of coolant flow at a temperature of $100°F$. Assuming volumetric flow rate does not change, which one of the following is the approximate mass flow rate that will be supplied by the system if cooling water temperature increases to $400°F$?

A.  $1.2 \times 10^8$ lbm/hr

B.  $1.1 \times 10^8$ lbm/hr

C.  $9.2 \times 10^7$ lbm/hr

D.  $8.7 \times 10^7$ lbm/hr

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:            P2182

A reactor coolant system is supplying $1.0 \times 10^8$ lbm/hr of coolant flow at a temperature of $100°F$. Assuming volumetric flow rate does not change, which one of the following is the approximate mass flow rate that will be supplied by the system if coolant temperature increases to $500°F$?

A.  $1.2 \times 10^8$ lbm/hr

B.  $1.1 \times 10^8$ lbm/hr

C.  $8.7 \times 10^7$ lbm/hr

D.  $7.9 \times 10^7$ lbm/hr

ANSWER:  D.

TOPIC:           193006
KNOWLEDGE:  K1.12   [2.5/2.6]
QID:             P2681

A cooling water system is supplying 2,000 lbm/min coolant flow at a temperature of 100°F. Assuming volumetric flow rate does not change, which one of the following is the approximate mass flow rate that will be supplied by the system if cooling water temperature increases to 140°F?

A.  1,964 lbm/min

B.  1,980 lbm/min

C.  2,020 lbm/min

D.  2,036 lbm/min

ANSWER:  B.

TOPIC:           193006
KNOWLEDGE:  K1.12   [2.5/2.6]
QID:             P2882

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

A.  increase due to a higher steam velocity.

B.  increase due to a greater steam density.

C.  decrease due to a lower steam velocity.

D.  decrease due to a reduced steam density.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.12   [2.5/2.6]
QID:              P3081   (B3032)

The volumetric flow rate of cooling water entering a heat exchanger is 500 gpm.

Given the following:

    Cooling water pressure entering and leaving the heat exchanger is 10 psig.
    Cooling water inlet temperature is 90°F.
    Cooling water outlet temperature is 160°F.
    Heat exchanger inlet and outlet piping have the same diameter.

What is the approximate volumetric flow rate of the cooling water exiting the heat exchanger?

A.  496 gpm

B.  500 gpm

C.  504 gpm

D.  509 gpm

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.12   [2.5/2.6]
QID:            P3783   (B3733)

A condensate pump is taking suction on a main condenser hotwell, containing water at 100°F, and discharging the water at a volumetric flow rate of 100,000 gpm to the main feedwater system.  The main feedwater system heats the water to 400°F before it enters the steam generators.  Assume there is no leakage, and no bypass or recirculation flow paths are in use.

What is the approximate volumetric flow rate of the feedwater entering the steam generators?

A.  100,000 gpm

B.  105,000 gpm

C.  109,000 gpm

D.  115,000 gpm

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:            P147

Operating two pumps in parallel instead of operating a single pump will result in a...

A.  large increase in system head and a small increase in flow rate.

B.  small increase in system head and a small increase in flow rate.

C.  small increase in system head and a large increase in flow rate.

D.  large increase in system head and a large increase in flow rate.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:              P280

The <u>major</u> effect of starting a second centrifugal pump in parallel with an operating centrifugal pump in an open system is increased...

A.  system pressure.

B.  system flow rate.

C.  pump discharge pressure.

D.  pump flow rate.

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:              P282

To decrease the flow rate through an operating positive displacement pump, an operator should...

A.  throttle the pump discharge valve partially closed.

B.  throttle the pump suction valve partially closed.

C.  decrease the pump net positive suction head.

D.  decrease the pump speed.

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:            P981

Which one of the following will <u>decrease</u> the head loss experienced in an operating cooling water system?

A.  Starting a second pump in parallel with the operating pump

B.  Shifting two heat exchangers from parallel to series operation

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

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

ANSWER:  D.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:            P1282

Two centrifugal pumps and two positive displacement pumps are able to be cross connected to provide flow in a system.  Each pump will produce 100 gpm at 1,000 psig and each pump has a design maximum pressure of 1,500 psig.

If system pressure is 1,200 psig, which one of the following will produce the <u>greatest</u> system flow rate?

A.  Two positive displacement pumps in series

B.  Two positive displacement pumps in parallel

C.  Two centrifugal pumps in series

D.  Two centrifugal pumps in parallel

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:            P1683

Two centrifugal pumps and two positive displacement pumps are able to be cross-connected to provide makeup water flow to a system.  Each pump will produce 100 gpm at 1,000 psig backpressure.

If system pressure is 800 psig, which one of the following combinations will produce the greatest flow rate to the system?

A.  Two centrifugal pumps in parallel

B.  Two centrifugal pumps in series

C.  Two positive displacement pumps in parallel

D.  Two positive displacement pumps in series

ANSWER:  A.

TOPIC:               193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:                    P1784   (B1725)

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 1,000 psig.

Given the following information:

   Centrifugal Pumps

   Shutoff head:                      1,500 psig
   Maximum design pressure:     2,000 psig

   Positive Displacement Pumps

   Maximum design pressure:     2,000 psig

Which one of the following pump configurations will supply the lowest makeup flow rate to the cooling water system if system pressure is at 1,700 psig?

A.  One PDP and one CP in series (CP supplying PDP)

B.  One PDP and one CP in parallel

C.  Two CPs in series

D.  Two CPs in parallel

ANSWER:  D.

TOPIC:            193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:              P1979

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 1,000 psig.

Given the following information:

  Centrifugal Pumps

  Shutoff head:                    1,500 psig
  Maximum design pressure:    2,000 psig

  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 at 800 psig?

A.  One PDP and one CP in series (CP supplying PDP)

B.  One PDP and one CP in parallel

C.  Two CPs in series

D.  Two CPs in parallel

ANSWER:  D.

TOPIC:           193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:             P2282   (B2281)

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

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

ANSWER:  A.

TOPIC:           193006
KNOWLEDGE:  K1.15  [3.1/3.3]
QID:             P2383  (B2324)

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

    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 at 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)

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:              P2481  (B2479)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec.  The pipe then splits into two pipes, a 3-inch diameter pipe and a 6-inch diameter pipe.  Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 3-inch and 6-inch diameter pipes?  (Assume fluid velocity is the same in each pipe.)

| | 3-inch Pipe (lbm/sec) | 6-inch Pipe (lbm/sec) |
|---|---|---|
| A. | 10 | 90 |
| B. | 20 | 80 |
| C. | 25 | 75 |
| D. | 33 | 67 |

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:            P2582   (B2581)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec.  The pipe then splits into two pipes, a 6-inch diameter pipe and an 8-inch diameter pipe.

Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 6-inch and 8-inch diameter pipes?  (Assume fluid velocity is the same in each pipe.)

|      | 6-inch Pipe (lbm/sec) | 8-inch Pipe (lbm/sec) |
|------|-----------------------|-----------------------|
| A.   | 24                    | 76                    |
| B.   | 32                    | 68                    |
| C.   | 36                    | 64                    |
| D.   | 40                    | 60                    |

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:            P2783   (B2723)

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 cooling water system if system pressure is at 1,700 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)

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:            P3183

A four-loop nuclear power plant uses four identical reactor coolant pumps (RCPs) to supply reactor coolant flow through the reactor vessel.  The plant is currently operating at 20% power with all RCPs in operation.

Which one of the following describes the stable RCS flow rate through the reactor vessel following the trip of one RCP?  (Assume that no operator actions are taken and the reactor does not trip.)

A.  Less than 75% of the original flow rate.

B.  Exactly 75% of the original flow rate.

C.  Greater than 75% of the original flow rate.

D.  Unpredictable without pump curves for the RCPs.

ANSWER:  C.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:             P3582

A reactor shutdown has been performed because of a leak from the reactor coolant system (RCS) to a steam generator (SG) via a tube leak.

Given the following initial conditions:

    SG pressure is 1,000 psia.
    RCS pressure is 2,200 psia.
    RCS average temperature is 500°F.
    Leak rate from the RCS to the SG is 100 gpm.

If RCS pressure is decreased to 1,600 psia, with <u>no</u> other changes in plant parameters, what will be the approximate leak rate from the RCS to the SG?

A.  50 gpm

B.  71 gpm

C.  79 gpm

D.  85 gpm

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:             P3683   (B3681)

Two identical single-speed centrifugal pumps (CPs) and two identical single-speed positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system.  The pumps are capable of being cross-connected to provide multiple configurations.  In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,200 psig.

Given the following information:

    Centrifugal Pumps

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

    Positive Displacement Pumps

    Maximum design pressure:               2,000 psig

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

A.  Two CPs in series

B.  Two CPs in parallel

C.  Two PDPs in parallel

D.  One CP and one PDP in series (CP supplying PDP)

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:            P4243   (B4242)

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

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 (P1 -  P2) 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 (P1 -  P2) across the venturi cannot increase further once the steam reaches sonic velocity in the throat of the venturi.

ANSWER:  C.



VENTURI

TOPIC:          193006
KNOWLEDGE:   K1.15   [3.1/3.3]
QID:            P4343   (B4342)

Two identical single-speed centrifugal pumps (CPs) and two identical single-speed positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system.  The pumps are capable of being cross-connected to provide multiple configurations.  In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,200 psig.

Given the following information:

   Centrifugal Pumps

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

   Positive Displacement Pumps

   Maximum design pressure:              2,000 psig

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

A.  Two CPs in series

B.  Two CPs in parallel

C.  Two PDPs in parallel

D.  One CP and one PDP in series (CP supplying PDP)

ANSWER:  D.

TOPIC:           193006
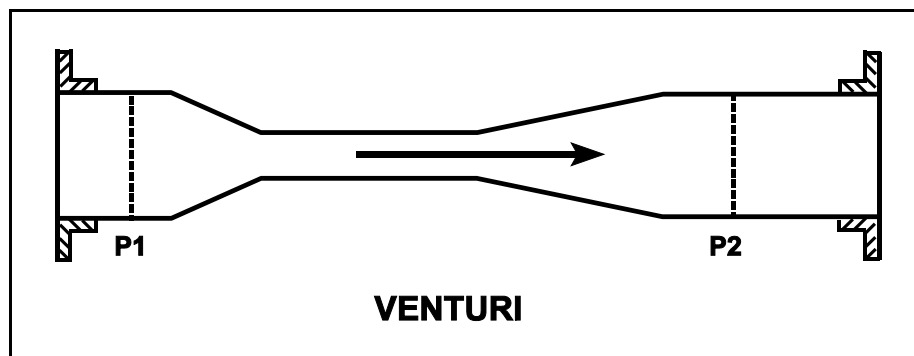KNOWLEDGE:   K1.15   [3.1/3.3]
QID:             P4543   (B4542)

Refer to the drawing of a main water header that splits into two parallel headers (see figure below).

Header A has a 2-inch diameter and header B has a 3-inch diameter.  The velocity of the water in both headers is the same.

If the main water header has a flow rate of 500 gpm, what is the approximate flow rate in each of the parallel headers?

|     | HEADER A (gpm) | HEADER B (gpm) |
|-----|----------------|----------------|
| A.  | 125            | 375            |
| B.  | 154            | 346            |
| C.  | 200            | 300            |
| D.  | 222            | 278            |

ANSWER:  B.

TOPIC:          193006
KNOWLEDGE:  K1.15   [3.1/3.3]
QID:            P5543  (B5542)

A vented water storage tank contains 60 feet of water at 70°F.  A cracked weld at the bottom rim of the tank results in a leak rate of 12 gpm.  If makeup water flow rate is 5 gpm, at what water level will the tank stabilize?  (Ignore any frictional head losses as the water exits the tank.)

A.  38.7 feet

B.  25.0 feet

C.  10.4 feet

D.  0.0 feet

ANSWER:  C.

TOPIC:        193007
KNOWLEDGE:  K1.01  [2.5/2.5]
QID:         P283

The transfer of heat from the reactor fuel pellets to the fuel cladding during normal plant operation is an example of _____ heat transfer.

A.  conduction

B.  convection

C.  radiant

D.  two-phase

ANSWER:  A.

TOPIC:          193007
KNOWLEDGE:  K1.01   [2.5/2.5]
QID:            P584    (B882)

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

Which one of the following is the <u>primary</u> method of heat transfer through the gap between the reactor fuel and the fuel clad?

A.  Conduction

B.  Convection

C.  Radiation

D.  Natural circulation

ANSWER:  A.



FUEL ROD AND COOLANT FLOW CHANNEL
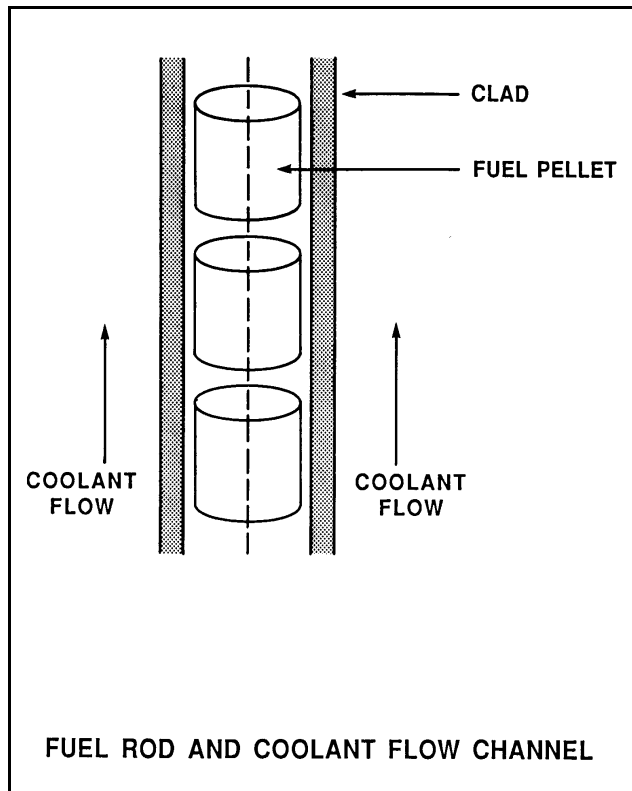
TOPIC:          193007
KNOWLEDGE:   K1.01   [2.5/2.5]
QID:              P784

During a loss-of-coolant accident, which one of the following heat transfer mechanisms provides the most core cooling when fuel elements are not in contact with the coolant?

A.  Radiation

B.  Emission

C.  Convection

D.  Conduction

ANSWER:  A.

TOPIC:          193007
KNOWLEDGE:   K1.01   [2.5/2.5]
QID:              P985    (B1982)

Nuclear reactor fuel rods are normally charged with _____ gas to improve the heat transferred by _____ from the fuel pellets to the cladding.

A.  helium; convection

B.  helium; conduction

C.  nitrogen; convection

D.  nitrogen; conduction

ANSWER:  B.

TOPIC:            193007
KNOWLEDGE:   K1.01   [2.5/2.5]
QID:              P1884

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

A.  Radiolysis

B.  Radiation

C.  Convection

D.  Conduction

ANSWER:  C.

TOPIC:            193007
KNOWLEDGE:   K1.01   [2.5/2.5]
QID:              P2284

Which one of the following describes a heat transfer process in which convection is the most significant heat transfer mechanism?

A.  From the reactor fuel to the core barrel during core uncovery

B.  Through the tube walls in a steam generator during normal operation at 100% power

C.  From the reactor fuel to the steam generators following a loss of all RCPs

D.  From the fuel pellet centerline to the fuel clad during normal operation at 100% power

ANSWER:  C.

TOPIC:           193007
KNOWLEDGE:   K1.01   [2.5/2.5]
QID:             P2884   (B2882)

Which one of the following describes a heat transfer flow path in which conduction is the most significant heat transfer mechanism?

A.  From the reactor fuel to the core barrel during core uncovery

B.  From the main turbine exhaust steam to the atmosphere via main condenser cooling water and a cooling tower during normal operation

C.  From the reactor fuel to the steam outlet of the steam generators during a station blackout

D.  From a fuel pellet to the fuel clad via the fuel rod fill gas during normal operation

ANSWER:  D.

TOPIC:           193007
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:             P83

If excessive amounts of air are entrained/dissolved in the cooling water passing through a single-phase (liquid) heat exchanger, the overall heat transfer coefficient of the heat exchanger will decrease because the...

A.  laminar layer thickness will decrease.

B.  laminar layer thickness will increase.

C.  thermal conductivity of the cooling fluid will decrease.

D.  thermal conductivity of the cooling fluid will increase.

ANSWER:  C.

TOPIC: 193007
KNOWLEDGE: K1.04 [2.8/3.0]
QID: P1184 (B1882)

Why is bulk boiling in the tubes of a single-phase heat exchanger undesirable?

A. The bubble formation will break up the laminar layer in the heat exchanger tubes.

B. The turbulence will restrict fluid flow through the heat exchanger tubes.

C. The ΔT across the tubes will decrease through the heat exchanger.

D. The thermal conductivity of the heat exchanger tubes will decrease.

ANSWER: B.

TOPIC: 193007
KNOWLEDGE: K1.04 [2.8/3.0]
QID: P2184 (B2184)

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

A. Oil to water in a lube oil cooler

B. Air to water in an air compressor after-cooler

C. Steam to water in a turbine exhaust steam condenser

D. Water to water in a cooling water heat exchanger

ANSWER: C.

TOPIC:          193007
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:             P2384   (B2383)

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

A.  Oil to water in a lube oil cooler

B.  Air to water in an air compressor after-cooler

C.  Steam to water in a turbine exhaust steam condenser

D.  Water to water in a cooling water heat exchanger

ANSWER:  B.

TOPIC:          193007
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:             P3084   (B3084)

A nuclear power plant is operating near100% power.  Main turbine extraction steam is being supplied to a feedwater heater.  Extraction steam parameters are as follows:

    Steam pressure:    414 psia
    Steam flow rate:   $7.5 \times 10^5$ lbm/hr
    Steam enthalpy:    1,150 Btu/lbm

Assume the extraction steam condenses to a saturated liquid at 414 psia and then leaves the feedwater heater via a drain line.

Assuming an ideal heat transfer process, what is the heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A.  $3.8 \times 10^7$ Btu/hr

B.  $8.6 \times 10^7$ Btu/hr

C.  $5.4 \times 10^8$ Btu/hr

D.  $7.2 \times 10^8$ Btu/hr

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P3384  (B3383)

A nuclear power plant was operating at a steady-state power level with the following main condenser parameters:

    Main condenser pressure:                1.2 psia
    Cooling water inlet temperature:        60°F
    Cooling water outlet temperature:       84°F

As a result of increased condenser air inleakage, the overall heat transfer coefficient of the main condenser decreases by 25%.  Main condenser heat transfer rate and cooling water temperatures are unchanged.  Which one of the following is the approximate resulting pressure in the main condenser?

A.  1.7 psia

B.  2.3 psia

C.  3.0 psia

D.  4.6 psia

ANSWER:  A.

TOPIC:          193007
KNOWLEDGE:   K1.04   [2.8/3.0]
QID:            P3684  (B3684)

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

A.  Oil to water in a lube oil cooler

B.  Steam to water in a feedwater heater

C.  Water to air in a ventilation heating unit

D.  Water to water in a cooling water heat exchanger

ANSWER:  B.

TOPIC:   193007
KNOWLEDGE: K1.04 [2.8/3.0]
QID:    P5144 (B5143)

A nuclear power plant is operating near 100% power.  Main turbine extraction steam is being supplied to a feedwater heater.  Extraction steam parameters are as follows:

 Steam pressure:  500 psia
 Steam flow rate:  $7.0 \times 10^5$ lbm/hr
 Steam enthalpy:  1,135 Btu/lbm

Assume the extraction steam condenses to a saturated liquid at 500 psia and then leaves the feedwater heater via a drain line.

Assuming an ideal heat transfer process, what is the heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A.  $3.2 \times 10^8$ Btu/hr

B.  $4.8 \times 10^8$ Btu/hr

C.  $5.3 \times 10^8$ Btu/hr

D.  $7.9 \times 10^8$ Btu/hr

ANSWER:  B.

TOPIC:   193007
KNOWLEDGE: K1.05 [2.7/2.9]
QID:    P585

During steady state power operation, core thermal power can be most accurately determined by multiplying the total mass flow rate of the...

A.  reactor coolant by the change in temperature across the core.

B.  reactor coolant by the change in enthalpy in the steam generators.

C.  feedwater by the change in enthalpy in the steam generators.

D.  feedwater by the change in temperature across the core.

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:   K1.05   [2.7/2.9]
QID:            P785

A nuclear reactor is producing 200 MW of core thermal power.  Reactor coolant pumps are adding 10 MW of additional thermal power into the coolant system based on heat balance calculations.  The core is rated at 1,330 MW thermal power.

Which one of the following is the core thermal power in percent?

A.  14.0%

B.  14.3%

C.  15.0%

D.  15.8%

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P137

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance.  Which one of the following would cause indicated reactor power to be <u>greater</u> than actual reactor power?

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

B.  The feedwater flow rate used in the heat balance calculation was lower than actual feedwater flow rate.

C.  The steam pressure used in the heat balance calculation was 50 psi higher than actual steam pressure.

D.  The enthalpy of the feed water was miscalculated to be 10 Btu/lbm higher than actual feed water enthalpy.

ANSWER:  A.

TOPIC:            193007
KNOWLEDGE:  K1.06   [3.1/3.3]
QID:              P332

.

Which one of the terms in the equation, Q= UA(T1-T2), is affected the most, and therefore most responsible for the initial increase in heat transfer rate from the reactor fuel during a minor (3%) steamline break?  (Assume <u>no</u> initial change in reactor power.)

A.  U

B.  A

C.  T1

D.  T2

ANSWER:  D.

TOPIC:            193007
KNOWLEDGE:  K1.06   [3.1/3.3]
QID:              P384    (B386)

The power range nuclear instruments have been adjusted to 100% based on a calculated secondary heat balance.  Which one of the following will result in indicated reactor power being <u>greater</u> than actual reactor power?

A.  The feedwater temperature used in the heat balance calculation was 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 lower than actual feedwater flow rate.

D.  The steam pressure used in the heat balance calculation was higher than actual steam pressure.

ANSWER:  B.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P685

A nuclear reactor is operating at 80% power with a core $\Delta T$ of 48°F when a station blackout occurs. Natural circulation is established and core $\Delta T$ stabilizes at 40°F.  If mass flow rate is 3%, which one of the following is the current decay heat level?

A.  1%

B.  2%

C.  3%

D.  4%

ANSWER:  B.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P1285

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

    RCS average coolant temperature:   575°F
    RCS hot leg temperatures:          600°F
    RCS cold leg temperatures:         550°F
    S/G pressures:                     885 psig

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

A.  584°F.

B.  582°F.

C.  580°F.

D.  578°F.

ANSWER:  D.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:              P1384

A secondary heat balance calculation is being performed at 90% reactor power to calibrate reactor power instrumentation.  Which one of the following will result in a calculated reactor power that is <u>less</u> than actual reactor power?

A.  Steam generator pressure is indicating 20 psi above actual steam generator pressure.

B.  Steam generator water level is indicating 3% below actual steam generator water level.

C.  Feedwater flow rate is indicating 3% above actual feedwater flow rate.

D.  Feedwater temperature is indicating 20°F below actual feedwater temperature.

ANSWER:  A.


TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:              P1685

A nuclear power plant with two steam generators (S/Gs) is operating at 90% power with the following S/G and reactor coolant system (RCS) parameters:

    RCS average coolant temperature  = 575°F
    RCS hot leg temperatures            = 600°F
    RCS cold leg temperatures           = 550°F
    S/G pressures                            = 885 psig

The reactor is shut down and a maintenance outage is performed in which multiple tubes are plugged in each S/G.  The reactor is restarted with 98% of the RCS flow that existed prior to the outage.

If RCS hot leg temperatures are maintained at 600°F at 90% power, the RCS cold leg temperatures will be...

A.  546°F.

B.  547°F.

C.  548°F.

D.  549°F.

ANSWER:  D.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P2185  (B2183)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance.  Which one of the following will result in indicated reactor power being <u>lower</u> than actual reactor power?

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

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

C.  The feed water flow rate used in the heat balance calculation was 10% higher than actual flow rate.

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

ANSWER:  A.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P2485  (B2684)

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

D.  The ambient heat loss term was omitted from the heat balance calculation.

ANSWER:  B.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P2685   (B2284)

The power range nuclear instruments have been adjusted to 100% based on a heat balance calculation.  Which one of the following will result in indicated reactor power being <u>lower</u> 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 were 10% higher than actual flow rates.

D.  The operator miscalculated the enthalpy of the steam exiting the steam generators to be 10 Btu/lbm higher than actual.

ANSWER:  A.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P2885   (B2484)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance.  Which one of the following will result in indicated reactor power being <u>lower</u> than actual reactor power?

A.  The feed water temperature used in the heat balance calculation was 20°F lower than actual feed water temperature.

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

C.  The ambient heat loss value used in the heat balance calculation was only half the actual ambient heat loss.

D.  The feed water flow rates used in the heat balance calculation were 10% higher than actual flow rates.

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:   K1.06   [3.1/3.3]
QID:            P3944   (B1684)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance.  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 10°F lower than actual feed water 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% lower than actual feedwater flow rate.

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

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:            P84

In a two-loop PWR nuclear power plant, indicated feedwater flow to each steam generator (S/G) is $3.3 \times 10^6$ lbm/hr at an enthalpy of 419 Btu/lbm.  The steam exiting each S/G is at 800 psia with 100% steam quality.

What is the core thermal power? (Ignoring blowdown and pump heat)

A.    677 MWt

B.    755 MWt

C.  1,334 MWt

D.  1,510 MWt

ANSWER:  D.

TOPIC:        193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:          P285

Reactor coolant enters a nuclear reactor core at 545°F and leaves at 595°F.  If the reactor coolant flow rate is 6.6 x 10$^7$ lbm/hour and the specific heat capacity of the coolant is 1.3 Btu/lbm-°F, what is the core thermal power?  (1 watt = 3.4127 Btu/hour)

A.  100.6 MWt

B.  125.7 MWt

C.  1005.7 MWt

D.  1257.1 MWt

ANSWER:  D.

TOPIC:          193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:            P485

A nuclear reactor is operating with the following parameters:

    Reactor power                      = 100%
    Core $\Delta T$                    = 42°F
    Reactor coolant system flow rate   = 100%
    Average coolant temperature        = 587°F

A station blackout occurs and natural circulation is established with the following stable parameters:

    Decay heat                         = 2%
    Core $\Delta T$                    = 28°F
    Average coolant temperature        = 572°F

What is the core mass flow rate in percent?

A.  2.0%

B.  2.5%

C.  3.0%

D.  4.0%

ANSWER:  C.

TOPIC:          193007
KNOWLEDGE:  K1.08   [3.1/3.4]
QID:            P1485

During a nuclear power plant outage, 5% of all steam generator (S/G) tubes were plugged due to wall thinning.  Full-power reactor coolant system flow rate and average coolant temperature ($T_{ave}$) have not changed.  Given the following 100% power conditions before the outage:

$T_{ave}$ = 578°F
$T_{S/G}$ = 538°F

Which one of the following will be the approximate S/G pressure when the plant is returned to 100% power after the outage?

A.  960 psia

B.  930 psia

C.  900 psia

D.  870 psia

ANSWER:  B.

TOPIC:           193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:             P1782

A nuclear power plant is operating with the following parameters:

Reactor power:                          100%
Core ΔT:                                60°F
Reactor coolant system flow rate:   100%
Average coolant temperature:        587°F

A station blackout occurs and natural circulation is established with the following stable parameters:

Decay heat:                             1%
Core ΔT:                                30°F
Average coolant temperature:        572°F

What is the core mass flow rate in percent?

A.  2.0%

B.  2.5%

C.  3.0%

D.  4.0%

ANSWER:  A.

TOPIC:         193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:          P2085

During a nuclear power plant outage, 6% of all steam generator (S/G) tubes were plugged.  Full-power reactor coolant system flow rate and average coolant temperature ($T_{ave}$) have not changed.  Given the following 100% power conditions <u>before</u> the outage:

$T_{ave} = 584°F$
$T_{S/G} = 544°F$

Which one of the following will be the approximate S/G pressure when the plant is returned to 100% power after the outage?

A.  974 psia

B.  954 psia

C.  934 psia

D.  914 psia

ANSWER:  A.

TOPIC:              193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:                P2585

During a nuclear power plant outage, 5% of all steam generator (S/G) tubes were plugged.  Full-power reactor coolant system flow rate and average coolant temperature ($T_{ave}$) have not changed. Given the following 100% power conditions <u>before</u> the outage:

$T_{ave}$ = 588.0°F
$T_{S/G}$ = 542.0°F

Which one of the following will be the approximate S/G pressure when the plant is returned to 100% power after the outage?

A.  998 psia

B.  979 psia

C.  961 psia

D.  944 psia

ANSWER:  C.

TOPIC:              193007
KNOWLEDGE:   K1.08   [3.1/3.4]
QID:                P2985   (B2984)

A nuclear power plant is operating at power.  Total feed water flow rate to all steam generators is 7.0 x $10^6$ lbm/hr at a temperature of 440°F.  The steam exiting the steam generators is at 1000 psia with 100% steam quality.

Ignoring all other heat gain and loss mechanisms, what is the reactor core thermal power?

A.   1335 MWt

B.   1359 MWt

C.   1589 MWt

D.   1612 MWt

ANSWER:  C.

TOPIC: 193007
KNOWLEDGE: K1.08 [3.1/3.4]
QID: P5044

Two of the parameters listed below are used for calculating core thermal power using the standard heat balance method.  Which one of the following identifies the two parameters?

|  | Reactor Coolant Mass Flow Rate | Feedwater Temperature | Steam Generator Pressure | Steam Generator Water Level |
|---|---|---|---|---|
| A. | Yes | No | Yes | No |
| B. | No | Yes | Yes | No |
| C. | Yes | No | No | Yes |
| D. | No | Yes | No | Yes |

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.01   [2.8/3.0]
QID:            P986

Which one of the following is an example of radiative heat transfer?

A.  Heat transfer from the fuel cladding to the reactor coolant during stable film boiling

B.  Heat transfer from the center to the edge of a fuel pellet at end of core life

C.  Heat transfer from the reactor coolant to the feedwater in a steam generator

D.  Heat transfer from the fuel cladding to the reactor coolant via subcooled nucleate boiling

ANSWER:  A.

TOPIC: 193008
KNOWLEDGE: K1.01 [2.8/3.0]
QID: P1186 (B1986)

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

Identify the region of the curve where the most efficient form of heat transfer exists.

A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



POOL BOILING CURVE

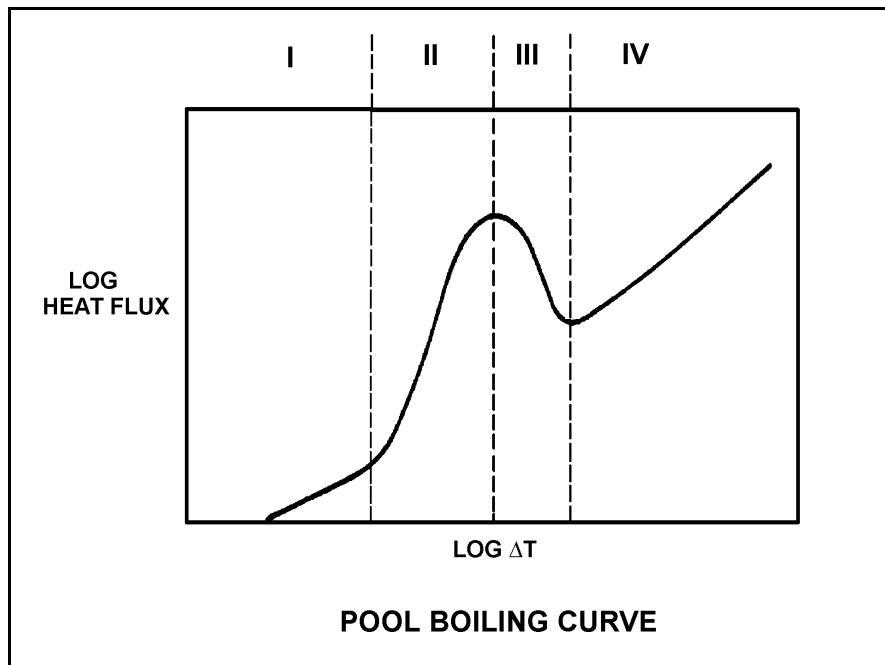TOPIC: 193008
KNOWLEDGE: K1.01 [2.8/3.0]
QID: P1286 (B2088)

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 the nuclear reactor operate to transfer heat from the cladding to the coolant at 100% power?

A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



POOL BOILING CURVE
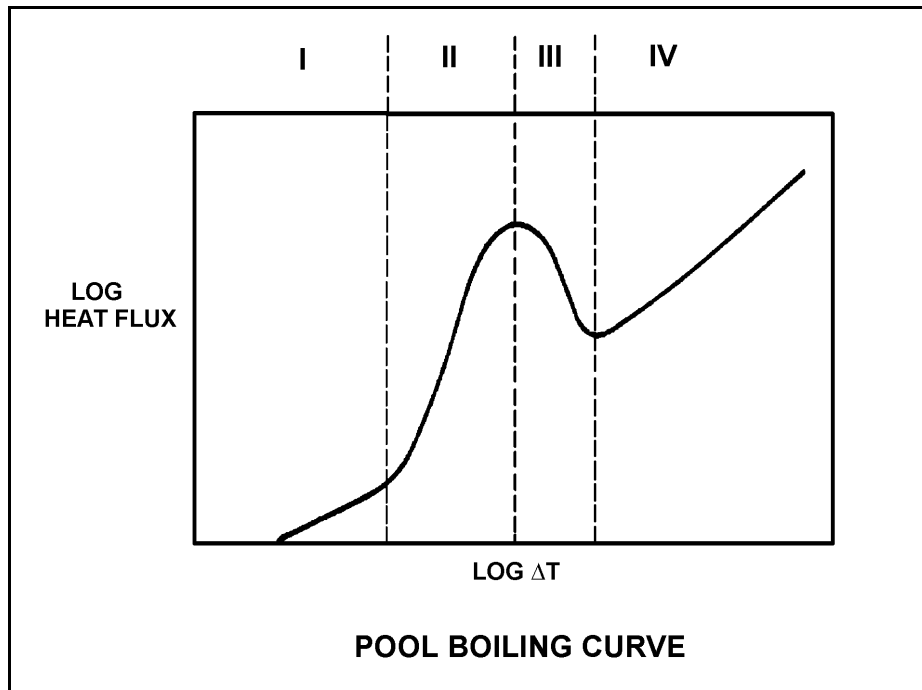
TOPIC:          193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:             P85

Why does nucleate boiling improve heat transfer in a nuclear reactor core?

A.  The formation of steam bubbles at nucleation sites on the fuel clad allows more heat to be transferred by conduction.

B.  The formation of steam bubbles at nucleation sites on the fuel clad promotes local radiative heat transfer and allows more heat to be transferred by convection.

C.  Heat is removed from the fuel rod as both sensible heat and latent heat of condensation, and the heat is transferred directly to the coolant by radiative heat transfer.

D.  Heat is removed from the fuel rod as both sensible heat and latent heat of vaporization, and the motion of the steam bubbles causes rapid mixing of the coolant.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:             P886

Convection heat transfer improves when nucleate boiling begins on the surface of a fuel rod because:

A.  steam bubble formation decreases coolant flow along the fuel rod.

B.  steam bubble formation increases coolant flow along the fuel rod.

C.  a steam blanket begins to form along the surface of the fuel rod.

D.  the motion of the steam bubbles causes rapid mixing of the coolant.

ANSWER:  D.

TOPIC:         193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:           P1086   (B2784)

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel rod if subcooled reactor coolant enters the coolant channel and exits as superheated steam?

A.  Increases continuously

B.  Increases, then decreases

C.  Decreases continuously

D.  Decreases, then increases

ANSWER:  B.

TOPIC:         193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:           P1187

Nucleate boiling affects heat transfer from a fuel rod primarily by...

A.  increasing the conductive heat transfer from the fuel rod to the coolant.

B.  increasing the convective heat transfer from the fuel rod to the coolant.

C.  decreasing the conductive heat transfer from the fuel rod to the coolant.

D.  decreasing the convective heat transfer from the fuel rod to the coolant.

ANSWER:  B.

TOPIC:        193008
KNOWLEDGE:  K1.02  [2.8/3.0]
QID:          P2386

Subcooled water enters the bottom of an operating nuclear reactor core. As the water flows upward past the fuel assemblies, boiling begins at the surface of a few fuel rods.

If the coolant at the surface of those fuel rods had remained subcooled, average fuel temperature in the affected fuel rods would have been _____ because single-phase convection is a _____ efficient method of heat transfer than boiling at the surface of the fuel rods.

A.  higher; more

B.  higher; less

C.  lower; more

D.  lower; less

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:              P2686  (B2486)

Case 1:  Pure subcooled reactor coolant is flowing through a fuel assembly in a reactor core operating at steady-state full power.  As the coolant flows upward through the fuel assembly, the water heats up and exits the fuel assembly still subcooled.

Case 2: Same as above except that reactor coolant system pressure is decreased such that the coolant begins to boil halfway up the fuel assembly, which results in a saturated steam-water mixture exiting the fuel assembly.

Assume departure from nucleate boiling is avoided in both cases and that both cores continue to operate at full power.  As compared to Case 1, the average fuel temperature for Case 2 will be _____ because boiling is a _____ efficient method of heat transfer.

A.  higher; more

B.  higher; less

C.  lower; more

D.  lower; less

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:              P2986  (B2986)

Subcooled reactor coolant flows into the bottom of a fuel assembly coolant channel and exits the top of the channel as a saturated steam-water mixture with a 98% moisture content.  How does the overall heat transfer coefficient in the coolant channel change as the coolant travels upward along the channel?

A.  Increases only

B.  Increases, then decreases

C.  Decreases only

D.  Decreases, then increases

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.02   [2.8/3.0]
QID:            P3786   (B3785)

Subcooled water is flowing into a fuel assembly in an operating nuclear reactor core.  As the water flows upward through the fuel assembly, some of the water in contact with the fuel rods begins to boil.

If fuel assembly power is unchanged and system pressure is increased such that all of the water remains subcooled, the average fuel temperature in the fuel assembly would be _____ because boiling is a _____ efficient method of heat transfer.

A.  higher; more

B.  higher; less

C.  lower; more

D.  lower; less

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:            P86

Subcooled nucleate boiling is occurring along a heated surface.  If the heat flux is increased slightly, what will be the effect on the $\Delta T$ between the surface and the fluid?  (Assume subcooled nucleate boiling is still occurring.)

A.  Small increase in $\Delta T$ because of steam blanketing.

B.  Large increase in $\Delta T$ because of steam blanketing.

C.  Small increase in $\Delta T$ as vapor bubbles form and collapse.

D.  Large increase in $\Delta T$ causing radiative heat transfer to become significant.

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:  K1.03   [2.8/3.1]
QID:              P286    (B389)

As heat is transferred to water adjacent to a heating surface, many factors influence steam bubble formation.  Which one of the following characteristics will <u>enhance</u> steam bubble formation?

A.  Chemicals dissolved in the water

B.  The absence of ionizing radiation exposure to the water

C.  A highly polished heat transfer surface with minimal scratches or cavities

D.  The presence of gases dissolved in the water

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:  K1.03   [2.8/3.1]
QID:              P387    (B388)

What type of boiling is described as follows:  The bulk temperature of the liquid is below saturation, but the temperature of the heat transfer surface is above saturation.  Vapor bubbles form at the heat transfer surface, but condense in the cold liquid so that no net generation of vapor is obtained.

A.  Bulk boiling

B.  Subcooled nucleate boiling

C.  Total film boiling

D.  Partial film boiling

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:             P1686   (B1087)

Which one of the following is a characteristic of subcooled nucleate boiling but <u>not</u> saturated nucleate boiling?

A.  $T_{Clad}$ equals $T_{Sat}$

B.  $T_{Clad}$ is greater than $T_{Sat}$

C.  $T_{Bulk\ Coolant}$ equals $T_{Sat}$

D.  $T_{Bulk\ Coolant}$ is less than $T_{Sat}$

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:             P1888   (B1786)

Which one of the following is a characteristic of saturated nucleate boiling but <u>not</u> subcooled nucleate boiling?

A.  $T_{Bulk\ Coolant}$ equals $T_{Sat}$

B.  $T_{Bulk\ Coolant}$ is less than $T_{Sat}$

C.  $T_{Clad}$ equals $T_{Sat}$

D.  $T_{Clad}$ is greater than $T_{Sat}$

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:                P2287   (B1086)

Which one of the following describes why the core heat transfer rate increases when nucleate boiling begins on the surface of a fuel rod?

A.  Steam has a greater thermal conductivity than water.

B.  The formation of steam bubbles increases coolant flow rate along the fuel rod.

C.  Radiative heat transfer begins to supplement convective heat transfer.

D.  Heat transfer by steam bubble formation is more effective than through a liquid film.

ANSWER:  D.

TOPIC:            193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:                P2687   (B1287)

Which one of the following modes of heat transfer is characterized by steam bubbles moving away from a heated surface and collapsing in the bulk fluid?

A.  Bulk boiling

B.  Subcooled nucleate boiling

C.  Saturated nucleate boiling

D.  Saturated natural convection

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:              P2787   (B1285)

A nuclear reactor is operating at 100% power.  Which one of the following will increase the likelihood of vapor bubble formation in the reactor coolant?

A.  Surface scratches or cavities in the fuel clad

B.  Subsurface void defect in the fuel clad

C.  Increased coolant velocity past the fuel rods

D.  Chemically inert material dissolved in the coolant

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.03   [2.8/3.1]
QID:              P3686   (B3685)

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

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

A.  At a scratch on the surface of a fuel rod near the top of a fuel assembly.

B.  At a scratch on the surface of a fuel rod near the bottom of a fuel assembly.

C.  In the bulk fluid of a coolant channel near the top of a fuel assembly.

D.  In the bulk fluid of a coolant channel near the bottom of a fuel assembly.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.04   [3.1/3.3]
QID:             P93

If departure from nucleate boiling is reached in the core, the surface temperature of the fuel clad will...

A.  increase rapidly.

B.  decrease rapidly.

C.  increase gradually.

D.  decrease gradually.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.04   [3.1/3.3]
QID:             P287    (B2987)

If $\Delta T$ is the temperature difference between the fuel rod clad surface and the bulk coolant, which one of the following describes the heat transfer from a fuel rod experiencing departure from nucleate boiling?

A.  Steam bubbles begin to blanket the fuel rod clad, causing a rapid increase in the $\Delta T$ for a given heat flux.

B.  Steam bubbles completely blanket the fuel rod clad, causing a rapid decrease in the $\Delta T$ for a given heat flux.

C.  Steam bubbles begin to form on the fuel rod clad, causing a rapid decrease in the heat flux from the fuel rod for a given $\Delta T$.

D.  Steam bubbles completely blanket the fuel rod clad, causing a rapid increase in the heat flux from the fuel rod for a given $\Delta T$.

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.04   [3.1/3.3]
QID:              P1288   (B1985)

Departure from nucleate boiling should <u>not</u> be allowed to occur in the core because the...

A.  steam bubbles begin to blanket the clad and decrease radiative heat transfer.

B.  steam bubbles in the coolant may cause flow oscillations.

C.  rapid increase in $\Delta T$ between the clad and the coolant may cause clad damage.

D.  associated addition of reactivity from the void coefficient could be uncontrollable.

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.04   [3.1/3.3]
QID:              P3388   (B1288)

Which one of the following is indicated by a rapid increase in the fuel clad-to-coolant $\Delta T$ and a decrease in heat flux from the fuel?

A.  Bulk boiling is occurring.

B.  Nucleate boiling is occurring.

C.  Critical heat flux is increasing.

D.  Departure from nucleate boiling has been reached.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P138

Which one of the following reactor coolant system parameters has the <u>least</u> effect on margin to departure from nucleate boiling?

A.  Pressurizer level

B.  Local power density

C.  Cold leg temperature

D.  Coolant flow rate

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P144

An adequate subcooling margin during a loss of coolant accident is the most direct indication that _____ is being maintained.

A.  steam generator water level

B.  pressure level

C.  core cooling

D.  subcriticality

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P288

Which one of the following parameter changes will reduce the departure from nucleate boiling ratio?

A.  Decrease in reactor power

B.  Increase in pressurizer pressure

C.  Increase in reactor coolant flow

D.  Increase in reactor coolant temperature

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P489

Which one of the following incidents will cause the departure from nucleate boiling ratio to increase?  (Assume the reactor does not trip.)

A.  A reactor coolant pump trips at 20% reactor power.

B.  A rod drops at 100% reactor power with manual rod control.

C.  One steam dump valve fails open at 50% reactor power.

D.  All pressurizer heaters energize fully at 40% reactor power.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P1093

Which one of the following will increase the departure from nucleate boiling ratio?

A.  Increasing reactor coolant temperature

B.  Increasing pressurizer pressure

C.  Increasing core bypass flow

D.  Increasing reactor power

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:            P1787

A nuclear power plant is operating with the following initial conditions:

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

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

A.  One reactor coolant pump trips with automatic rod control.

B.  A spray valve malfunction decreases reactor coolant system pressure by 20 psig with no rod motion.

C.  The operator decreases reactor coolant boron concentration by 5 ppm with no rod motion.

D.  Core Xe-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:             P1889

A nuclear power plant is operating with the following initial conditions:

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

Which one of the following will decrease the steady-state departure from nucleate boiling ratio?

A.  A reactor trip occurs and one control rod remains fully withdrawn from the core.

B.  A pressurizer malfunction increases reactor coolant system pressure by 20 psig with no rod motion.

C.  The operator decreases reactor coolant boron concentration by 5 ppm with no rod motion.

D.  Core Xe-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:             P2288

A nuclear power plant is operating with the following initial conditions:

•   Reactor power is 55% in the middle of a fuel cycle.
•   Axial and radial power distributions are peaked in the center of the core.

Which one of the following will decrease the steady-state departure from nucleate boiling ratio?

A.  A reactor trip occurs and one control rod remains fully withdrawn from the core.

B.  A pressurizer malfunction increases reactor coolant system pressure by 20 psig.

C.  The operator increases reactor coolant boron concentration by 5 ppm with no rod motion.

D.  Core Xe-135 depletes in proportion to the axial and radial power distribution with no rod motion.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:  K1.05   [3.4/3.6]
QID:             P2387

A nuclear power plant is operating with the following initial conditions:

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

Which one of the following will decrease the steady-state departure from nucleate boiling ratio?

A.  A reactor trip occurs and one control rod remains fully withdrawn from the core.

B.  A pressurizer malfunction decreases reactor coolant system pressure by 20 psig with no rod motion.

C.  The operator increases reactor coolant boron concentration by 5 ppm with no control rod motion.

D.  Core Xe-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:  K1.05   [3.4/3.6]
QID:             P2487   (B2487)

A nuclear reactor is shutdown at normal operating temperature and pressure with all control rods inserted.  Which one of the following will decrease the departure from nucleate boiling ratio for this reactor?  (Assume the reactor remains shutdown.)

A.  Fully withdrawing a bank of shutdown rods

B.  Diluting RCS boron concentration by 50 ppm

C.  Reducing RCS flowrate by 1%

D.  Increasing RCS pressure by 10 psig

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:             P2587

A nuclear power plant is operating with the following initial conditions:

- Reactor power is 55% in the middle of a fuel cycle.
- Axial and radial power distributions are peaked in the center of the core.

Which one of the following will increase the steady-state departure from nucleate boiling ratio?

A.  A reactor trip occurs and one control rod remains fully withdrawn from the core.

B.  A pressurizer malfunction decreases reactor coolant system pressure by 20 psig.

C.  The operator decreases reactor coolant boron concentration by 5 ppm with no rod motion.

D.  Core Xe-135 depletes in proportion to the axial and radial power distribution with no rod motion.

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:             P2788

A nuclear power plant is operating with the following initial conditions:

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

Which one of the following will increase the steady-state departure from nucleate boiling ratio?

A.  Core Xe-135 decays with <u>no</u> change in the axial and radial power distributions.

B.  A reactor trip occurs and one control rod remains fully withdrawn from the core.

C.  The operator decreases reactor coolant boron concentration by 5 ppm with <u>no</u> control rod motion.

D.  A pressurizer malfunction decreases reactor coolant system pressure by 20 psig with <u>no</u> control rod motion.

ANSWER:  B.

TOPIC:              193008
KNOWLEDGE:   K1.05   [3.4/3.6]
QID:                  P2989

A nuclear reactor is shut down at normal operating temperature and pressure with all control rods inserted.  Which one of the following will decrease the departure from nucleate boiling ratio for this reactor?  (Assume the reactor remains shutdown.)

A.  Fully withdrawing a bank of shutdown rods.

B.  Diluting RCS boron concentration by 50 ppm.

C.  Reducing RCS temperature by 5°F.

D.  Decreasing RCS pressure by 10 psig.

ANSWER:  D.

TOPIC:              193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:                  P87

Which one of the following parameter changes would move a nuclear reactor farther away from the critical heat flux?

A.  Decrease pressurizer pressure

B.  Decrease reactor coolant flow

C.  Decrease reactor power

D.  Increase reactor coolant temperature

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P145    (B1888)

How does critical heat flux vary from the bottom to the top of the nuclear reactor core during normal full power operation?

A.  Increases continuously

B.  Increases, then decreases

C.  Decreases continuously

D.  Decreases, then increases

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P587

The heat transfer rate that causes departure from nucleate boiling is the...

A.  critical heat flux.

B.  nucleate heat flux.

C.  transition heat flux.

D.  departure heat flux.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P989

Critical heat flux is the heat transfer rate per unit _____ of fuel rod that will initially cause _____.

A.  volume; nucleate boiling

B.  area; nucleate boiling

C.  volume; departure from nucleate boiling

D.  area; departure from nucleate boiling

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:            P1087

How does critical heat flux (CHF) vary with core height during normal full power operation?

A.  CHF increases from the bottom to the top of the core.

B.  CHF decreases from the bottom to the core midplane, then increases from the midplane to the top of the core.

C.  CHF decreases from the bottom to the top of the core.

D.  CHF increases from the bottom to the core midplane, then decreases from the midplane to the top of the core.

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:              P1586

A nuclear reactor is operating at steady-state 75% power.  Which one of the following parameter changes will cause the core to operate closer to critical heat flux?  (Assume reactor power does not change unless stated.)

A.  Decrease reactor coolant flow by 5%.

B.  Decrease reactor power by 10%.

C.  Decrease reactor coolant temperature by 3°F.

D.  Increase pressurizer pressure by 20 psia.

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.06   [2.8/2.9]
QID:              P3587   (B1997)

Which one of the following is most likely to result in fuel clad damage?

A.  Operating at 110% of reactor vessel design pressure.

B.  An inadvertent reactor trip from 100% power.

C.  Operating at a power level that exceeds the critical heat flux.

D.  Operating with subcooled nucleate boiling occurring in a fuel assembly.

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:            P689

A small increase in ΔT (at the fuel clad-to-coolant interface) causes increased steam blanketing and a reduction in heat flux.  This describes which type of boiling?

A.  Subcooled boiling

B.  Nucleate boiling

C.  Partial film boiling

D.  Total film boiling

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:            P789    (B788)

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

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:            P1089

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

Choose the region of the curve where transition boiling is the primary heat transfer process.

A.  Region I

B.  Region II

C.  Region III

D.  Region IV

ANSWER:  C.



POOL BOILING CURVE

TOPIC:            193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:              P1689   (B1386)

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

Which one of the points shown represents the onset of transition boiling?

A.  A

B.  B

C.  C

D.  D

ANSWER:  B.



**POOL BOILING CURVE**

TOPIC:          193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:            P1891   (B987)

Which one of the following describes the conditions in a fuel coolant channel 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

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:            P1987   (B2288)

Which one of the following describes the conditions in a fuel channel 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.  Steam bubbles form and collapse on the fuel rod surface

D.  Steam bubbles form on the fuel rod surface and are swept away by subcooled bulk coolant

ANSWER:  B.
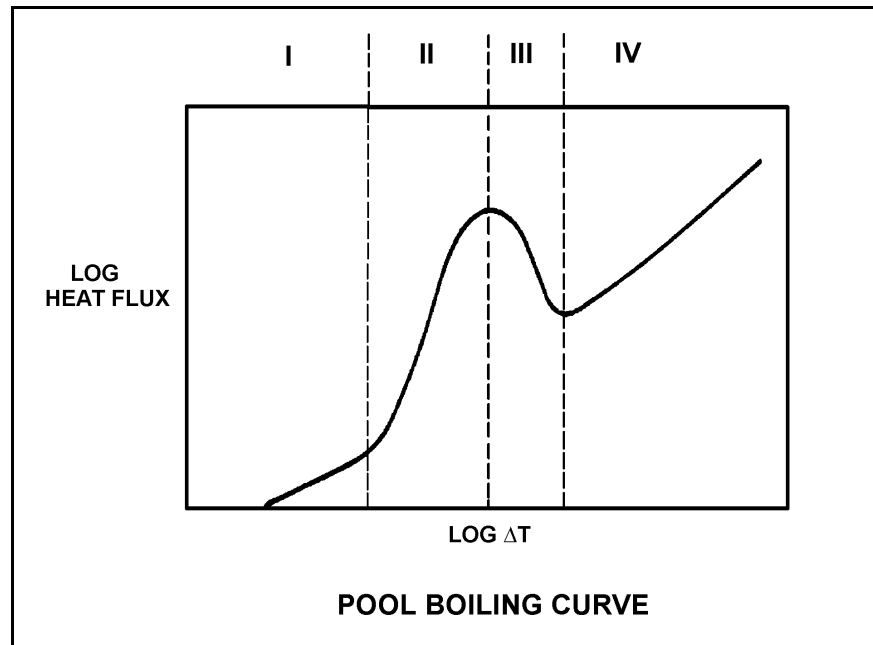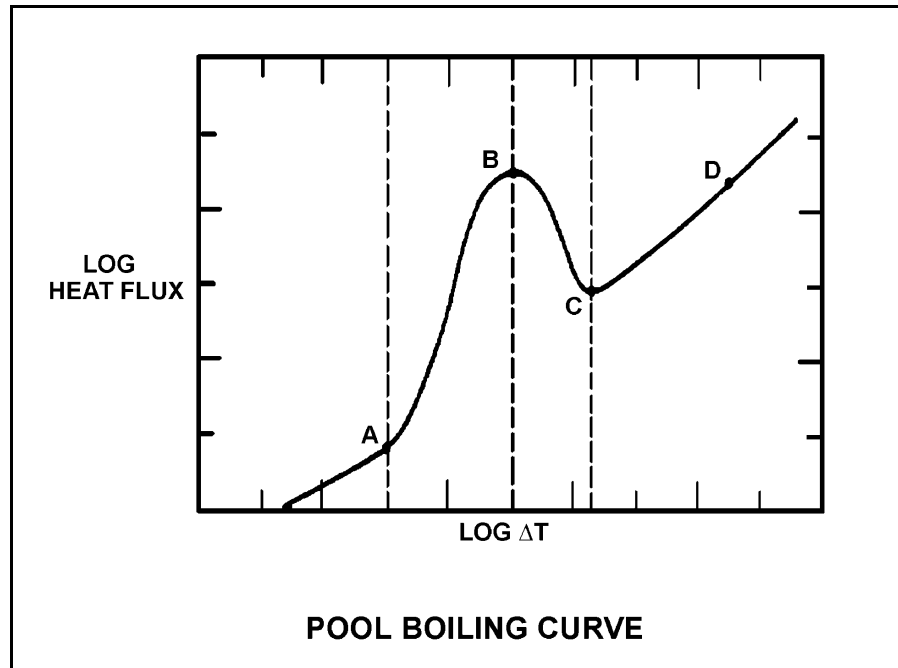
TOPIC:          193008
KNOWLEDGE:  K1.07   [2.6/2.6]
QID:               P2188  (B2185)

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

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

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

ANSWER:  B.



POOL BOILING CURVE

TOPIC:            193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:               P2289   (B289) (B2688)

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

The point at which heat flux stops increasing and the critical heat flux has been reached (point B), marks the beginning of...

A.  nucleate boiling.

B.  stable film boiling.

C.  partial film boiling.

D.  single-phase convection.

ANSWER:  C.



**POOL BOILING CURVE**
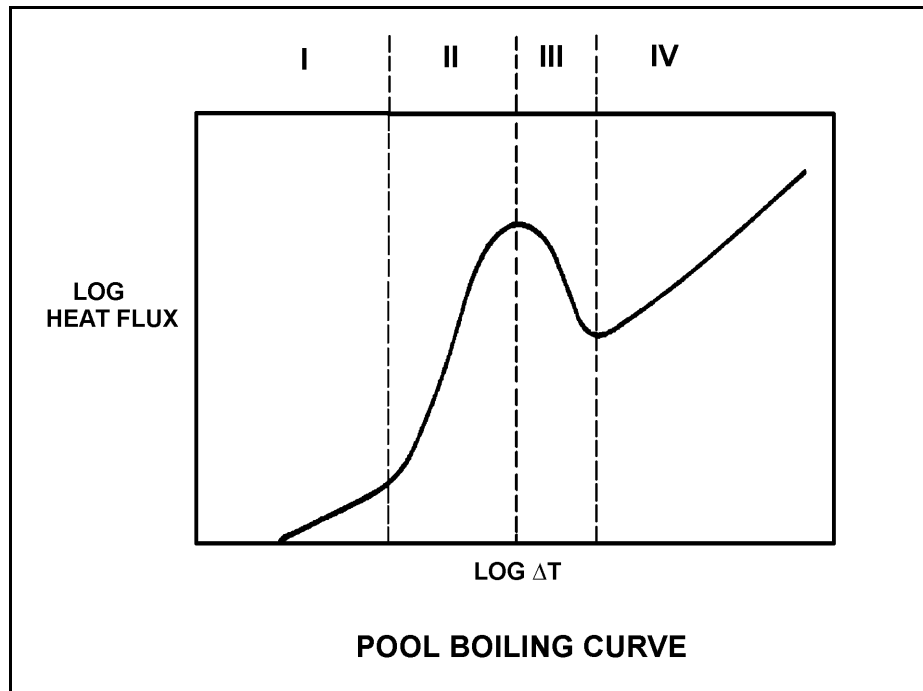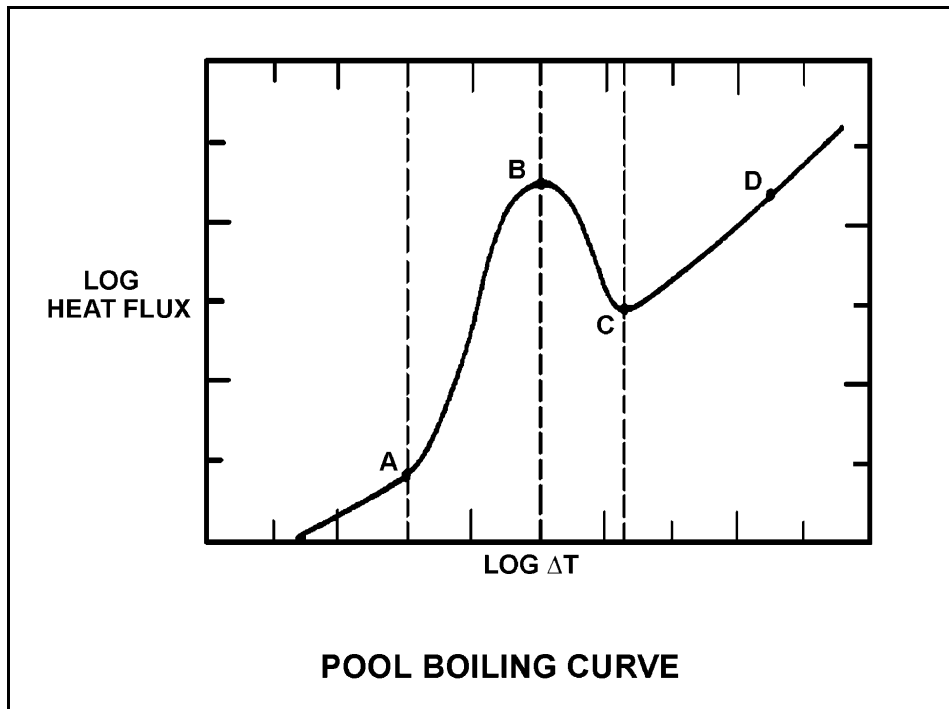
TOPIC:           193008
KNOWLEDGE:   K1.07   [2.6/2.6]
QID:                P2688   (B1486)

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

Which one of the following regions represents the most unstable heat transfer?

A.  I

B.  II

C.  III

D.  IV

ANSWER:  C.



POOL BOILING CURVE
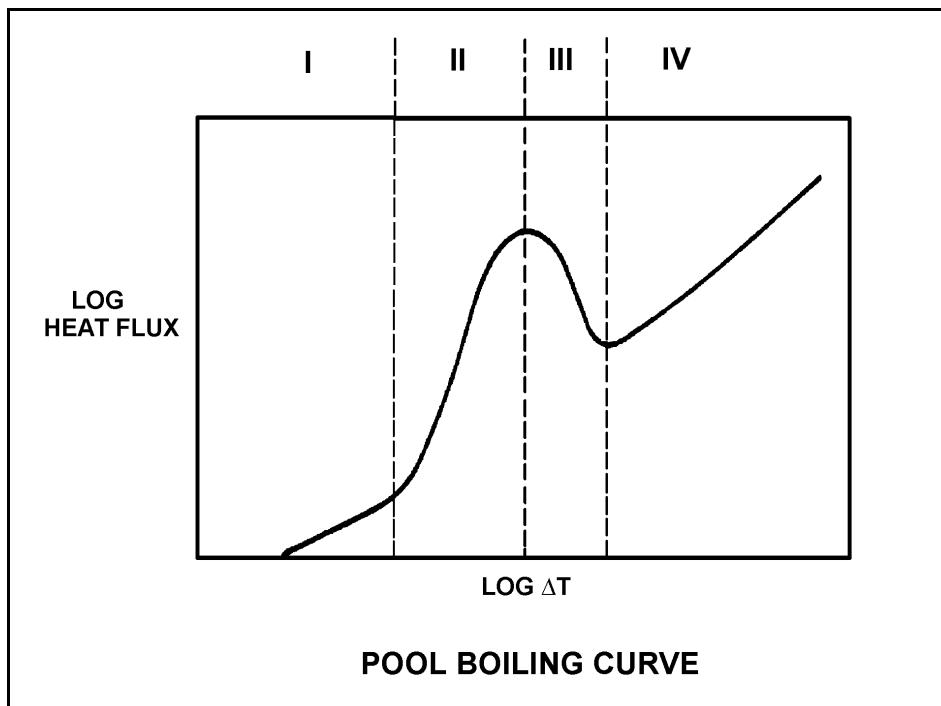
TOPIC:          193008
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:            P88

Film boiling is...

A.  the most efficient method of boiling heat transfer.

B.  heat transfer through an oxide film on the cladding.

C.  heat transfer being accomplished with no enthalpy change.

D.  heat transfer through a vapor blanket that covers the fuel cladding.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:            P139

Reactor power is increased sufficiently to cause steam blanketing of several fuel rods.  This condition is being caused by...

A.  departure from nucleate boiling.

B.  subcooled nucleate boiling.

C.  saturated nucleate boiling.

D.  onset of nucleate boiling.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:              P889    (B1987)

If the fission rate in a nuclear reactor core steadily increases, the mode of heat transfer that occurs immediately after the critical heat flux is reached is called...

A.  transition boiling.

B.  subcooled nucleate boiling.

C.  saturated nucleate boiling.

D.  stable film boiling.

ANSWER:  A.

TOPIC: 193008
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P1587 (B1587)

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

Which one of the points shown marks the lowest ΔT at which stable film boiling can exist?

A. A

B. B

C. C

D. D

ANSWER: C.



POOL BOILING CURVE
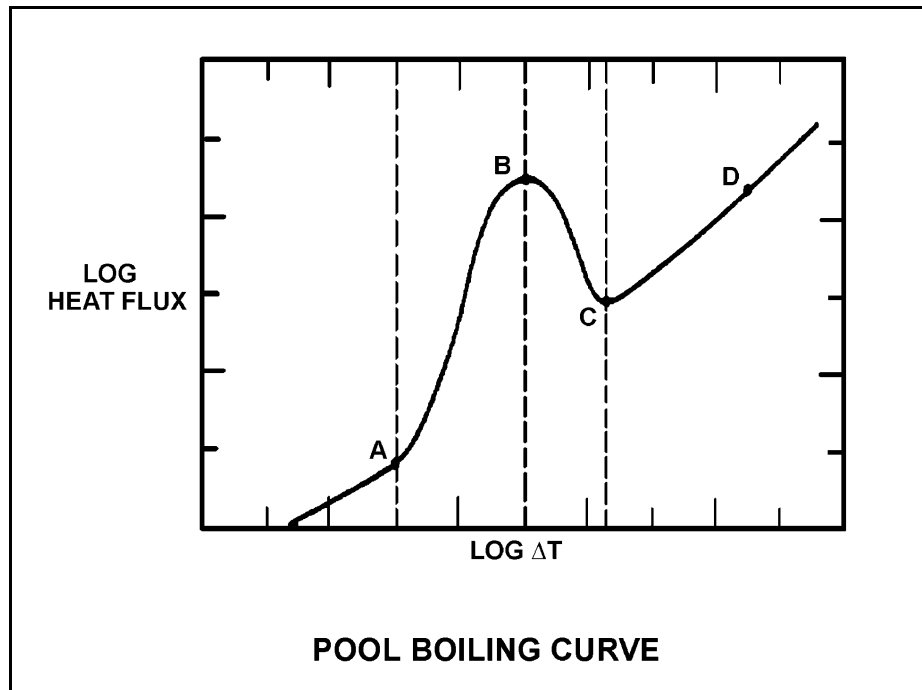
TOPIC: 193008
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P2189 (B687)

Which one of the following describes the relative contributions of the convective and radiative modes of heat transfer, and the relationship of $\Delta T$ ($T_{wall}$ - $T_{bulk\ coolant}$) to heat flux, during stable film boiling heat transfer in the core?

A. Only radiative heat transfer is significant, and heat flux increases in direct proportion to $\Delta T$ squared.

B. Both heat transfer modes are significant, and heat flux increases in direct proportion to $\Delta T$ squared.

C. Only radiative heat transfer is significant, and a significant increase in heat flux requires a large $\Delta T$ increase.

D. Both heat transfer modes are significant, and a significant increase in heat flux requires a large $\Delta T$ increase.

ANSWER: C.

TOPIC:             193008
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:               P2588   (B2588)

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

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

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

ANSWER:  A.



POOL BOILING CURVE
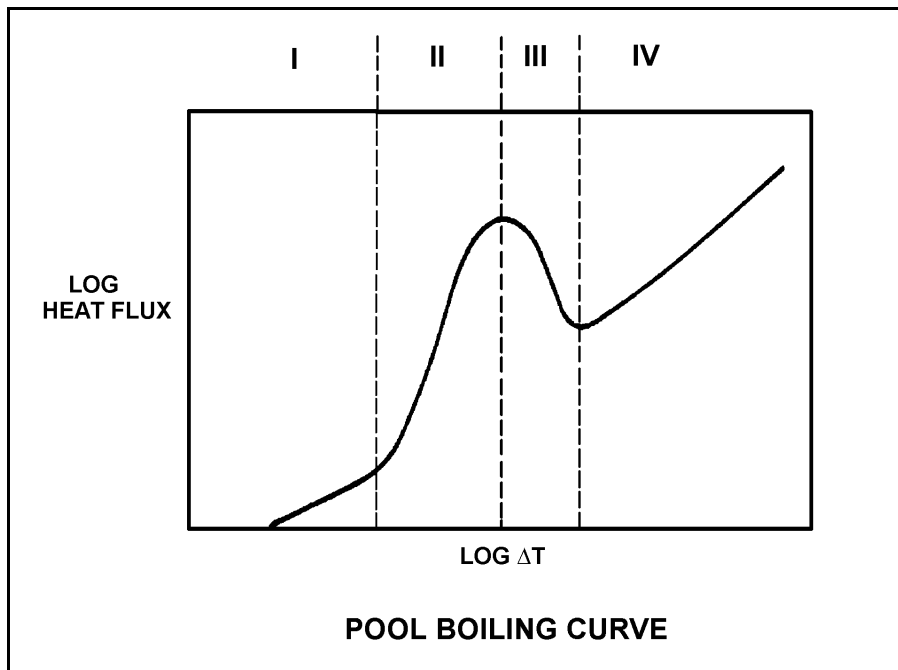
TOPIC:            193008
KNOWLEDGE:   K1.08   [2.6/2.6]
QID:              P3488   (B3485)

During a loss of coolant accident, the reactor fuel may experience stable film boiling.  Which one of the following types of heat transfer from the fuel cladding will increase significantly when stable film boiling begins?

A.  Forced convection

B.  Natural convection

C.  Conduction

D.  Radiation

ANSWER:  D.

TOPIC:            193008
KNOWLEDGE:   K1.10   [2.9/3.1]
QID:              P89

The departure from nucleate boiling (DNB) ratio is defined as the...

A.  actual heat flux divided by the critical heat flux at any point along a fuel rod.

B.  critical heat flux divided by the actual heat flux at any point along a fuel rod.

C.  core thermal power divided by the total reactor coolant mass flow rate.

D.  number of coolant channels that have reached DNB divided by the number of coolant channels that are subcooled.

ANSWER:  B.

TOPIC:             193008
KNOWLEDGE:  K1.10   [2.9/3.1]
QID:               P289

In the definition of the departure from nucleate boiling ratio, the term "actual heat flux" refers to the...

A.  heat transfer rate per unit area at any point along the fuel rod.

B.  average heat transfer rate per unit area across the core.

C.  integrated heat transfer rate along the entire fuel rod.

D.  total heat transfer rate along the entire fuel rod.

ANSWER:  A.

TOPIC:             193008
KNOWLEDGE:  K1.10   [2.9/3.1]
QID:               P990

A nuclear reactor is operating at 100% steady-state power at the end of core life with all control rods fully withdrawn.  At what axial location in a typical fuel assembly will the <u>minimum</u> departure from nucleate boiling ratio occur?

A.  At the bottom of the fuel assembly

B.  At the top of the fuel assembly

C.  Between the bottom and the midplane of the fuel assembly

D.  Between the midplane and the top of the fuel assembly

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.10   [2.9/3.1]
QID:            P1190

A nuclear reactor is operating at 100% steady-state power near the end of a fuel cycle with all control rods fully withdrawn.  At what axial location in a typical fuel assembly will the <u>maximum</u> departure from nucleate boiling ratio occur?

A.  At the top of the fuel assembly

B.  At the bottom of the fuel assembly

C.  Between the bottom and midplane of the fuel assembly

D.  Between the midplane and the top of the fuel assembly

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.10   [2.9/3.1]
QID:            P2590

If a nuclear reactor is operating with DNBR at its limit, which one of the following is indicated?

A.  None of the fuel rods are experiencing critical heat flux.

B.  A small fraction of the fuel rods may be experiencing critical heat flux.

C.  All radioactive fission products are being contained within the reactor fuel.

D.  All radioactive fission products are being contained within either the reactor fuel or the reactor vessel.

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.14   [2.6/2.7]
QID:             P389    (B588)

Core heat transfer is <u>maximized</u> by the presence of...

A.  laminar flow with <u>no</u> nucleate boiling.

B.  turbulent flow with <u>no</u> nucleate boiling.

C.  laminar flow with nucleate boiling.

D.  turbulent flow with nucleate boiling.

ANSWER:  D.

TOPIC:            193008
KNOWLEDGE:   K1.14   [2.6/2.7]
QID:             P690

The heat transfer coefficient of the core will be directly increased if:  (Assume bulk coolant subcooling.)

A.  the coolant temperature is decreased.

B.  the coolant flow rate is decreased.

C.  nucleate boiling occurs in the coolant.

D.  the coolant flow is laminar instead of turbulent.

ANSWER:  C.

TOPIC:        193008
KNOWLEDGE:  K1.14  [2.6/2.7]
QID:        P891

Increasing coolant flow rate through a nuclear reactor core improves heat transfer from the fuel because it _____ the laminar film thickness and _____ the temperature of the coolant adjacent to the fuel.

A.  increases; raises

B.  increases; lowers

C.  decreases; raises

D.  decreases; lowers

ANSWER:  D.

TOPIC:        193008
KNOWLEDGE:  K1.14  [2.6/2.7]
QID:        P1691

Which one of the following will minimize core heat transfer?

A.  Laminar flow with no nucleate boiling

B.  Turbulent flow with no nucleate boiling

C.  Laminar flow with nucleate boiling

D.  Turbulent flow with nucleate boiling

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:            P90

A nuclear power plant is operating at 100% power.  The reactor coolant subcooling margin will be <u>directly</u> reduced by:

A.  increasing reactor coolant temperature.

B.  increasing pressurizer pressure.

C.  increasing reactor coolant flow.

D.  increasing pressurizer level.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:            P290

The difference between the actual temperature and the saturation temperature of a liquid is the...

A.  critical heat flux.

B.  subcooling margin.

C.  departure from nucleate boiling.

D.  saturation margin.

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:               P393

Which one of the following must be present to assure adequate core cooling following a small loss-of-coolant accident?

A.  Emergency cooling injection flow rate on scale.

B.  Pressurizer level in the indicating range.

C.  Subcooling margin greater than zero.

D.  Pressurizer pressure greater than safety injection actuation setpoint.

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:               P992

Which one of the following will increase the reactor coolant system (RCS) subcooling margin with the reactor operating at full power?

A.  Decreased RCS pressure

B.  Decreased RCS hot leg temperature

C.  Increased RCS cold leg temperature

D.  Increased concentration of soluble gases in the RCS

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:              P1491

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

A.  reactor vessel head.

B.  RCS loop hot leg.

C.  RCS loop cold leg.

D.  reactor core.

ANSWER:  A.

TOPIC:            193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:              P2090

A reactor coolant system (RCS) cooldown and depressurization is in progress on natural circulation following a loss of offsite power.  The following conditions exist:

    RCS Tcold:                520°F, decreasing
    RCS Thot:                 538°F, decreasing
    Pressurizer pressure:   2000 psia, decreasing

If the cooldown rate is being maintained at 50°F/hour, which one of the following locations is most likely to experience steam formation?

A.  Reactor vessel head

B.  RCS loop hot leg

C.  Steam generator U-tubes

D.  Reactor core

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:             P2591

Which one of the following is most likely to result in steam bubble formation in a reactor vessel head while maintaining a 60°F subcooling margin in the hottest RCS hot leg?

A.  Performing a 25°F/Hr RCS cooldown on natural circulation.

B.  Performing a 50°F/Hr RCS cooldown on natural circulation.

C.  Performing a 25°F/Hr RCS heatup on forced circulation.

D.  Performing a 50°F/Hr RCS heatup on forced circulation.

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:             P2790

Which one of the following is most likely to result in steam bubble formation in a reactor vessel head while maintaining a 40°F subcooling margin in the hottest RCS hot leg?

A.  Performing a 25°F/Hr RCS cooldown on natural circulation.

B.  Performing a 25°F/Hr RCS cooldown on forced circulation.

C.  Performing a 50°F/Hr RCS cooldown on natural circulation.

D.  Performing a 50°F/Hr RCS cooldown on forced circulation.

ANSWER:  C.

TOPIC:           193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:             P2890

A nuclear power plant maintains the reactor coolant system (RCS) cold leg temperature ($T_{cold}$) at 557°F from 0% to 100% power.  At 100% power, the reactor differential temperature ($T_{hot}$ - $T_{cold}$) is 60°F.

If this plant also maintains RCS pressure constant at 2235 psig, which one of the following is the approximate RCS subcooling margin at 50% power?

A.  30°F

B.  36°F

C.  66°F

D.  96°F

ANSWER:  C.

TOPIC:           193008
KNOWLEDGE:   K1.15   [3.6/3.8]
QID:             P2991

Assume that a 30°F subcooling margin is maintained in the reactor coolant system (RCS) hot legs during each of the following shutdown reactor cooldown operations.  Which one of the following will maintain the greatest subcooling margin in the reactor vessel head?

A.  Performing a 25°F/Hr RCS cooldown on natural circulation using one steam generator.

B.  Performing a 25°F/Hr RCS cooldown with all reactor coolant pumps running.

C.  Performing a 100°F/Hr RCS cooldown on natural circulation using all steam generators.

D.  Performing a 100°F/Hr RCS cooldown with one reactor coolant pump running.

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.16   [2.4/2.6]
QID:              P391    (B1989)

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

At 100% reactor power, the greatest temperature difference in a fuel channel radial temperature profile will occur across the:  (Assume the temperature profile begins at the fuel centerline.)

A.  fuel pellet centerline to pellet surface.

B.  fuel pellet surface-to-clad gap.

C.  zircaloy cladding.

D.  flow channel boundary (laminar) layer.

ANSWER:  A.



FUEL ROD AND COOLANT FLOW CHANNEL
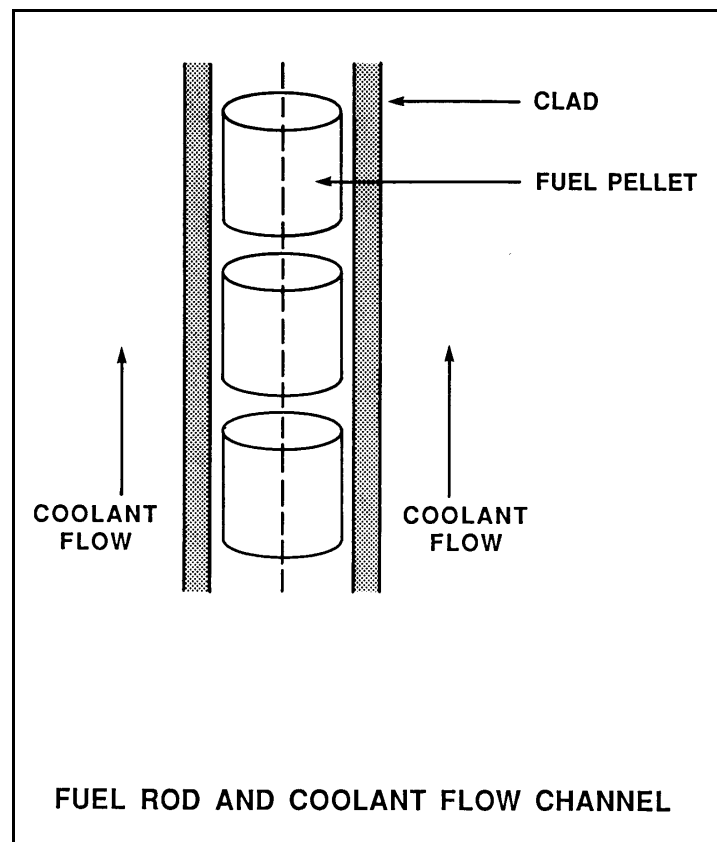
TOPIC:          193008
KNOWLEDGE:   K1.17   [2.9/3.2]
QID:             P692

During a plant cooldown and depressurization with forced circulation, reactor coolant system (RCS) loop flow and reactor coolant pump (RCP) current indications become erratic.  These abnormal indications are most likely caused by...

A.  RCP cavitation.

B.  RCP runout.

C.  RCS loop water hammer.

D.  RCS hot leg saturation.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.18   [2.3/2.5]
QID:             P1790   (B1789)

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

ANSWER:  C.

TOPIC: 193008
KNOWLEDGE: K1.18 [2.3/2.5]
QID: P5446 (B5445)

Refer to the drawing of a section of pipe that contains flowing water (see figure below).

Given:

    Pressure at $P_1$ is 24 psig.
    Pressure at $P_2$ is 16 psig.
    Pressure change due to change in velocity is 2 psig.
    Pressure change due to change in elevation is 10 psig.

The pressure decrease due to friction head loss between $P_1$ and $P_2$ is _____; and the direction of flow is from _____.

A. 2 psig; left to right

B. 2 psig; right to left

C. 4 psig; left to right

D. 4 psig; right to left

ANSWER: D.
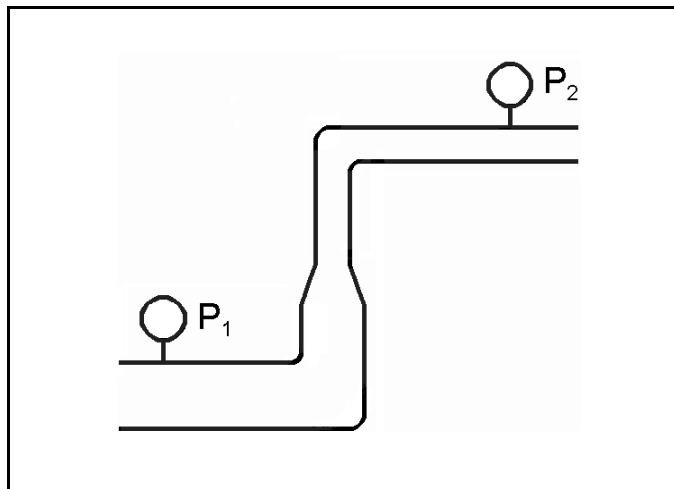
TOPIC:          193008
KNOWLEDGE:   K1.19   [2.5/2.8]
QID:            P1192

A nuclear reactor is producing 3,400 MW of thermal output with a vessel $\Delta$T of 60°F and a vessel mass flow rate of 1.4 x $10^8$ lbm/hour.  If core $\Delta$T is 63.6°F, what is core bypass flow rate?  (Assume bypass flow $\Delta$T equals 0°F.)

A.  7.92 x $10^6$ lbm/hour

B.  8.40 x $10^6$ lbm/hour

C.  1.26 x $10^8$ lbm/hour

D.  1.32 x $10^8$ lbm/hour

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.19   [2.5/2.8]
QID:            P1886

A nuclear reactor is producing 3,400 MW of thermal output with a vessel $\Delta$T of 60°F and a vessel mass flow rate of 1.0 x $10^8$ lbm/hr.  If core $\Delta$T is 63.6°F, what is core bypass flow rate?  (Assume bypass flow $\Delta$T equals 0°F.)

A.  5.66 x $10^6$ lbm/hr

B.  8.40 x $10^6$ lbm/hr

C.  3.60 x $10^7$ lbm/hr

D.  9.43 x $10^7$ lbm/hr

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.19   [2.5/2.8]
QID:             P2291

A nuclear reactor is producing 3,400 MW of thermal output with a vessel differential temperature ($\Delta$T) of 60°F and a vessel mass flow rate of 1.1 x $10^8$ lbm/hr.  If core $\Delta$T is 63.6°F, what is core bypass flow rate?  (Assume bypass flow $\Delta$T equals 0°F.)

A.  5.66 x $10^6$ lbm/hr

B.  6.23 x $10^6$ lbm/hr

C.  5.66 x $10^7$ lbm/hr

D.  6.23 x $10^7$ lbm/hr

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.20   [2.9/2.9]
QID:             P590

Adequate core bypass flow is needed to...

A.  cool the excore nuclear instrument detectors.

B.  provide reactor coolant pump minimum flow requirements.

C.  prevent stratification of reactor coolant inside the reactor vessel.

D.  equalize the temperatures between the reactor vessel and the upper vessel head.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.20   [2.9/2.9]
QID:              P1391

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

A.  Prevents excessive reactor vessel wall differential temperature

B.  Prevents boron precipitation in the core baffle area

C.  Provides a means of measuring core flow

D.  Provides cooling to various reactor vessel internal components

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.20   [2.9/2.9]
QID:              P1488

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

A.  Provides even flow distribution through the fuel.

B.  Provides mixing of water in the reactor vessel head.

C.  Ensures that core exit thermocouple readings represent average fuel temperatures.

D.  Ensures that natural circulation will be initiated when forced circulation is lost.

ANSWER:  B.

TOPIC:            193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:              P91

Maximizing the elevation difference between the core thermal center and the steam generator thermal centers and minimizing flow restrictions in the reactor coolant system (RCS) piping are plant designs that...

A.  minimize the RCS volume.

B.  maximize the RCS flow rate during forced circulation.

C.  ensure a maximum RCS loop transit time.

D.  ensure RCS natural circulation flow can be established.

ANSWER:  D.

TOPIC:            193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:              P292

Which one of the following must exist for natural circulation flow to occur?

A.  The heat source must be larger than the heat sink.

B.  The heat source must be located higher than the heat sink.

C.  The heat sink must be larger than the heat source.

D.  The heat sink must be located higher than the heat source.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:             P893

The driving head for natural circulation flow through the core is developed by differences in _____ between the hot leg and the cold leg.

A.  water density

B.  water volume

C.  pipe diameter

D.  piping length

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:             P1387

If the steam generator thermal centers were at the same elevation as the reactor core thermal center, natural circulation flow in the reactor coolant system would...

A.  not occur.

B.  not be affected.

C.  be greater than if they were at different elevations.

D.  flow in the reverse direction.

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:            P1393

A nuclear reactor is shut down with natural circulation core cooling.  Decay heat generation is equivalent to 1.0% rated thermal power.  Stable natural circulation mass flow rate is 1,000 gpm.

When decay heat generation decreases to 0.5% rated thermal power, stable natural circulation flow rate will be approximately...

A.  125 gpm.

B.  250 gpm.

C.  707 gpm.

D.  794 gpm.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:            P1692

A nuclear reactor is shut down with natural circulation core cooling.  Decay heat generation is equivalent to 1.0% rated thermal power.  Core $\Delta T$ has stabilized at 16°F.

When decay heat generation decreases to 0.5% rated thermal power, core $\Delta T$ will be approximately...

A.  2°F.

B.  4°F.

C.  8°F.

D.  10°F.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:  K1.21   [3.9/4.2]
QID:            P1887

Establishing natural circulation requires that a heat sink be _____ in elevation than a heat source and that a _____ difference exist between the heat sink and heat source.

A.  lower; pressure

B.  lower; temperature

C.  higher; pressure

D.  higher; temperature

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:  K1.21   [3.9/4.2]
QID:            P1989   (B2386)

Which one of the following conditions must occur to sustain natural circulation in a fluid system?

A.  Subcooling of the fluid

B.  A phase change in the fluid

C.  A density change in the fluid

D.  Radiative heat transfer to the fluid

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:            P2092

A nuclear reactor is shut down with natural circulation core cooling.  Decay heat generation is equivalent to 1.0% rated thermal power.  Core $\Delta T$ has stabilized at 16°F.

When decay heat generation decreases to 0.333% rated thermal power, core $\Delta T$ will be approximately...

A.  2°F.

B.  4°F.

C.  8°F.

D.  10°F.

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:            P2392

A nuclear reactor is shut down with natural circulation core cooling.  Decay heat generation is equivalent to 1.0% rated thermal power.  Core $\Delta T$ has stabilized at 13°F.

When decay heat generation decreases to 0.5% rated thermal power, core $\Delta T$ will be approximately...

A.  4°F.

B.  6°F.

C.  8°F.

D.  10°F.

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.21   [3.9/4.2]
QID:              P2491

A nuclear reactor is shut down with natural circulation core cooling.  Decay heat generation is equivalent to 1.0% rated thermal power.  Stable natural circulation flow rate is 800 gpm.

When decay heat generation decreases to 0.5% rated thermal power, stable natural circulation flow rate will be approximately...

A.  400 gpm.

B.  565 gpm.

C.  635 gpm.

D.  696 gpm.

ANSWER:  C.


TOPIC:            193008
KNOWLEDGE:   K1.22   [4.2/4.2]
QID:              P1492

A nuclear power plant is operating at 100% power when a loss of offsite power occurs, resulting in a reactor trip and a loss of forced reactor coolant circulation.  After 30 minutes, reactor coolant system (RCS) hot leg temperature is greater than cold leg temperature and steam generator (S/G) levels are stable.

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

|  | RCS Hot Leg Temperature | RCS Cold Leg Temperature | S/G Pressures | RCS CET Subcooling |
|---|---|---|---|---|
| A. | Decreasing | Stable | Stable | Increasing |
| B. | Increasing | Decreasing | Increasing | Decreasing |
| C. | Decreasing | Decreasing | Decreasing | Decreasing |
| D. | Increasing | Increasing | Decreasing | Increasing |

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.22   [4.2/4.2]
QID:             P1791

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

Which one of the following combinations of parameter trends, occurring 2 hours after the trip, indicates that natural circulation is <u>not</u> occurring?  (CET = core exit thermocouples)

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

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:             P92

A nuclear reactor is shut down at normal operating temperature and pressure with all reactor coolant pumps stopped.  Stable natural circulation cooling is in progress with 50°F of RCS 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.  Feed water flow rate

D.  Steam generator pressure

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:             P293

Fully-developed natural circulation flow rate will be <u>greatest</u> when...

A.  all reactor coolant pumps stop sequentially within 1 hour after a reactor trip.

B.  all reactor coolant pumps stop at the same time the reactor trips.

C.  all reactor coolant pumps run for 1 hour after a reactor trip, and then stop.

D.  only one reactor coolant pump runs for 1 hour after a reactor trip, and then stops.

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:             P392

Natural circulation flow can be enhanced by...

A.  increasing the elevation of the heat source to equal that of the heat sink.

B.  increasing the temperature difference between the heat sink and the heat source.

C.  decreasing the temperature difference between the heat sink and the heat source.

D.  decreasing the elevation difference between the heat source and the heat sink.

ANSWER:  B.

TOPIC:              193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:                P1493

Which one of the following will enhance natural circulation flow in the reactor coolant system?

A.  Pressurizer level decreases.

B.  Steam generator level increases.

C.  Pressurizer pressure decreases.

D.  Steam generator pressure increases.

ANSWER:  B.

TOPIC:              193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:                P1591

A nuclear reactor had been operating at a constant power level for the last two weeks when a loss of all ac power occurred, thereby causing a reactor trip and a loss of forced reactor coolant flow. Natural circulation reactor coolant flow developed and stabilized 30 minutes after the trip.

Which one of the following combinations of <u>initial</u> reactor power and <u>post-trip</u> steam generator pressure will result in the <u>highest</u> stable natural circulation flow rate 30 minutes after the trip?

|  | INITIAL REACTOR POWER | POST-TRIP STEAM GENERATOR PRESSURE |
|---|---|---|
| A. | 100% | 1,100 psia |
| B. | 25% | 1,100 psia |
| C. | 100% | 1,000 psia |
| D. | 25% | 1,000 psia |

ANSWER:  C.

TOPIC:            193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:              P1985

A nuclear reactor had been operating at a constant power level for the last two weeks when a loss of all ac power occurred, thereby causing a reactor trip and a loss of forced reactor coolant flow. Natural circulation reactor coolant flow developed and stabilized 30 minutes after the trip.

Which one of the following combinations of <u>initial</u> reactor power and <u>post-trip</u> steam generator pressure will result in the <u>lowest</u> stable natural circulation flow rate 30 minutes after the trip? (Assume constant steam generator water levels.)

| INITIAL<br>REACTOR<br><u>POWER</u> | POST-TRIP<br>STEAM GENERATOR<br><u>PRESSURE</u> |
|---|---|
| A.  100% | 1,100 psia |
| B.  25% | 1,100 psia |
| C.  100% | 1,000 psia |
| D.  25% | 1,000 psia |

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:            P2492

A nuclear reactor had been operating at steady state 100% power when a loss of offsite power occurred, thereby causing a reactor trip and a complete loss of forced reactor coolant flow.  Natural circulation reactor coolant flow developed and stabilized approximately 30 minutes after the trip.

Which one of the following combinations of reactor power history and post-trip steam generator pressure will result in the highest stable natural circulation flow rate?

DAYS AT      POST-TRIP
FULL          STEAM GENERATOR
POWER        PRESSURE

A.   12          1,100 psia

B.  100          1,100 psia

C.   12          1,000 psia

D.  100          1,000 psia

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.23   [3.9/4.1]
QID:             P3292

A few minutes ago, a nuclear power plant experienced a loss of offsite power that caused a reactor trip and a loss of all reactor coolant pumps.  Natural circulation flow is currently developing in the reactor coolant system (RCS).

Which one of the following operator actions will enhance RCS natural circulation flow rate?

A.  Establish and maintain saturation conditions in the RCS.

B.  Establish and maintain a steam bubble in the reactor vessel.

C.  Establish and maintain steam generator pressure above RCS pressure.

D.  Establish and maintain steam generator water level high in the normal operating range.

ANSWER:  D.

TOPIC:          193008
KNOWLEDGE:   K1.24   [2.7/3.1]
QID:             P592

During the reflux boiling method of core cooling, the steam that is generated in the core is condensed in the _____ side of a steam generator and flows back into the core via the _____.  (Assume the steam generators contain U-tubes.)

A.  hot leg; hot leg

B.  cold leg; hot leg

C.  hot leg; cold leg

D.  cold leg; cold leg

ANSWER:  A.

TOPIC:          193008
KNOWLEDGE:   K1.24   [2.7/3.1]
QID:            P786

Which one of the following describes the method of core heat removal during reflux core cooling following a loss of coolant accident?

A.  Convection with forced coolant flow.

B.  Convection with natural circulation coolant flow.

C.  Conduction with stagnant coolant flow.

D.  Radiation with total core voiding.

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:   K1.24   [2.7/3.1]
QID:            P2692

A nuclear power plant is experiencing natural circulation core cooling following a loss of coolant accident.  Which one of the following, when it first occurs, marks the beginning of reflux core cooling?  (Assume the steam generators contain U-tubes.)

A.  Reactor core steam production results in two-phase coolant entering the hot leg and being delivered to the steam generators.

B.  Hot leg steam quality is so high that the steam generators cannot fully condense it and two-phase coolant is returned to the reactor vessel via the cold leg.

C.  Hot leg condensation is unable to pass completely through the steam generators to enter the cold legs.

D.  The steam generators are no longer able to condense any of the steam contained in the hot leg.

ANSWER:  C.

TOPIC:          193008
KNOWLEDGE:  K1.25   [3.3/3.4]
QID:            P593

A reactor coolant system cooldown is in progress on natural circulation via the steam generator (S/G) atmospheric steam relief valves (operated in manual control).  If high point voiding interrupts natural circulation, which one of the following will occur?  (Assume feed flow rate, relief valve position, and decay heat level are constant.)

A.  S/G level increases and S/G pressure increases.

B.  S/G level increases and S/G pressure decreases.

C.  S/G level decreases and S/G pressure increases.

D.  S/G level decreases and S/G pressure decreases.

ANSWER:  B.

TOPIC:          193008
KNOWLEDGE:  K1.25   [3.3/3.4]
QID:            P793

A reactor coolant system natural circulation cooldown is in progress via the steam generator (SG) atmospheric steam relief valves (operated in manual control).  Assume feed flow rate, relief valve position, and 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

ANSWER:  C.

TOPIC:             193008
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:               P2093

A reactor coolant system natural circulation cooldown is in progress via the steam generator (S/G) atmospheric steam relief valves (operated in manual control).

If voids interrupt natural circulation, which one of the following will occur?  (Assume feed flow rate, relief valve position, and decay heat level are constant.)

A.  S/G pressure decreases and core exit thermocouple (CETC) temperature increases.

B.  S/G pressure decreases and CETC temperature remains constant.

C.  S/G pressure increases and CETC temperature increases.

D.  S/G pressure increases and CETC temperature remains constant.

ANSWER:  A.

TOPIC:             193008
KNOWLEDGE:   K1.25   [3.3/3.4]
QID:               P2493

A reactor coolant system natural circulation cooldown is in progress using the steam generator (S/G) atmospheric steam relief valves, operated in manual control.  Assume feed flow rate, relief valve position, and decay heat level remain constant.

If S/G tube high point voiding interrupts natural circulation, S/G steam flow rate will _____ and core exit thermocouple temperature will _____.

A.  decrease; increase

B.  decrease; remain constant

C.  increase; increase

D.  increase; remain constant

ANSWER:  A.

TOPIC:          193009
KNOWLEDGE:   K1.01   [2.3/2.8]
QID:            P2794

A nuclear reactor is operating at 75% power at the middle of a fuel cycle with radial power distribution peaked in the center of the core.  All control rods are fully withdrawn and in manual control.

Assuming all control rods remain fully withdrawn, except as noted, which one of the following will cause the maximum steady-state radial peaking (or hot channel) factor to decrease?

A.  Turbine load/reactor power is reduced by 20%.

B.  A control rod located at the edge of the core drops into the core.

C.  Reactor coolant system boron concentration is reduced by 10 ppm.

D.  The reactor is operated continuously at 75% power for three months.

ANSWER:  D.

TOPIC:          193009
KNOWLEDGE:   K1.02   [2.3/2.8]
QID:            P1195

A nuclear reactor is operating at 80% power near the beginning of a fuel cycle.  All control rods are fully withdrawn and in manual control.  The moderator temperature coefficient is negative.  Core axial power distribution is peaked below the core midplane.

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

A.  One bank of control rods is inserted 10%.

B.  One control rod fully inserts into the core.

C.  Turbine load/reactor power is reduced by 20%.

D.  Reactor coolant system boron concentration is reduced by 50 ppm.

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.04   [2.3/2.7]
QID:            P3295

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

ANSWER:  B.

TOPIC:          193009
KNOWLEDGE:   K1.04   [2.3/2.7]
QID:            P3794

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 power.  If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 1.5, 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

ANSWER:  A.

TOPIC:          193009
KNOWLEDGE:   K1.04   [2.3/2.7]
QID:              P4949

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 power.  If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 3.0, 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

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.04   [2.3/2.7]
QID:            P5249

A nuclear reactor is operating at 3,400 MW thermal power.  The core linear power density limit is 12.2 kW/ft.

Given:

- The reactor core contains 198 fuel assemblies.
- Each fuel assembly contains 262 fuel rods, each with an active length of 12.0 feet
- The highest total peaking factors measured in the core are as follows:

    Location A:  2.5
    Location B:  2.4
    Location C:  2.3
    Location D:  2.2

Which one of the following describes the operating conditions in the core relative to the linear power density limit?

A.  All locations in the core are operating below the linear power density limit.

B.  Location A has exceeded the linear power density limit while the remainder of the core is operating below the limit.

C.  Locations A and B have exceeded the linear power density limit while the remainder of the core is operating below the limit.

D.  Locations A, B, and C have exceeded the linear power density limit while the remainder of the core is operating below the limit.

ANSWER:  D.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:            P56

The basis for the maximum power density (kW/foot) power limit is to...

A.  provide assurance of fuel integrity.

B.  prevent xenon oscillations.

C.  allow for fuel pellet manufacturing tolerances.

D.  prevent nucleate boiling.

ANSWER:  A.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:            P94

If a nuclear reactor is operated within core thermal limits, then...

A.  plant thermal efficiency is optimized.

B.  fuel cladding integrity is ensured.

C.  pressurized thermal shock will be prevented.

D.  reactor vessel thermal stresses will be minimized.

ANSWER:  B.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P396 (B1793)

The 2,200°F maximum peak fuel cladding temperature limit is imposed because...

A. 2,200°F is approximately 500°F below the fuel cladding melting temperature.

B. the rate of the zircaloy-steam reaction increases significantly at temperatures above 2,200°F.

C. any cladding temperature higher than 2,200°F correlates to a fuel centerline temperature above the fuel melting point.

D. the thermal conductivity of zircaloy decreases rapidly at temperatures above 2,200°F.

ANSWER: B.

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P894

During normal operation, fuel clad integrity is ensured by...

A. the primary system relief valves.

B. core bypass flow restrictions.

C. the secondary system relief valves.

D. operating within core thermal limits.

ANSWER: D.

TOPIC:              193009
KNOWLEDGE:    K1.05    [3.1/3.5]
QID:                 P994

Maximum fuel cladding integrity is attained by...

A.  always operating below 110% of reactor coolant system design pressure.

B.  actuation of the reactor protection system upon a reactor accident.

C.  ensuring that actual heat flux is always less than critical heat flux.

D.  ensuring operation above the critical heat flux during all operating conditions.

ANSWER:  C.

TOPIC:              193009
KNOWLEDGE:    K1.05    [3.1/3.5]
QID:                 P1194

Nuclear reactor core peaking (or hot channel) factors are used to establish a maximum reactor power level such that fuel pellet temperature is limited to prevent _____ and fuel clad temperature is limited to prevent _____ during most analyzed transients and abnormal conditions.

A.  fuel pellet melting; fuel clad melting

B.  excessive fuel pellet expansion; fuel clad melting

C.  fuel pellet melting; excessive fuel clad oxidation

D.  excessive fuel pellet expansion; excessive fuel clad oxidation

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:            P1295

Nuclear reactor thermal limits are established to...

A.  ensure the integrity of the reactor fuel.

B.  prevent exceeding reactor vessel mechanical limitations.

C.  minimize the coolant temperature rise across the core.

D.  establish control rod insertion limits.

ANSWER:  A.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:            P1395   (B1893)

Thermal limits are established to protect the nuclear reactor core, and thereby protect the public during plant operations which include...

A.  normal operations only.

B.  normal and abnormal operations only.

C.  normal, abnormal, and postulated accident operations only.

D.  normal, abnormal, postulated and unpostulated accident operations.

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:           P2194   (B2194)

Which one of the following describes the basis for the 2,200°F maximum fuel clad temperature limit?

A.  The material strength of zircaloy decreases rapidly at temperatures above 2,200°F.

B.  At the normal operating pressure of the reactor vessel a clad temperature above 2,200°F indicates that the critical heat flux has been exceeded.

C.  The rate of the zircaloy-water reaction becomes significant at temperatures above 2,200°F.

D.  2,200°F is approximately 500°F below the fuel clad melting temperature.

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:           P2595

The linear power density thermal limit is designed to prevent melting of the _____ during normal reactor plant operation; the limit is dependent on the axial and radial peaking factors, of which the _____ peaking factor is normally the most limiting.

A.  fuel clad; axial

B.  fuel clad; radial

C.  fuel pellets; axial

D.  fuel pellets; radial

ANSWER:  D.

TOPIC:          193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:             P2696   (B2693)

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

- 90% of the fuel clad has remained below 1,800°F.
- 10% of the fuel clad has exceeded 1,800°F.
- 5% of the fuel clad has exceeded 2,000°F.
- 0.5% of the fuel clad has reached 2,200°F.
- 0.0% of the fuel clad has exceeded 2,200°F.
- Peak centerline fuel temperature is 4,650°F.

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

A.  Release of radioactive fission products due to rupture of the fuel clad

B.  Release of radioactive fission products due to melting of the fuel pellets and fuel clad

C.  Explosive concentration inside the reactor vessel

D.  Explosive hydrogen concentration inside the reactor containment building

ANSWER:  A.

TOPIC:              193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:                P2796

Given the following initial core parameters for a segment of a fuel rod:

    Power density = 3 kW/ft
    $T_{coolant}$              = 579°F
    $T_{fuel\ centerline}$       = 2,400°F

Reactor power is increased such that the following core parameters now exist for the same fuel rod segment:

    Power density = 5 kW/ft
    $T_{coolant}$              = 590°F
    $T_{fuel\ centerline}$       =  ?°F

Assuming <u>no</u> boiling occurs and coolant flow rate is unchanged, what will be the new stable $T_{fuel\ centerline}$?

A.  3,035°F

B.  3,614°F

C.  3,625°F

D.  4,590°F

ANSWER:  C.

TOPIC:         193009
KNOWLEDGE:   K1.05   [3.1/3.5]
QID:         P2995  (B2292)

Which one of the following describes the basis for the 2,200°F maximum fuel clad temperature limit?

A.  2,200°F is approximately 500°F below the fuel clad melting temperature.

B.  The rate of the zircaloy-steam reaction increases significantly above 2,200°F.

C.  If fuel clad temperature reaches 2,200°F, the onset of transition boiling is imminent.

D.  The differential expansion between the fuel pellets and the fuel clad becomes excessive above 2,200°F.

ANSWER:  B.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:             P383     (B394)

Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$          = 500°F
$T_{fuel\ centerline}$      = 3,000°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled?  (Assume reactor power is constant.)

A.  2,000°F

B.  1,750°F

C.  1,500°F

D.  1,250°F

ANSWER:  B.



**FUEL ROD AND COOLANT FLOW CHANNEL**

TOPIC:           193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:              P394    (B396)

The pellet-to-clad gap in fuel rod construction is designed to...

A.  decrease fuel pellet slump.

B.  reflect fission neutrons.

C.  increase heat transfer rate.

D.  reduce internal clad strain.

ANSWER:  D.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P495    (B495)

Refer to the drawing of a fuel rod and coolant flow channel (see figure below) at beginning of core life.
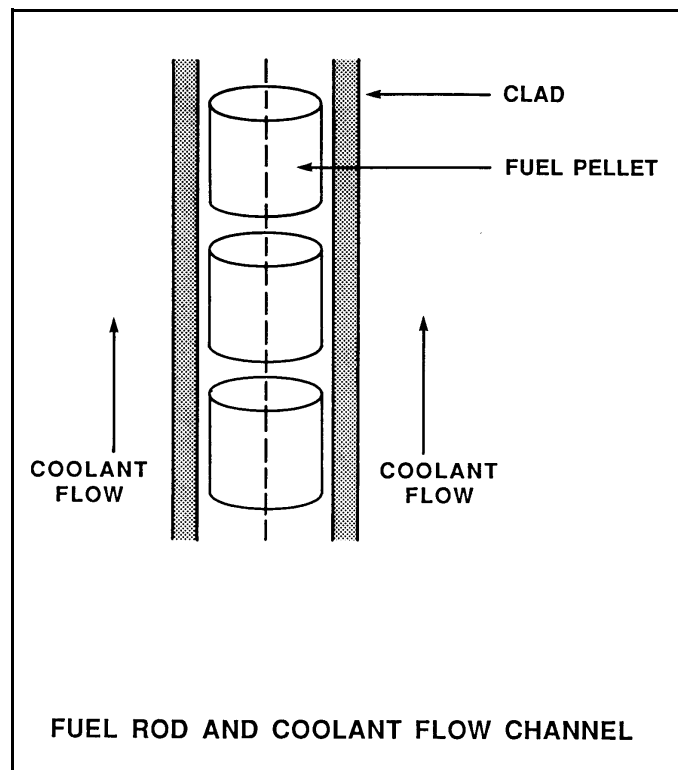
Given the following initial core parameters:

Reactor power  =  100%
$T_{coolant}$              =  500°F
$T_{fuel\ centerline}$        = 2,500°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled?  (Assume reactor power is constant.)

A.  1,000°F

B.  1,250°F

C.  1,500°F

D.  1,750°F

ANSWER:  C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:              P1095

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

A.  larger; smaller

B.  larger; larger

C.  smaller; smaller

D.  smaller; larger

ANSWER:  A.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:             P1594   (B1594)

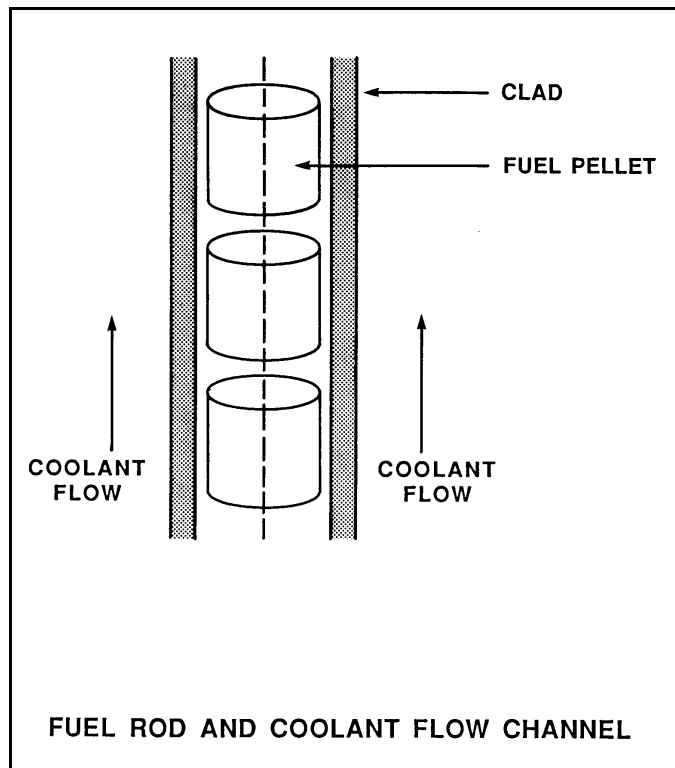Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

     Reactor power = 100%
     $T_{coolant}$          = 500°F
     $T_{fuel\ centerline}$        = 2,700°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles?   (Assume reactor power is constant.)

A.  1,100°F

B.  1,350°F

C   1,600°F

D.  1,850°F

ANSWER:  C.



FUEL ROD AND COOLANT FLOW CHANNEL
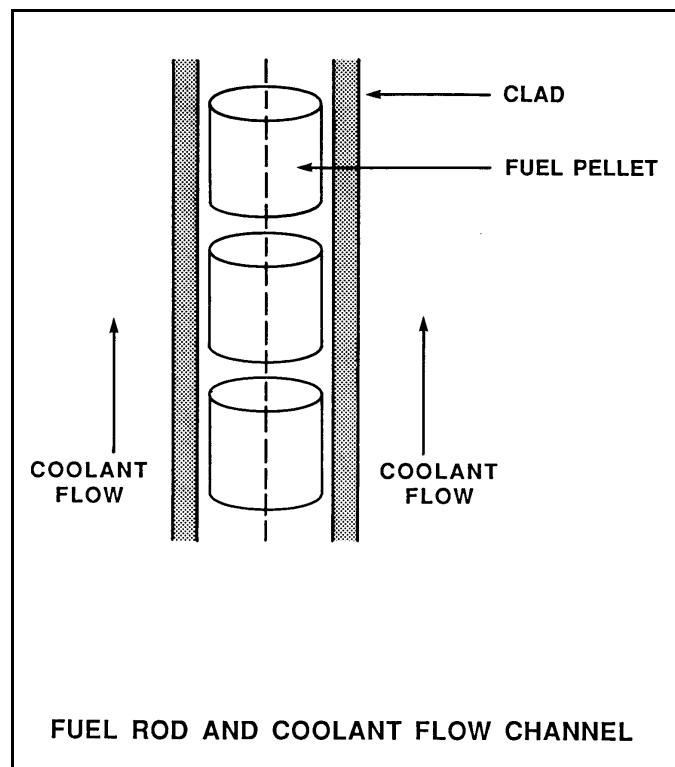
TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P1795

A nuclear reactor is operating at 80% power with all control rods fully withdrawn.  Compared to a 50% insertion of a group (or bank) of control rods, 50% insertion of a single control rod will cause a _____ increase in the axial peaking hot channel factor and a _____ increase in the radial peaking hot channel factor.  (Assume reactor power remains constant.)

A.  larger; smaller

B.  larger; larger

C.  smaller; smaller

D.  smaller; larger

ANSWER:  D.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P1894   (B1395)

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

A.  Smaller at EOL due to fuel pellet densification.

B.  Smaller at EOL due to contamination of fill gas with fission product gases.

C.  Larger at EOL due to reduction in gap between fuel pellets and clad.

D.  Larger at EOL due to greater temperature difference between fuel pellets and coolant.

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P1994   (B1995)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

   Reactor power  = 60%
   $T_{coolant}$           = 540°F
   $T_{fuel\ centerline}$         = 2,540°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles?   (Assume reactor power is constant.)

A.  1,270°F

B.  1,370°F

C.  1,440°F

D.  1,540°F

ANSWER:  D.



FUEL ROD AND COOLANT FLOW CHANNEL
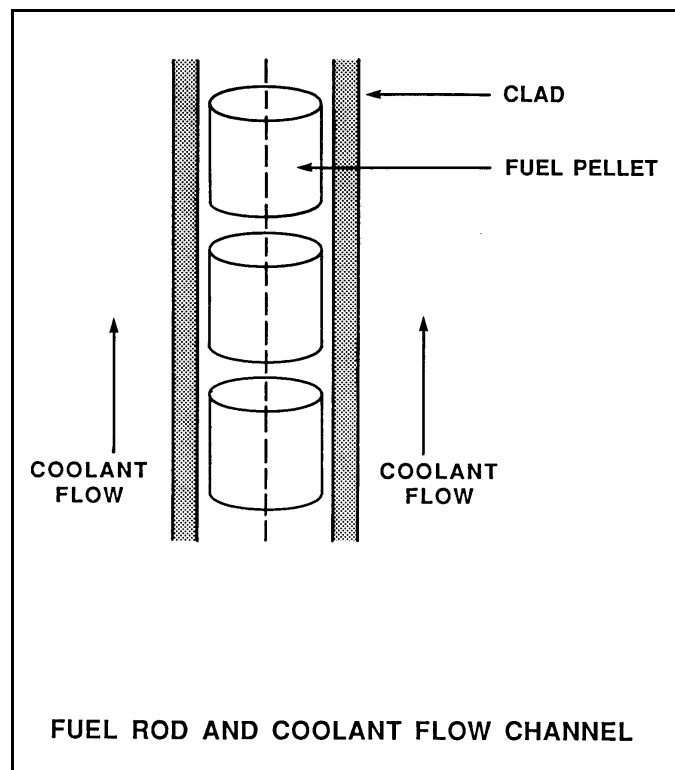
TOPIC:             193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:                  P2195   (B2192)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel assembly at the beginning of a fuel cycle (BOC) as compared to the end of a fuel cycle (EOC)?

A.  Larger at BOC due to a higher fuel pellet density.

B.  Larger at BOC due to lower contamination of fuel rod fill gas with fission product gases.

C.  Smaller at BOC due to a larger gap between the fuel pellets and clad.

D.  Smaller at BOC due to a smaller corrosion film on the surface of the fuel rods.

ANSWER:  C.

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P2296   (B2696)

Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 60%
$T_{coolant}$          = 560°F
$T_{fuel\ centerline}$      = 2,500°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles?   (Assume reactor power is constant.)

A.  1,080°F

B.  1,250°F

C.  1,530°F

D.  1,810°F

ANSWER:  C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC:          193009
KNOWLEDGE:   K1.07   [3.1/3.5]
QID:            P2395   (B2394)

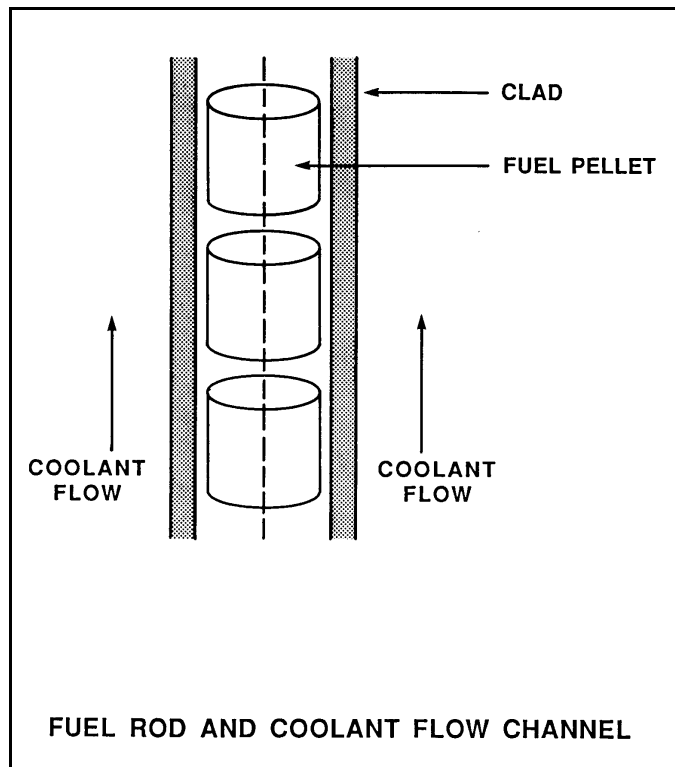Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

The nuclear reactor is shut down with the following parameter values:

$T_{coolant}$           $= 320°F$
$T_{fuel\ centerline}$      $= 780°F$

What would the fuel centerline temperature be under these same conditions at the end of core life if the total fuel-to-coolant thermal conductivity were doubled?

A.  550°F

B.  500°F

C.  450°F

D.  400°F

ANSWER:  A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC:          193009
KNOWLEDGE:   K1.07   [2.9/3.3]
QID:            P3195   (B3193)

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

The nuclear reactor is shut down at the beginning of a fuel cycle with the following average parameter values:

$T_{coolant}$          $= 440°F$
$T_{fuel\ centerline}$  $= 780°F$

If the total fuel-to-coolant thermal conductivity doubles over core life, what will the fuel centerline temperature be with the same coolant temperature and reactor decay heat conditions at the end of the fuel cycle?

A.  610°F

B.  580°F

C.  550°F

D.  520°F

ANSWER:  A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3395 (B1697)

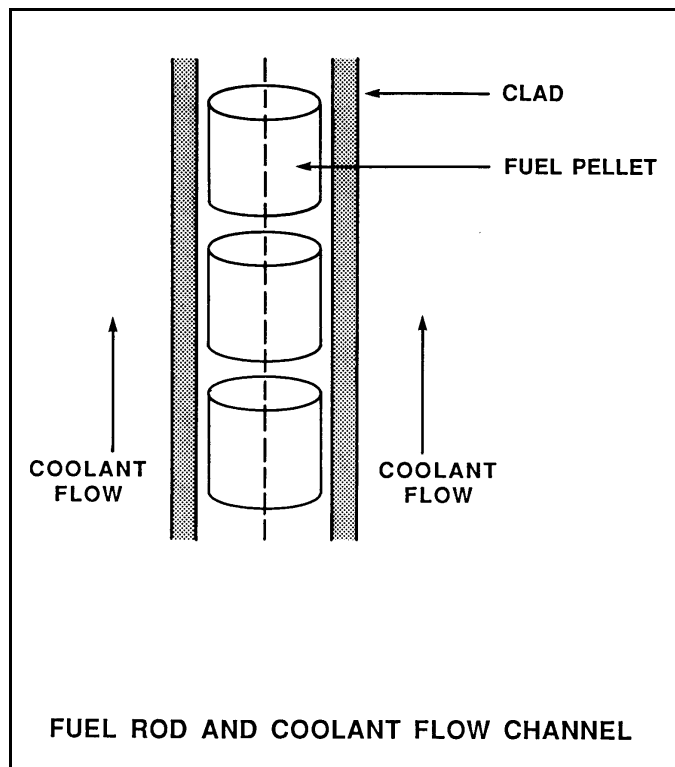Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power $= 50\%$
$T_{coolant}$ $= 550\,^\circ F$
$T_{fuel\ centerline}$ $= 2{,}750\,^\circ F$

What will the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power and $T_{coolant}$ are constant.)

A. $1{,}100\,^\circ F$

B. $1{,}375\,^\circ F$

C. $1{,}525\,^\circ F$

D. $1{,}650\,^\circ F$

ANSWER: D.

CLAD

FUEL PELLET

COOLANT FLOW          COOLANT FLOW

FUEL ROD AND COOLANT FLOW CHANNEL
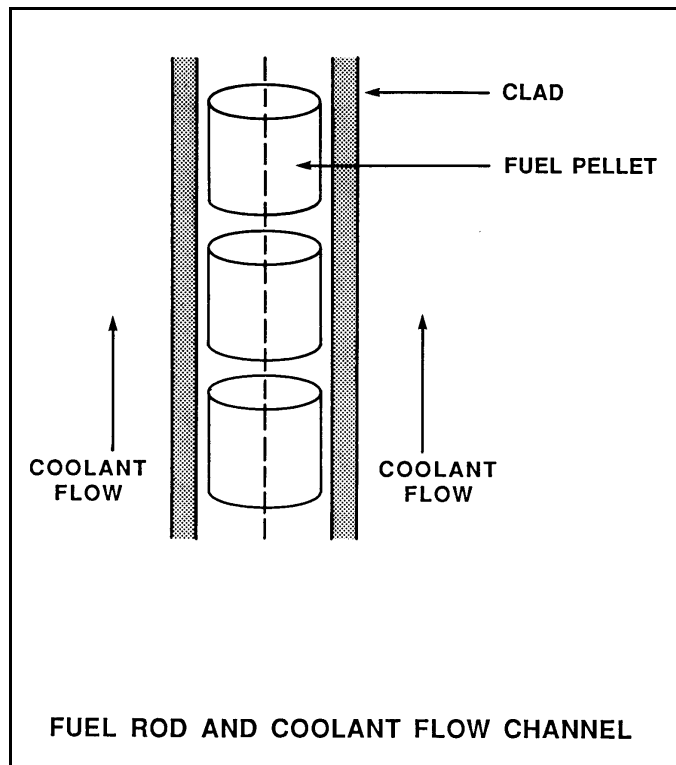
TOPIC:          193009
KNOWLEDGE:   K1.07   [2.9/3.3]
QID:            P3895

Refer to the drawing of a fuel rod and coolant flow channel (see figure below).
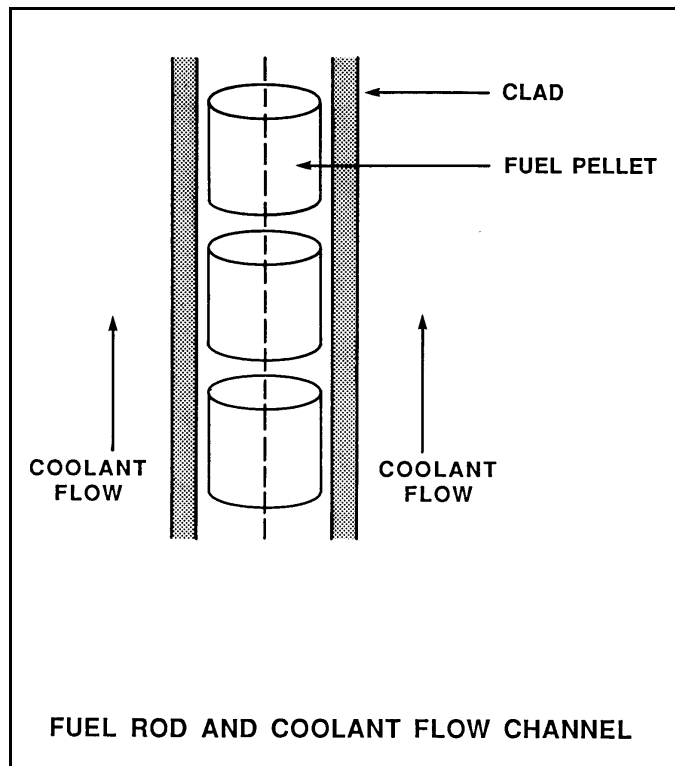
Given the following initial stable core parameters:

    Reactor power  = 50%
    $T_{coolant}$          = 550°F
    $T_{fuel\ centerline}$      = 2,250°F

Assume that the total heat transfer coefficient and the reactor coolant temperature do <u>not</u> change. What will the approximate stable fuel centerline temperature be if reactor power is increased to 75%?

A.  2,550°F

B.  2,800°F

C.  2,950°F

D.  3,100°F

ANSWER:  D.



**FUEL ROD AND COOLANT FLOW CHANNEL**
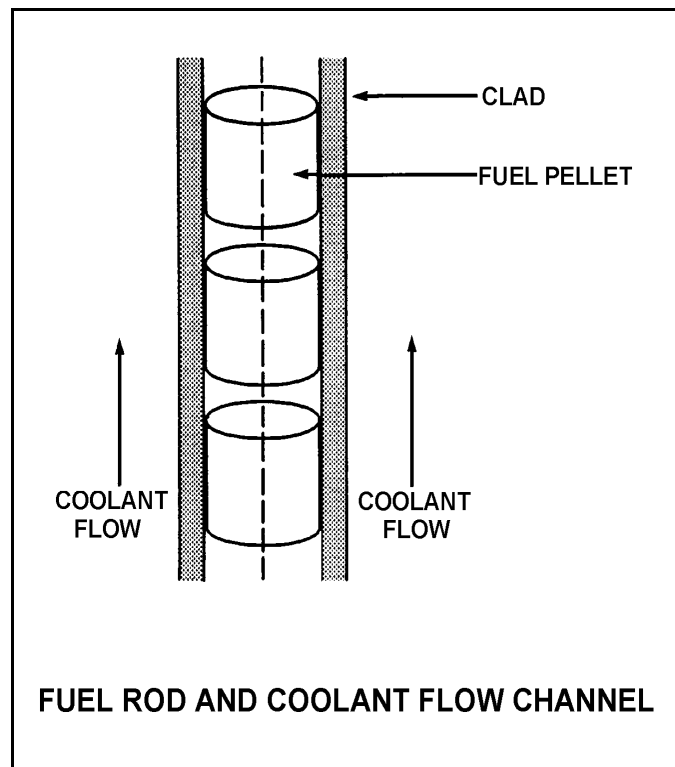
TOPIC:              193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:                 P97      (B899)

A pressure stress applied to the reactor vessel is...

A.  compressive at the inner wall, tensile at the outer wall.

B.  tensile at the inner wall, compressive at the outer wall.

C.  tensile across the entire wall.

D.  compressive across the entire wall.

ANSWER:  C.

TOPIC:              193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:                 P296

Brittle fracture is the fragmentation of metal resulting from the application of _____ stress at relatively _____ temperatures.

A.  compressive; high

B.  compressive; low

C.  tensile; high

D.  tensile; low

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P397    (B398)

Brittle fracture of the reactor coolant system pressure boundary is <u>most</u> <u>likely</u> to occur at...

A.  120°F and 2200 psig.

B.  120°F and 400 psig.

C.  400°F and 2200 psig.

D.  400°F and 400 psig.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P497    (B499)

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

A.  A high reactor gamma flux rather than a high neutron flux.

B.  A high reactor vessel material strength rather than a high material ductility.

C.  A high reactor coolant oxygen content rather than a low oxygen content.

D.  A rapid 100°F reactor cooldown at a high temperature rather than a low temperature.

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P1200

Which one of the following reduces the probability of brittle fracture of the reactor vessel?

A.  The presence of a preexisting flaw

B.  The presence of a tensile stress

C.  Operation at low temperatures

D.  Small heatup and cooldown rates

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P1296

Which one of the following comparisons increases the probability of brittle fracture of a pressure vessel wall?

A.  A high temperature rather than a low temperature.

B.  A tensile stress rather than a compressive stress.

C.  Performing a 100°F/hour heatup rather than a 100°F/hour cooldown.

D.  Using materials fabricated from stainless steel rather than carbon steel.

ANSWER:  B.

TOPIC:              193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:                 P1396

Which one of the following statements describes the relationship between brittle fracture and nil-ductility temperature?

A.  Operation below the nil-ductility temperature will result in brittle fracture.

B.  Operation above the nil-ductility temperature will result in brittle fracture.

C.  Operation below the nil-ductility temperature will increase the probability of brittle fracture.

D.  Operation above the nil-ductility temperature will increase the probability of brittle fracture.

ANSWER:  C.

TOPIC:              193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:                 P1597   (B1899)

Which one of the following comparisons increases the probability of brittle fracture for a reactor pressure vessel wall?

A.  Using materials fabricated from stainless steel rather than carbon steel.

B.  A compressive stress rather than a tensile stress.

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

D.  Performing a 100°F/hr cooldown rather than a 100°F/hr heatup.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P1696   (B2700)

Which one of the following comparisons increases the probability of brittle fracture of a reactor pressure vessel wall?

A.  Performing a 50°F/hr cooldown at 1600 psia rather than a 50°F/hr cooldown at 1200 psia.

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

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

D.  Changing wall design to increase toughness while maintaining the same strength.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P1796

Brittle fracture of the reactor coolant system pressure boundary is <u>least likely</u> to occur at...

A.  120°F and 2,200 psig.

B.  120°F and 400 psig.

C.  400°F and 2,200 psig.

D.  400°F and 400 psig.

ANSWER:  D.

TOPIC:            193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:             P1896   (B1299)

Brittle fracture of the reactor vessel (RV) is most likely to occur during a _____ of the reactor coolant system (RCS) when RCS temperature is _____ the RV reference temperature for nil-ductility transition ($RT_{NDT}$).

A.  heatup; above

B.  heatup; below

C.  cooldown; above

D.  cooldown; below

ANSWER:  D.

TOPIC:            193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:             P2096   (B2099)

Which one of the following will prevent brittle fracture failure of a reactor vessel?

A.  Manufacturing the reactor vessel from low carbon steel.

B.  Maintaining reactor vessel pressure below the maximum design limit.

C.  Operating above the reference temperature for nil-ductility transition ($RT_{NDT}$).

D.  Maintaining the number of reactor vessel heatup/cooldown cycles within limits.

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:              P2196

Brittle fracture of the reactor vessel (RV) is <u>least</u> likely to occur during a _____ of the RV when RV temperature is _____ the reference temperature for nil-ductility transition (RT$_{NDT}$).

A.  cooldown; above

B.  heatup; above

C.  cooldown; below

D.  heatup; below

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:              P2496   (B2499)

Brittle fracture of a low-carbon steel is more likely to occur when the temperature of the steel is _____ the nil ductility temperature, and will normally occur when the applied stress is _____ the steel's yield strength (or yield stress).

A.  greater than; greater than

B.  greater than; less than

C.  less than; greater than

D.  less than; less than

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P2497   (B2500)

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

A.  An RCS pH of 8.5 rather than 9.0

B.  A high reactor coolant oxygen content rather than a low oxygen content

C.  A 50°F/hr RCS cooldown rather than a 100°F/hr heatup

D.  A high gamma flux rather than a high neutron flux

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.01   [2.8/3.2]
QID:            P2896

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

A.  An RCS pH of 9.0 rather than 8.5

B.  A low reactor coolant oxygen content rather than a high oxygen content

C.  A 50°F/hr RCS cooldown rather than a 100°F/hr heatup

D.  A high gamma flux rather than a high neutron flux

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P98

The nil-ductility temperature is that temperature...

A.  below which the probability of brittle fracture significantly increases.

B.  determined by fracture mechanics to be equivalent to reference transition temperature.

C.  determined by Charpy V-notch test to be equivalent to reference transition temperature.

D.  below which the yield stress of the metal is inversely proportional to Young's modulus of elasticity.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:             P597    (B2699)

The nil-ductility transition temperature of the reactor vessel (RV) is the temperature...

A.  above which the RV metal will elastically deform as RCS pressure decreases.

B.  above which the RV metal loses its ability to elastically deform as RCS pressure increases.

C.  below which the RV metal will elastically deform as reactor coolant system (RCS) pressure decreases.

D.  below which the RV metal loses its ability to elastically deform as RCS pressure increases.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:            P697    (B1500)

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

A.  a large compressive stress can result in brittle fracture.

B.  a metal exhibits more ductile tendencies.

C.  the probability of brittle fracture increases.

D.  no appreciable deformation occurs prior to failure.

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.02   [2.4/2.5]
QID:            P996    (B2299)

The nil-ductility transition temperature is that temperature...

A.  below which vessel failure is imminent.

B.  above which vessel failure is imminent.

C.  below which the probability of brittle fracture significantly increases.

D.  above which the probability of brittle fracture significantly increases.

ANSWER:  C.

TOPIC:           193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:              P96      (B100)

The likelihood of brittle fracture failure of the reactor vessel is <u>reduced</u> by...

A.  increasing vessel age.

B.  reducing vessel pressure.

C.  reducing vessel temperature.

D.  reducing gamma flux exposure.

ANSWER:  B.

TOPIC:           193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:              P142

Operating with which of the following conditions is <u>least</u> <u>effective</u> in preventing brittle fracture in the reactor coolant system (RCS)?

A.  Operating within prescribed heatup and cooldown rate limitations.

B.  Operating with RCS temperature greater than nil-ductility transition temperature.

C.  Operating with RCS pressure low when RCS temperature is low.

D.  Operating with a ramped RCS temperature as power level varies.

ANSWER:  D.

TOPIC:        193010
KNOWLEDGE:  K1.04   [3.3/3.7]
QID:          P297

Why are reactor coolant system cooldown rate limitations established?

A.  Prevent excessive reactivity additions.

B.  Prevent brittle fracture of the reactor vessel.

C.  Prevent excessive reactor coolant system subcooling.

D.  Prevent impurities from precipitating out of solution in the reactor vessel.

ANSWER:  B.

TOPIC:        193010
KNOWLEDGE:  K1.04   [3.3/3.7]
QID:          P300

The thermal stress experienced by the reactor vessel during a reactor coolant system heatup is...

A.  compressive at the inner wall and tensile at the outer wall of the vessel.

B.  tensile at the inner wall and compressive at the outer wall of the vessel.

C.  tensile across the entire vessel wall.

D.  compressive across the entire vessel wall.

ANSWER:  A.

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P398 (B400)

The probability of reactor vessel brittle fracture is <u>decreased</u> by minimizing...

A. oxygen content in the reactor coolant.

B. operation at high temperatures.

C. the time taken to cool down the reactor coolant system.

D. the amount of copper manufactured into the reactor vessel.

ANSWER: D.

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P399 (B399)

The total stress on the reactor vessel inner wall is greater during cooldown than heatup because...

A. heatup stress totally offsets pressure stress at the inner wall.

B. both pressure stress and cooldown stress are tensile at the inner wall.

C. cooldown stress and heatup stress are both tensile at the inner wall, but cooldown stress is greater in magnitude.

D. the tensile cooldown stress at the inner wall is greater in magnitude than the compressive pressure stress at the same location.

ANSWER: B.

TOPIC:         193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:           P898

The likelihood of brittle fracture failure of the reactor vessel is reduced by...

A.  increasing vessel age.

B.  reducing reactor vessel pressure.

C.  reducing reactor vessel temperature.

D.  increasing gamma flux exposure.

ANSWER:  B.

TOPIC:         193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:           P1098

Which one of the following will increase the compressive stress on the <u>outside</u> surface of the reactor vessel wall?

A.  Neutron irradiation

B.  Gamma irradiation

C.  Reactor coolant system cooldown

D.  Reactor coolant system heatup

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:             P1298

Which one of the following applies a compressive stress to the inner wall of the reactor pressure vessel during a reactor coolant system heatup?

A.  Embrittlement stress

B.  Yield stress

C.  Pressure stress

D.  Thermal stress

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:             P1397

Which one of the following is the most limiting component for establishing reactor coolant system heatup/cooldown rate limits?

A.  Pressurizer

B.  Reactor vessel

C.  Fuel rod

D.  Steam generator

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:            P1598

Which one of the following stresses is compressive on the outer wall of the reactor pressure vessel during a reactor coolant system cooldown?

A.  Yield stress

B.  Thermal stress

C.  Pressure stress

D.  Embrittlement stress

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:            P1897   (B300)

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

A.  Decreasing reactor coolant system (RCS) pressure

B.  Increasing RCS pressure

C.  Performing an RCS cooldown

D.  Performing an RCS heatup

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:            P2397  (B2399)

Reactor coolant system pressure-temperature limit curves are derived by using a conservative value for the reactor vessel reference temperature for nil ductility transition ($RT_{NDT}$).

Early in core life, the assumed value of $RT_{NDT}$ is _____ than actual $RT_{NDT}$; and actual $RT_{NDT}$ is verified periodically over core life by _____.

A.  higher; removing and testing irradiated specimens of reactor vessel material

B.  higher; inservice inspection and analysis of the reactor vessel wall

C.  lower; removing and testing irradiated specimens of reactor vessel material

D.  lower; inservice inspection and analysis of the reactor vessel wall

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.04   [3.3/3.7]
QID:            P2998

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel?

A.  Maximum setpoint for the pressurizer safety valves

B.  Maximum differential pressure between the RCS and the steam generators

C.  Maximum RCS pressure vs. RCS temperature for a given RCS heatup rate

D.  Maximum differential temperature between the RCS and the pressurizer

ANSWER:  C.

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P3698 (B3700)

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

A. Decreases, because the temperature gradient across the RV wall will decrease.

B. Increases, because the temperature gradient across the RV wall will decrease.

C. Decreases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

D. Increases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

ANSWER: A.

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P95

Fast neutron irradiation of the reactor vessel results in _____ stresses within the vessel metal, thereby _____ the nil-ductility transition temperature.

A. decreased; increasing

B. decreased; decreasing

C. increased; increasing

D. increased; decreasing

ANSWER: C.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P143

Fast neutron irradiation adversely affects the reactor pressure vessel primarily by causing...

A.  metal embrittlement.

B.  brittle fracture.

C.  flaw initiation.

D.  flaw propagation.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P298    (B599)

Prolonged exposure of the reactor vessel to a fast neutron flux will cause the reference temperature for nil-ductility transition ($RT_{NDT}$) to...

A.  increase due to the propagation of existing flaws.

B.  decrease due to the propagation of existing flaws.

C.  increase due to changes in the material properties of the vessel wall.

D.  decrease due to changes in the material properties of the vessel wall.

ANSWER:  C.

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P499 (B500)

Which one of the following types of radiation significantly reduces the ductility of the metal of a reactor pressure vessel?

A. Beta

B. Thermal neutrons

C. Gamma

D. Fast neutrons

ANSWER: D.

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P899 (B1900)

After several years of operation the maximum allowable stress to the reactor pressure vessel is more limited by the inner wall than the outer wall because...

A. the inner wall operates at a higher temperature than the outer wall.

B. the inner wall has a smaller surface area than the outer wall.

C. the inner wall experiences more neutron-induced embrittlement than the outer wall.

D. the inner wall experiences more tensile stress than the outer wall.

ANSWER: C.

TOPIC:           193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P998    (B1999)

Prolonged exposure to _____ will cause nil-ductility transition temperature of the reactor vessel to _____.

A.  neutron radiation; increase

B.  neutron radiation; decrease

C.  boric acid; increase

D.  boric acid; decrease

ANSWER:  A.

TOPIC:           193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P1100   (B1100)

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

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

A.  Reactor A due to the lower average power capacity.

B.  Reactor A due to the greater number of heatup/cooldown cycles.

C.  Reactor B due to the higher average power capacity.

D.  Reactor B due to the fewer number of heatup/cooldown cycles.

ANSWER:  A.

TOPIC:           193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P1498

The two factors that have the greatest effect on the reference temperature for nil-ductility transition (RT$_{NDT}$) of the reactor vessel over its life are...

A.  thermal neutron flux and vessel copper content.

B.  thermal neutron flux and vessel carbon content.

C.  fast neutron flux and vessel copper content.

D.  fast neutron flux and vessel carbon content.

ANSWER:  C.

TOPIC:           193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:             P1699   (B1800)

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

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

A.  Reactor A due to the fewer number of heatup/cooldown cycles

B.  Reactor A due to the higher average power capacity

C.  Reactor B due to the greater number of heatup/cooldown cycles

D.  Reactor B due to the lower average power capacity

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P1898   (B1200)

Which one of the following is the <u>major</u> contributor to embrittlement of the reactor vessel?

A.  High-energy fission fragments

B.  High operating temperature

C.  High-energy gamma radiation

D.  High-energy neutron radiation

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P1997   (B299)

Which one of the following describes the effect of fast neutron irradiation on a reactor pressure vessel?

A.  Increased fatigue crack growth rate

B.  Increased plastic deformation prior to failure

C.  Increased metal toughness

D.  Increased nil-ductility reference transition temperature

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P2098   (B2100)

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

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

A.  Reactor A due to the fewer number of heatup/cooldown cycles

B.  Reactor A due to the higher average power capacity

C.  Reactor B due to the greater number of heatup/cooldown cycles

D.  Reactor B due to the lower average power capacity

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P2298

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

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

A.  Reactor A due to the greater number of heatup/cooldown cycles

B.  Reactor A due to the lower average power capacity

C.  Reactor B due to the fewer number of heatup/cooldown cycles

D.  Reactor B due to the higher average power capacity

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P2599   (B2600)

Two identical nuclear reactors are currently shut down for refueling.  Reactor A has an average lifetime power capacity of 60% and has been operating for 15 years.  Reactor B has an average lifetime power capacity of 75% and has been operating for 12 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A.  Reactor A due to the lower average lifetime power capacity.

B.  Reactor B due to the higher average lifetime power capacity.

C.  Both reactors will have approximately the same nil ductility transition temperature because each core has produced approximately the same number of fissions.

D.  Both reactors will have approximately the same nil ductility transition temperature because fast neutron irradiation in a shut down core is not significant.

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P2698   (B3000)

Two identical nuclear reactors are currently shut down for refueling.  Reactor A has an average lifetime power capacity of 60% and has been operating for 15 years.  Reactor B has an average lifetime power capacity of 60% and has been operating for 12 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A.  Reactor A because it has produced the greater number of fissions.

B.  Reactor B because it has produced the fewer number of fissions.

C.  Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

D.  Both reactors will have approximately the same nil ductility transition temperature because the fission rate in a shut down core is not significant.

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P2799   (B2800)

Two identical nuclear reactors have been in operation for the last 10 years.  Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%.  Reactor B has experienced 20 heatup/cooldown cycles and has an average power capacity of 80%.

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

A.  Reactor A due to the greater number of heatup/cooldown cycles

B.  Reactor A due to the lower average power capacity

C.  Reactor B due to the fewer number of heatup/cooldown cycles

D.  Reactor B due to the higher average power capacity

ANSWER:  D.


TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P3197   (B3200)

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 is removed from the reactor vessel for testing.  The testing determines that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 42°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 <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B.  The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C.  The test results are questionable because the specimen NDT temperature would <u>not</u> decrease during the described 18-month period of operation.

D.  The test results are questionable because the specimen NDT temperature would decrease by <u>more</u> than 2°F during the described 18-month period of operation.

ANSWER:  C.

TOPIC:              193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:                  P3297   (B3300)

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 is removed from the reactor vessel for testing.  The testing determines that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 44°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 <u>more</u> susceptible to brittle fracture now than after the previous refueling shutdown.

B.  The test results are credible and the reactor vessel is <u>less</u> susceptible to brittle fracture now than after the previous refueling shutdown.

C.  The test results are questionable because the vessel NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D.  The test results are questionable because the vessel NDT temperature would increase by <u>at least</u> 10°F during the described 18-month period of operation.

ANSWER:  A.

TOPIC:             193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:                  P3598   (B3600)

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 is removed from the reactor vessel for testing.  The testing indicates that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 32°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 <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B.  The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C.  The test results are questionable because the actual specimen NDT temperature would <u>not</u> decrease during the described 18-month period of operation.

D.  The test results are questionable because the actual specimen NDT temperature would decrease by much <u>less</u> than indicated by the test results.

ANSWER:  C.


TOPIC:             193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:                  P3898   (B3900)

Two identical nuclear reactors are currently shut down for refueling.  Reactor A has an average lifetime power capacity of 90% and has been operating for 10 years.  Reactor B has an average lifetime power capacity of 80% and has been operating for 15 years.

Which reactor will have the higher reactor vessel nil ductility transition temperature and why?

A.  Reactor A because it has the higher average lifetime power capacity.

B.  Reactor B because it has the lower average lifetime power capacity.

C.  Reactor A because it has produced significantly less fissions.

D.  Reactor B because it has produced significantly more fissions.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P4250   (B4250)

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 <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B.  The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C.  The test results are questionable because the specimen NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D.  The test results are questionable because the specimen NDT temperature would increase by <u>less</u> than indicated during the described 18-month period of operation.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:  K1.05   [2.9/3.0]
QID:            P4450  (B4450)

A nuclear reactor is shut down for refueling.  During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing.  The specimen was last tested six years ago.  During the subsequent six years, the reactor has completed several 18-month fuel cycles with an average power level of 85%.

The test determines that the nil-ductility transition (NDT) temperature of the specimen has remained unchanged at 44°F since it was last tested.  Which one of the following conclusions is warranted?

A.  The test results are credible, however, the reactor vessel is more susceptible to brittle fracture now than six years ago.

B.  The test results are credible, however, the reactor vessel is less susceptible to brittle fracture now than six years ago.

C.  The test results are questionable because the specimen NDT temperature should have increased since it was last tested.

D.  The test results are questionable because the specimen NDT temperature should have decreased since it was last tested.

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P4650   (B4650)

Two identical nuclear reactors are currently shut down for refueling.  Reactor A has achieved an average lifetime power capacity of 60% while operating for 12 years.  Reactor B has achieved an average lifetime power capacity of 60% while operating for 15 years.

Which reactor, if any, will have the lower reactor vessel nil ductility transition temperature?

A.  Reactor A because it has produced the fewer total number of fissions.

B.  Reactor B because it has produced the greater total number of fissions.

C.  Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

D.  Both reactors will have approximately the same nil ductility transition temperature because the fission rate in a shut down core is not significant.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.06   [3.6/3.8]
QID:            P99

A nuclear power plant is shut down with the reactor coolant system at 1,200 psia and 350°F.  Which one of the following would be most likely to cause pressurized thermal shock of the reactor vessel?

A.  A rapid depressurization followed by a rapid heatup

B.  A rapid depressurization followed by a rapid cooldown

C.  A rapid cooldown followed by a rapid pressurization

D.  A rapid heatup followed by a rapid pressurization

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.05   [2.9/3.0]
QID:            P5550   (B5550)

Two identical nuclear reactors are currently shut down for refueling.  Reactor A has an average lifetime power capacity of 90% and has been operating for 24 years.  Reactor B has an average lifetime power capacity of 72% and has been operating for 30 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A.  Reactor A because it has produced the greater total number of fissions.

B.  Reactor B because it has produced the fewer total number of fissions.

C.  Both reactors will have approximately the same nil ductility transition temperature because fast neutron irradiation in a shut down core is not significant.

D.  Both reactors will have approximately the same nil ductility transition temperature because each core has produced approximately the same total number of fissions.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.06   [3.6/3.8]
QID:            P299

Pressurized thermal shock is a condition that can occur following a rapid _____ of the reactor coolant system (RCS) if RCS pressure is rapidly _____.

A.  cooldown; decreased

B.  cooldown; increased

C.  heatup; decreased

D.  heatup; increased

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.06   [3.6/3.8]
QID:            P2800

Which one of the following would be most likely to cause pressurized thermal shock of a reactor vessel?

A.  Starting a reactor coolant pump in an idle loop with the associated steam generator temperature less than RCS loop temperature.

B.  Starting a reactor coolant pump in an idle loop with the associated steam generator temperature greater than RCS loop temperature.

C.  Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a steam generator steam outlet nozzle.

D.  Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a reactor vessel coolant outlet nozzle.

ANSWER:  C.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:            P100

During a severe overcooling transient, a major concern to the operator is...

A.  accelerated zirconium hydriding.

B.  loss of reactor vessel water level.

C.  loss of reactor coolant pump net positive suction head.

D.  brittle fracture of the reactor vessel.

ANSWER:  D.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:            P1000

An uncontrolled cooldown is a brittle fracture concern because it creates a large _____ stress at the _____ wall of the reactor vessel.

A.  tensile;  inner

B.  tensile; outer

C.  compressive; inner

D.  compressive; outer

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:            P1099

During an uncontrolled cooldown of a reactor coolant system, the component most susceptible to pressurized thermal shock is the...

A.  reactor vessel.

B.  steam generator tube sheet.

C.  cold leg accumulator penetration.

D.  loop resistance temperature detector penetration.

ANSWER:  A.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:            P1199

Which one of the following describes the thermal stress placed on the reactor vessel during a cooldown of the reactor coolant system?

A.  Compressive at the inner wall, tensile at the outer wall

B.  Tensile at the inner wall, compressive at the outer wall

C.  Compressive across the entire wall

D.  Tensile across the entire wall

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:            P1500

The thermal stress experienced by the reactor vessel during a reactor coolant system cooldown is...

A.  tensile across the entire vessel wall.

B.  tensile at the inner wall, compressive at the outer wall of the vessel.

C.  compressive across the entire vessel wall.

D.  compressive at the inner wall, tensile at the outer wall of the vessel.

ANSWER:  B.

TOPIC:          193010
KNOWLEDGE:   K1.07   [3.8/4.1]
QID:             P2797

A nuclear power plant heatup is in progress using reactor coolant pumps.  The heatup stress applied to the reactor vessel is...

A.  tensile across the entire wall.

B.  tensile at the inner wall and compressive at the outer wall.

C.  compressive across the entire wall.

D.  compressive at the inner wall and tensile at the outer wall.

ANSWER:  D.