March 8, 2001

UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001--FORM A (with answers and proofs)

Please Print

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

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

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 44		
REACTOR THEORY	45 - 72		
THERMODYNAMICS	73 - 100		
TOTALS	100		

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

_____
Applicant's Signature

RULES AND GUIDELINES FOR THE GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

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

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

2. Fill in the name of your facility.

3. Fill in your individual docket number.

4. Fill in your start and stop times at the appropriate time.

5. Two aids are provided for your use during the examination:

   (1) An equations and conversions sheet contained within the examination copy, and

   (2) Steam tables provided by your proctor.

6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.

7. Scrap paper will be provided for calculations.

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

9. Restroom trips are limited. Only **ONE** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside of the examination room.

10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination.

11. Turn in your examination materials, answer sheet on top, followed by the examination booklet, then examination aids - steam table booklets, handouts, and scrap paper used during the examination.

12. After turning in your examination materials, leave the examination area, as defined by the proctor. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

$\lambda_{eff} = 0.1$ seconds^{-1}

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

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

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

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

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

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

Eff. = Net Work Out/Energy In

$\upsilon(P_2 - P_1) + \dfrac{(\vec{v}_2^{\,2} - \vec{v}_1^{\,2})}{2g_c} + \dfrac{g(z_2 - z_1)}{g_c} = 0$

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

CONVERSIONS

1 Mw	= 3.41×10^6 Btu/hr	1 Curie	= 3.7×10^{10} dps
1 hp	= 2.54×10^3 Btu/hr	1 kg	= 2.21 lbm
1 Btu	= 778 ft-lbf	1 gal_{water}	= 8.35 lbm
°C	= (5/9)(°F - 32)	1 ft^3_{water}	= 7.48 gal
°F	= (9/5)(°C) + 32		

QUESTION: 1
TOPIC: 191001
KNOWLEDGE: K1.03 [2.7/2.9]
QID: P2302 (Rev) (On BWR also)

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.

QUESTION: 2
TOPIC: 191001
KNOWLEDGE: K1.05
QID: P2503 (B2603)

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

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

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

QUESTION: 3
TOPIC: 191001
KNOWLEDGE: K1.07
QID: P1503 (B205)

Check valves are used to prevent:

A. pump runout by providing a constant backpressure.

B. pump cavitation by keeping nonoperating systems filled.

C. backflow through nonoperating components or flowpaths.

D. overpressurization of nonoperating system piping and components.

ANSWER: C.

QUESTION: 4
TOPIC: 191001
KNOWLEDGE: K1.08
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 lowest system pressure drop when fully open.

A. ball; ball

B. ball; butterfly

C. butterfly; ball

D. butterfly; butterfly

ANSWER: A.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 5
TOPIC: 191002
KNOWLEDGE: K1.02
QID: P2005 (B2006)

A plant is operating at 100% power. A main steam flow measuring instrument uses density compensation and square root extraction to convert the D/P sensed by the steam flow detector to main steam mass flow rate.

If the steam pressure sensed by the density compensation circuit decreases, indicated flow rate will _____ and if square root extraction is bypassed, indicated flow rate will _____.

A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase

ANSWER: B.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 6
TOPIC: 191002
KNOWLEDGE: K1.05
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 hole 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.

PROOF:

$$\frac{Flow_1}{Flow_2} = \frac{\sqrt{\Delta P_1}}{\sqrt{\Delta P_2}}$$

$$\frac{100}{x} = \frac{\sqrt{9}}{\sqrt{4}} = \frac{3}{2}$$

$$x = 66.7 \text{ gpm}$$

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 7
TOPIC: 191002
KNOWLEDGE: K1.06
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 at a given temperature, which indicator will indicate the lower level?

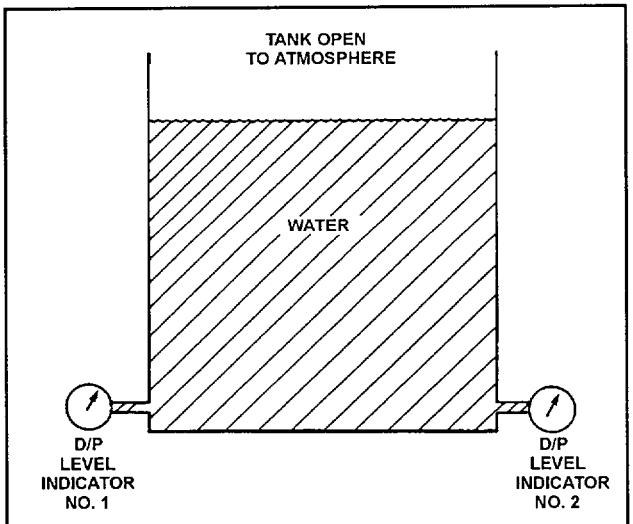
A. Indicator 1 at all water temperatures

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 DIFFERENTIAL PRESSURE LEVEL INDICATORS

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 8
TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P910 (Rev) (On BWR also)

Refer to the drawing of a tank with differential pressure (D/P) level detector (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 not 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.

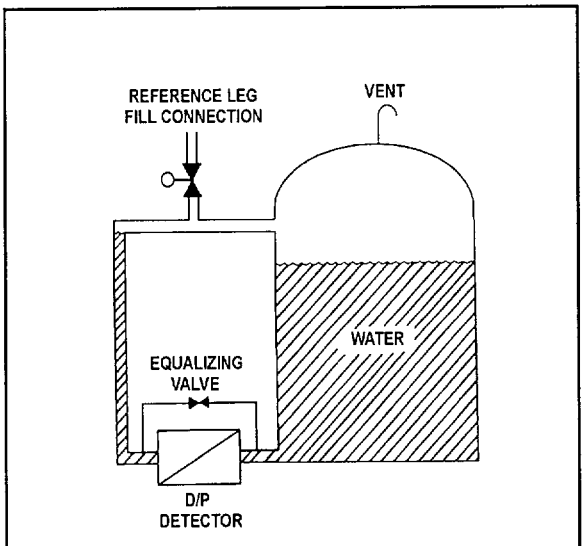
A. increase; level

B. decrease; level

C. increase; mass

D. decrease; mass

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 9
TOPIC: 191002
KNOWLEDGE: K1.10
QID: P1508 (B1011)

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

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

B. straighten due to the greater 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.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 10
TOPIC: 191002
KNOWLEDGE: K1.12
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?

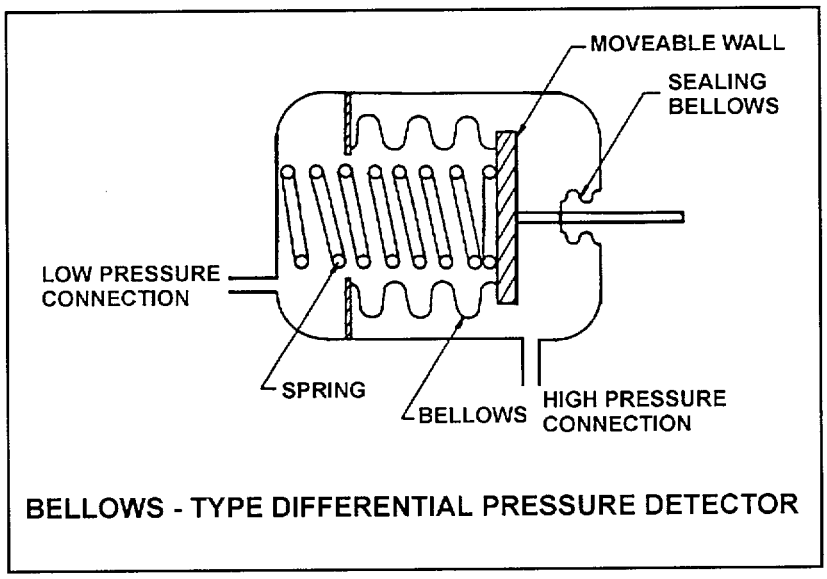
A. Increase, because the spring will expand more.

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

QUESTION: 11
TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P2212 (Rev) (BWR also)

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. If an ambient temperature decrease lowers reference junction temperature to 110°F, the new thermocouple temperature indication will be:

(Assume measuring junction temperature remains constant.)

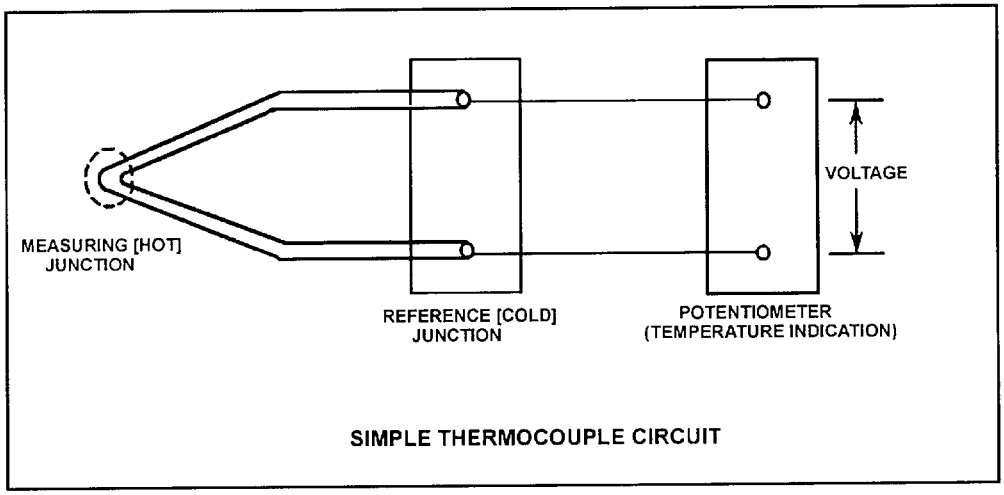
A. 380°F.

B. 395°F.

C. 410°F.

D. 425°F.

ANSWER: D.



SIMPLE THERMOCOUPLE CIRCUIT

PROOF: $T_{ind} = T_H - T_C$

If T_C decreases by 15°F, then T_{ind} increases by 15°F.

410°F + 15°F = 425°F

QUESTION: 12
TOPIC: 191002
KNOWLEDGE: K1.17
QID: P2513

A plant startup is in progress immediately following a reactor refueling. The external nuclear instrumentation (NI) was calibrated just prior to the refueling shutdown and has not been readjusted.

If power level is stabilized at 90%, NI power level will be _____ than actual power level because, compared to pre-shutdown 90% power level operation, _____.

A. lower; total core neutron production rate has decreased

B. higher; total core neutron production rate has increased

C. lower; power production in the outer portion of the core has decreased

D. higher; power production in the outer portion of the core has increased

ANSWER: C.

QUESTION: 13
TOPIC: 191002
KNOWLEDGE: K1.18
QID: P214 (B213)

Most of the electrons collected in a fission chamber are released as a result of ionizations caused directly by:

A. fission betas.

B. fission gammas.

C. fission neutrons.

D. fission fragments.

ANSWER: D.

QUESTION: 14
TOPIC: 191002
KNOWLEDGE: K1.20
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.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 15
TOPIC: 191003
KNOWLEDGE: K1.04 [2.8/3.0]
QID: New (on BWR also)

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

Assume the orientation of the bistable symbol indicates the characteristics of the bistable. 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?

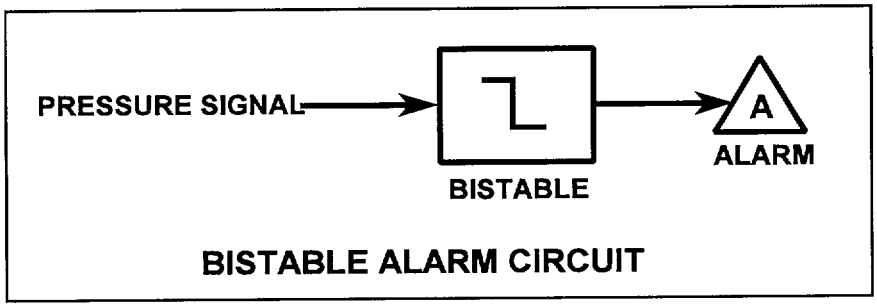
A. The alarm is currently actuated and will turn off at 95 psig.

B. The alarm is currently actuated and will turn off at 105 psig.

C. The alarm will actuate at 100 psig and will NOT turn off.

D. The alarm will actuate at 100 psig and will turn off at 105 psig.

ANSWER: B.



BISTABLE ALARM CIRCUIT

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 16
TOPIC: 191003
KNOWLEDGE: K1.03
QID: P2117

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 actuator of the feed control valve.

If the level control signal fails high, S/G level will _____ because the control air pressure to the valve positioner will _____.

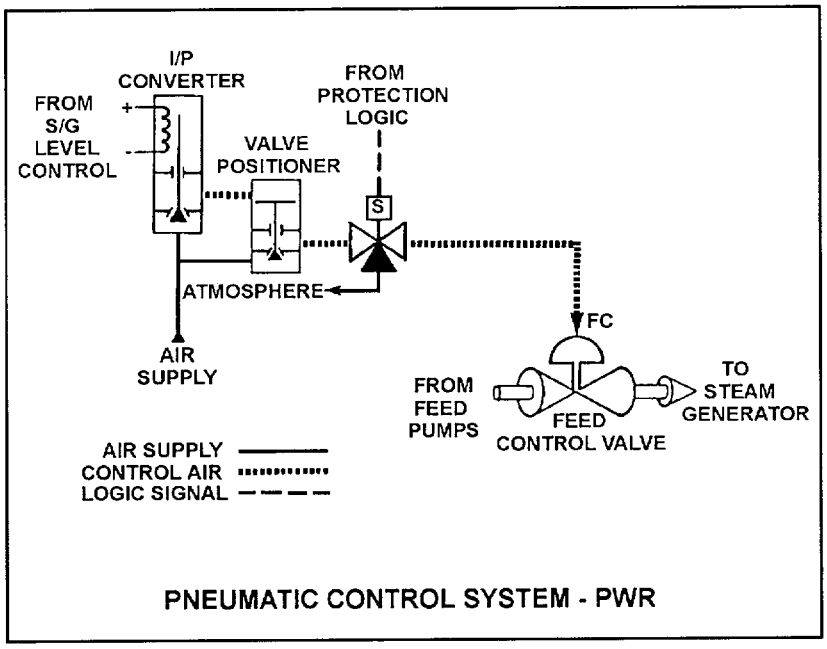
A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: A.



PNEUMATIC CONTROL SYSTEM - PWR

QUESTION: 17
TOPIC: 191003
KNOWLEDGE: K1.06
QID: P2818 (B2817)

A diesel generator (DG) is supplying an isolated electrical bus with the governor operating in the speed droop mode. Assuming the DG does not trip, if a large electrical bus load trips, generator frequency will:

A. remain constant during and after the load trip.

B. initially increase, then decrease and stabilize below the initial value.

C. initially increase, then decrease and stabilize at the initial value.

D. initially increase, then decrease and stabilize above the initial value.

ANSWER: D.

QUESTION: 18
TOPIC: 191003
KNOWLEDGE: K1.07
QID: P618

What may be damaged if an operator attempts to manually disengage the motor on a motor-operated valve while the motor is operating?

A. Motor

B. Clutch

C. Limit switches

D. Torque switches

ANSWER: B.

QUESTION: 19
TOPIC: 191003
KNOWLEDGE: K1.08
QID: P917 (B1015)

Which one of the following describes the response of a direct-acting derivative controller, operating in automatic, to an increase in the controlled parameter above the controller setpoint?

A. The controller will develop an output signal that will remain directly proportional to the rate of change of the controlled parameter.

B. The controller will develop an output signal that will remain directly proportional to the difference between the controlled parameter and the controller setpoint.

C. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes zero.

D. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes constant.

ANSWER: A.

QUESTION: 20
TOPIC: 191004
KNOWLEDGE: K1.06 [3.2/3.3]
QID: New (on BWR also)

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.

QUESTION: 21
TOPIC: 191004
KNOWLEDGE: K1.09
QID: P1823 (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 only pump A is operating. If pump B is started, after the system stabilizes system flow rate will be:

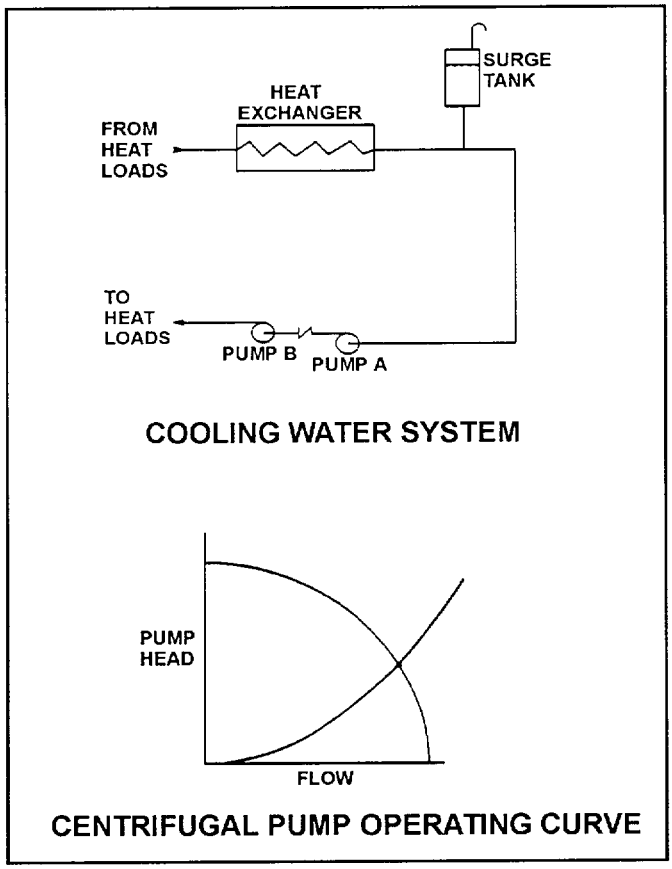
A. twice the original flow.

B. the same as the original flow.

C. less than twice the original flow.

D. more than twice the original flow.

ANSWER: C.



QUESTION: 22
TOPIC: 191004
KNOWLEDGE: K1.12
QID: P1623 (B1323)

A centrifugal pump is operating at 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 will operate at runout conditions.

C. The pump required net positive suction head will decrease.

D. The pump available net positive suction head will increase.

ANSWER: B.

QUESTION: 23
TOPIC: 191004
KNOWLEDGE: K1.20
QID: P1025

Minimum required net positive suction head for an ideal positive displacement pump will increase if the pump:

A. motor speed increases.

B. discharge pressure decreases.

C. suction temperature increases.

D. discharge valve is positioned from 90% open to fully open.

ANSWER: A.

QUESTION: 24
TOPIC: 191004
KNOWLEDGE: K1.22 [2.3/2.5]
QID: New (on BWR also)

A pump is needed to supply fuel oil from a day tank to a diesel 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 1900 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.

QUESTION: 25
TOPIC: 191004
KNOWLEDGE: K1.04
QID: P1222 (B1181)

A plant is operating at full power when a 200 gpm reactor coolant leak occurs, which results in a reactor scram and initiation of emergency coolant injection. Reactor coolant system pressure stabilizes at 1000 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: 2500 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.

QUESTION: 26
TOPIC: 191004
KNOWLEDGE: K1.24
QID: P626 (B2425)

What is the purpose of the safety/relief valve located between the pump outlet and 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 shutdown with its suction valve closed.

ANSWER: C.

QUESTION: 27
TOPIC: 191005
KNOWLEDGE: K1.02
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 overheat.

C. Motor current will begin to decrease.

D. Motor windings will begin to overheat.

ANSWER: D.

QUESTION: 28
TOPIC: 191005
KNOWLEDGE: K1.03
QID: P2027 (B2028)

A diesel generator (D/G) is supplying both kW and kVAR to an electrical bus in parallel with the grid. Assuming D/G and bus voltage do not change, if the D/G voltage regulator set point is increased slightly, then D/G kW 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.

QUESTION: 29
TOPIC: 191005
KNOWLEDGE: K1.05
QID: P1230

The starting current in an ac motor is significantly higher than the full-load running current because:

A. motor torque production is highest during motor start.

B. work performed by the motor is highest during motor start.

C. little counter electromotive force is induced onto the rotor during motor start.

D. little counter electromotive force is induced onto the stator during motor start.

ANSWER: D.

QUESTION: 30
TOPIC: 191005
KNOWLEDGE: K1.04
QID: P2230 (B2227)

Two identical 4160 Vac induction motors are connected to identical centrifugal pumps being used to provide cooling water flow in separate systems in a 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.

QUESTION: 31
TOPIC: 191005
KNOWLEDGE: K1.06
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 wear of motor thrust bearings

B. Prevent excessive torsional stresses on the motor shaft

C. Prevent excessive heat buildup within the motor windings

D. Prevent excessive arcing and degradation of motor breaker contacts

ANSWER: C.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 32
TOPIC: 191006
KNOWLEDGE: K1.04
QID: P2433 (B2431)

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

All valves are identical and are initially 50% open. To raise the temperature at point 1, the operator can adjust valve _____ in the _____ direction.

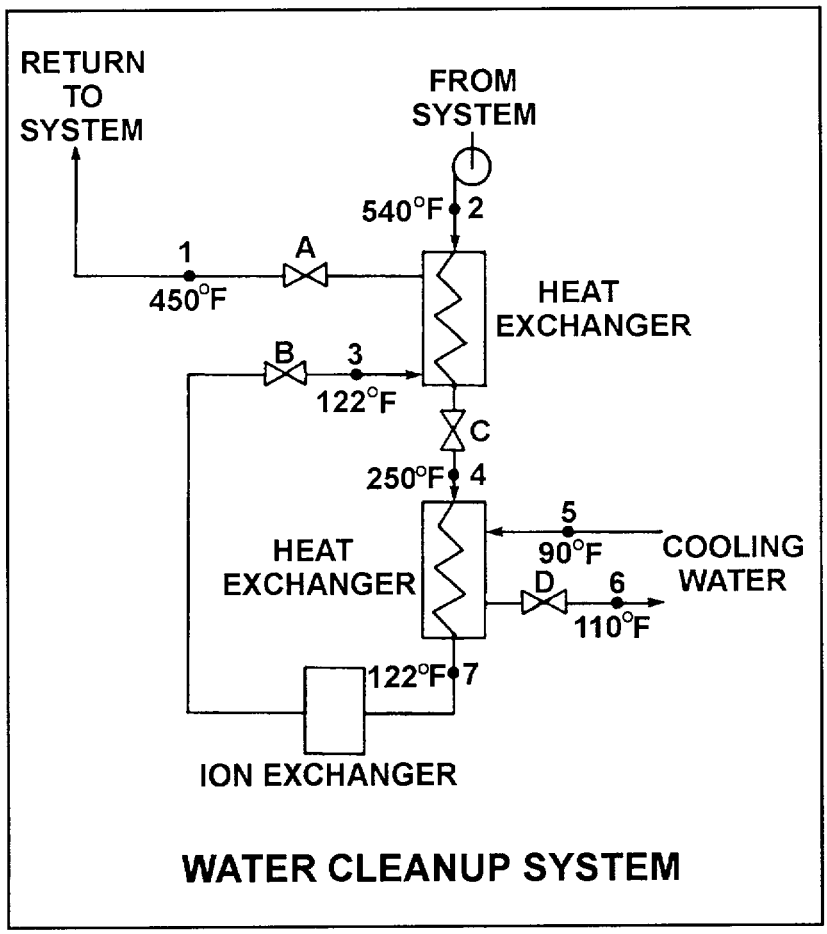
A. A; shut

B. B; open

C. C; shut

D. D; open

ANSWER: B.



QUESTION: 33
TOPIC: 191006
KNOWLEDGE: K1.04 [2.5/2.7]
QID: P432 (Rev) (BWR also)

A counter-flow lube oil cooler is located inside a machinery room that is maintained at 80°F. The cooler has been isolated for several days. When the cooler is returned to service, it will be supplied with seawater at 45°F to cool lube oil from 125°F to 105°F.

To minimize the thermal shock experienced by the cooler when it is returned to service, the lube oil flow rate should be _____ increased to design flow rate, while the cooling water flow rate is _____ increased to design flow rate.

A. quickly; subsequently

B. quickly; simultaneously

C. gradually; subsequently

D. gradually; simultaneously

ANSWER: D.

QUESTION: 34
TOPIC: 191006
KNOWLEDGE: K1.07 [2.4/2.6]
QID: New (on BWR also)

Refer to the drawing of a 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?

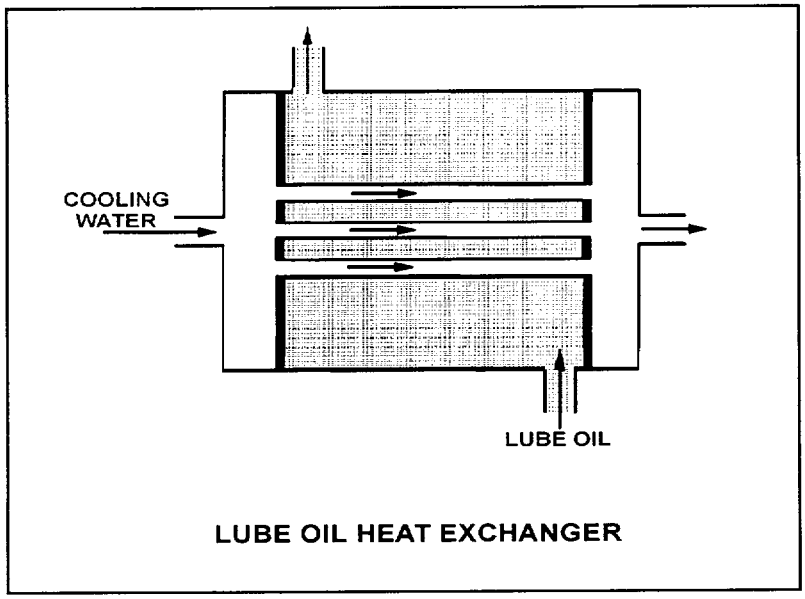
A. 76°F

B. 85°F

C. 92°F

D. 124°F

ANSWER A.



PROOF:

$Q_{oil} = m\ c_{p\text{-}oil}\ (T_{in} - T_{out})_{oil}$
$Q_{cw} = m\ c_{p\text{-}cw}\ (T_{out} - T_{in})_{cw}$
$Q_{oil} = Q_{cw}$
$m\ c_{p\text{-}oil}\ (T_{in} - T_{out})_{oil} = Q_{oil} = Q_{cw} = m\ c_{p\text{-}cw}\ (T_{out} - T_{in})_{cw}$

200 lbm/min x 0.8 BTU/lbm/°F x (140 °F – 100°F) = 400 lbm/min x 1.0 BTU/lbm/°F x (T_{out} – 60°F)

$T_{out} = 76$ °F

QUESTION: 35
TOPIC: 191007
KNOWLEDGE: K1.03
QID: P936

The ion exchange efficiency of a condensate demineralizer is determined by performing a calculation using the:

A. demineralizer inlet and outlet pH.

B. demineralizer inlet and outlet conductivity.

C. change in pH at the outlet of the demineralizer over a period of time.

D. change in conductivity at the outlet of the demineralizer over a period of time.

ANSWER: B.

QUESTION: 36
TOPIC: 191007
KNOWLEDGE: K1.08
QID: P2836 (B2138)

Refer to the drawing of a parallel demineralizer loop that is currently aligned for normal flow direction through the demineralizer (see figure below).

A minor seawater leak has occurred into the process water system, which is a closed system. Which one of the following will decrease the time required for the demineralizer loop to reduce the concentration of ionic impurities in the process water system?

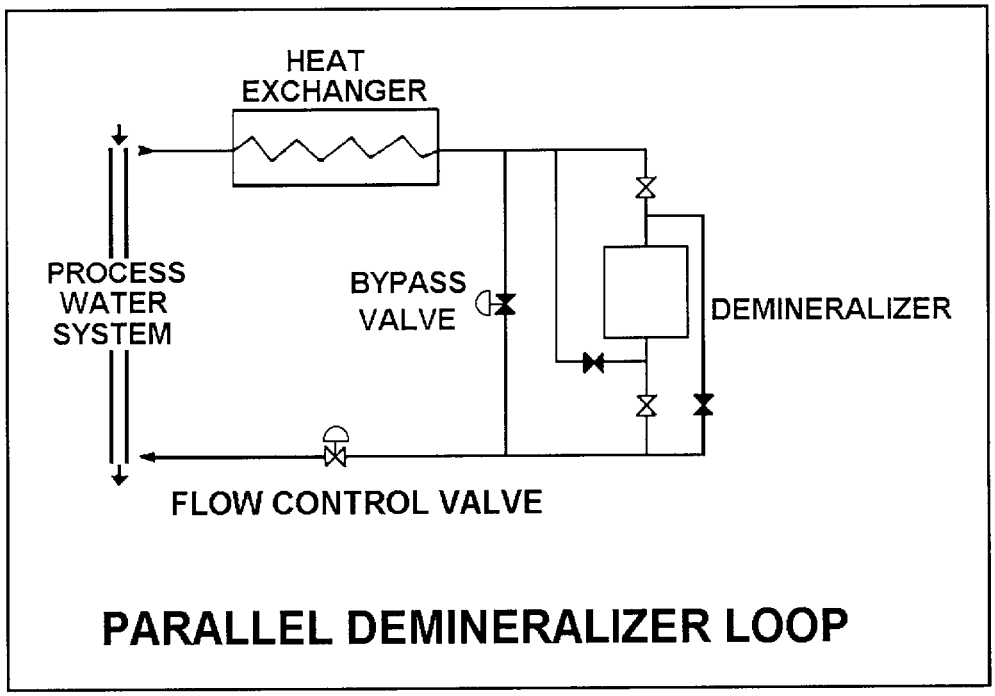
A. Reverse the flow direction through the demineralizer.

B. Divert 50% of the loop flow to bypass the demineralizer.

C. Increase the flow rate in the loop from 95 gpm to 105 gpm.

D. Decrease the temperature in the loop from 110°F to 100°F.

ANSWER: C.



QUESTION: 37
TOPIC: 191007
KNOWLEDGE: K1.09
QID: P236

A demineralizer that has been exposed to _____ should be bypassed because the resin beads may release unwanted ions.

A. low flow

B. high flow

C. low temperature

D. high temperature

ANSWER: D.

QUESTION: 38
TOPIC: 191008
KNOWLEDGE: K1.01
QID: P938

Which one of the following capabilities would remain functional following a loss of control power to a typical 480 Vac bus feeder breaker?

A. Remote breaker control

B. Remote bus voltage indication

C. Remote breaker position indication

D. Breaker closing spring automatic recharging

ANSWER: B.

QUESTION: 39

DELETED

QUESTION: 40
TOPIC: 191008
KNOWLEDGE: K1.04
QID: P840 (B840)

A typical 120 Vac manual circuit breaker has tripped due to overload. To close 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.

QUESTION: 41
TOPIC: 191008
KNOWLEDGE: K1.06
QID: P2640

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 follow 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?

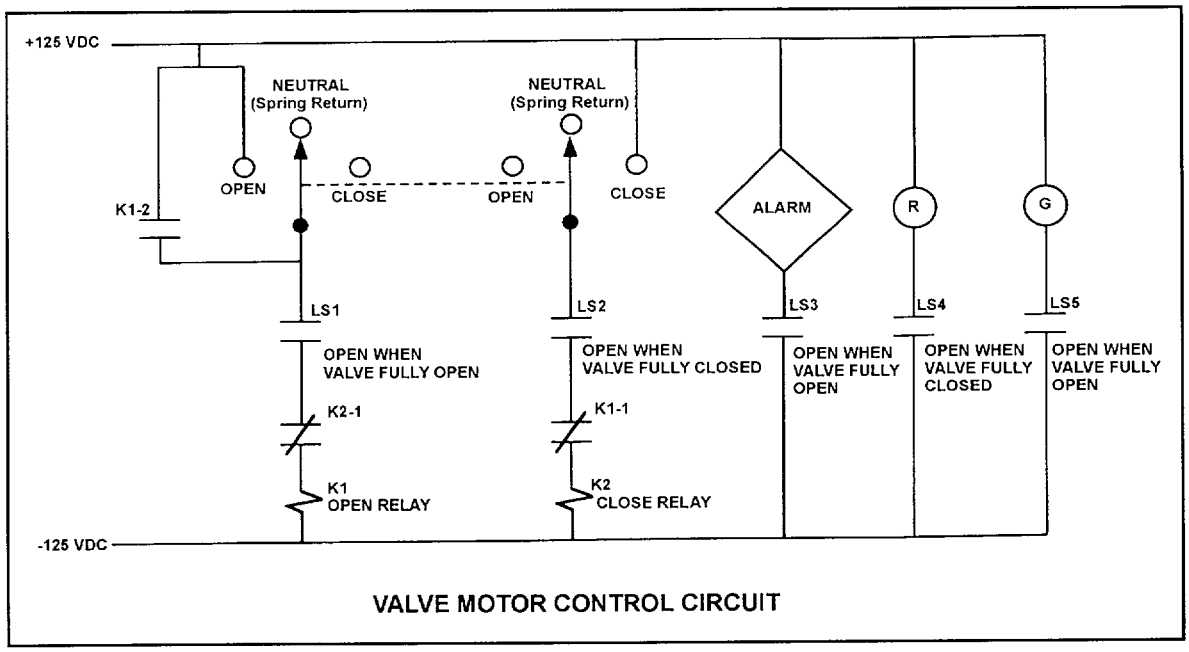
A. The valve will stop opening and remain partially open.

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

QUESTION: 42
TOPIC: 191008
KNOWLEDGE: K1.10
QID: P2742 (B2744)

Refer to the simplified drawing of an electrical distribution system showing 7.2 KV switchgear, step-down transformers, and 480V motor control centers (MCCs) (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?

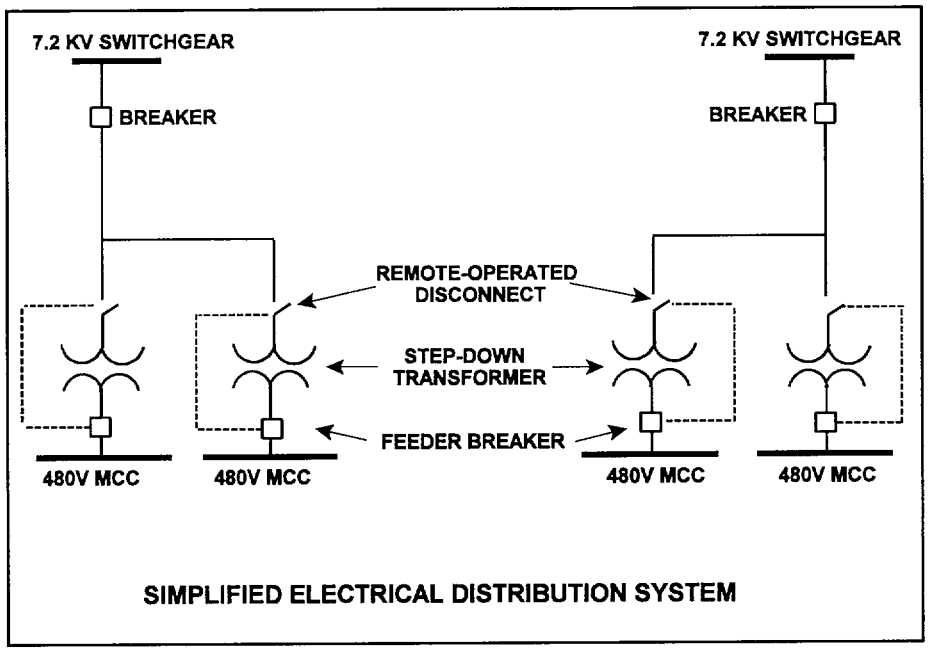
A. Prevent damage to the disconnect.

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

QUESTION: 43
TOPIC: 191008
KNOWLEDGE: K1.08
QID: P341 (B343)

The main generator is being paralleled to the grid. Generator voltage has been properly adjusted and the synchroscope is rotating slowly in the clockwise direction. The generator output breaker must be closed just prior to the synchroscope pointer reaching the 12 o'clock position to prevent:

A. motoring of the generator due to unequal frequencies.

B. excessive current within the breaker due to out-of-phase voltages.

C. excessive MW load transfer to the generator due to unequal frequencies.

D. excessive MVAR load transfer to the generator due to out-of-phase voltages.

ANSWER: B.

QUESTION: 44
TOPIC: 191008
KNOWLEDGE: K1.11
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.

QUESTION: 45
TOPIC: 192001
KNOWLEDGE: K1.02
QID: P2645 (B2645)

As compared to prompt neutrons, delayed neutrons:

A. are more likely to leak out of the core.

B. are more likely to cause fission of U-238.

C. are more likely to become thermal neutrons.

D. are responsible for the majority of U-235 fissions.

ANSWER: C.

QUESTION: 46
TOPIC: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P2647 (Rev)

A reactor is currently operating at equilibrium 80% power near the middle of a fuel cycle. Reactor reactivity control systems are in manual. During the next 3 days no operator action is taken. Assume a reactor scram does not occur.

How will core K_{eff} be affected during the 3-day period?

A. K_{eff} will gradually increase during the entire period.

B. K_{eff} will gradually decrease during the entire period.

C. K_{eff} will tend to increase, but inherent reactivity feedback will maintain K_{eff} at 1.0.

D. K_{eff} will tend to decrease, but inherent reactivity feedback will maintain K_{eff} at 1.0.

ANSWER: D.

QUESTION: 47
TOPIC: 192002
KNOWLEDGE: K1.14
QID: P2547

A 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 not changed.

If the initial shutdown margin was 3.5 %ΔK/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 %ΔK/K due only to the power defect.

B. Greater than 3.5 %ΔK/K due only to the insertion of control rods.

C. Less than 3.5 %ΔK/K due to the combined effects of control rod insertion and power defect.

D. Equal to 3.5 %ΔK/K regardless of the reactivity effects of control rod insertion and power defect.

ANSWER: D.

PROOF:

Variations in power and/or control rod position do not affect operating shutdown margin unless RCS boron concentration is also changed.

QUESTION: 48
TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: New (On BWR also)

A 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.

PROOF: Initial withdrawal of control rods caused the subcritical neutron population (also count rate) to double twice. Therefore, the first doubling occurred after 3.0 %ΔK/K was added (leaving the core subcritical by 3.0 %ΔK/K) and the second doubling occurred after the remaining 1.5 %ΔK/K was added. This left the core subcritical by 1.5 %ΔK/K. Therefore, an additional positive 1.5 %ΔK/K is necessary to make the reactor critical.

$$
\begin{aligned}
CR_1(1-K_1) &= CR_2(1-K_2) \\
20(1-K_1) &= 80[1-(K_1+0.045)] \\
(1-K_1) &= 80/20[1-(K_1+0.045)] \\
1-K_1 &= 4-4K_1-0.18 \\
4K_1-K_1 &= 4-0.18-1 \\
3K_1 &= 2.82, \text{ so } K_1 = 0.94
\end{aligned}
$$

Inserting 0.94 for K_1, in initial equations:

$$
\begin{aligned}
20(1 - 0.94) &= 80(1 - K_2) \\
20(0.06)/80 &= 1 - K_2 \\
0.015 &= 1 - K_2 \\
K_2 &= 0.985
\end{aligned}
$$

so +0.015 ΔK/K or 1.5 %ΔK/K required to achieve 0.0 reactivity

QUESTION: 49
TOPIC: 192003
KNOWLEDGE: K1.07
QID: P2348 (B2349)

Which one of the following percentages of fission, by fuel, occurring in a reactor will result in the smallest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	60%	6%	34%
B.	70%	7%	23%
C.	80%	6%	14%
D.	90%	7%	3%

ANSWER: A.

PROOF: Pu-239 has the smallest B. Therefore, the fuel that contains the most Pu-239 will have the smallest Beff.

QUESTION: 50
TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: New (on BWR also)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent 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.

PROOF:

It will be necessary for the power coefficient to add -0.3 %ΔK/K to stabilize reactor power. With power coefficient equal to -0.04 %ΔK/K/% power, reactor power will have to increase by 7.5% [0.3/.04] to return core reactivity to zero.

QUESTION: 51
TOPIC: 192004
KNOWLEDGE: K1.07
QID: P651

Which one of the following will cause the Doppler power coefficient to become more negative?

A. Lower power level

B. Increased clad creep

C. Increased pellet swell

D. Higher coolant boron concentration

ANSWER: A.

QUESTION: 52
TOPIC: 192004
KNOWLEDGE: K1.08
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.

QUESTION: 53
TOPIC: 192004
KNOWLEDGE: K1.10
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.

QUESTION: 54
TOPIC: 192005
KNOWLEDGE: K1.03
QID: P1955 (B954)

A 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. remain the same.

B. increase and stabilize at a new higher level.

C. increase temporarily then return to the original value.

D. increase exponentially until the operator inserts the control rod.

ANSWER: B.

QUESTION: 55
TOPIC: 192005
KNOWLEDGE: K1.07
QID: P2854

The reactor is operating at 85% power with the controlling group of control rods inserted 10%. Which one of the following will cause group differential control rod worth to become more negative? (Assume reactor power and control rod position remain constant for each case.)

A. RCS boron concentration is increased by 5 ppm .

B. Core Xe-135 builds up in the lower half of the core.

C. RCS average temperature drifts from 580°F to 575°F.

D. Fuel temperature increases as fission product gasses accumulate in a fuel rod.

ANSWER: B.

QUESTION: 56
TOPIC: 192005
KNOWLEDGE: K1.10
QID: P1357

The reactor is operating at 75% power at the middle of core life. 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 average reactor coolant temperature by 5°F.

C. Decrease reactor coolant boron concentration by 10 ppm.

D. Decrease reactor coolant system operating pressure by 15 psia.

ANSWER: A.

QUESTION: 57
TOPIC: 192005
KNOWLEDGE: K1.16
QID: P2257

A reactor is operating at 85% power with all control rods fully withdrawn. Assuming reactor power does not 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 greater change in shutdown margin.

B. A partially inserted rod causes a smaller change in shutdown margin.

C. A partially inserted rod causes a smaller change in axial power distribution.

D. A partially inserted rod causes a smaller change in radial power distribution.

ANSWER: D.

QUESTION: 58
TOPIC: 192006
KNOWLEDGE: K1.02
QID: P2458 (B1658)

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Boron-10

B. Xenon-135

C. Samarium-149

D. Uranium-235

ANSWER: B.

PROOF:

σ for B-10 is 3.0×10^3 barns
σ for Xe-135 is 2.5×10^6 barns
σ for Sm-149 is 4.1×10^4 barns
σ for U-235 is 6.9×10^2 barns

QUESTION: 59
TOPIC: 192006
KNOWLEDGE: K1.04
QID: P2659

A 3400 Mw reactor has been operating at 100% power for several months. Which one of the following describes the contributions of beta decay and neutron capture to Xe-135 removal from the reactor core?

A. Primary - beta decay; secondary - neutron capture

B. Primary - neutron capture; secondary - beta decay

C. Equally from beta decay and neutron capture

D. Not enough information given to make a comparison

ANSWER: B.

QUESTION: 60
TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: New (on BWR also)

A 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 scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. 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-scram peak location, and the flux peak will be moving _____.

A. higher; downward

B. higher; upward

C. lower; downward

D. lower; upward

ANSWER: A.

QUESTION: 61
TOPIC: 192006
KNOWLEDGE: K1.14
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 constant reactor power, the operator must add _____ reactivity because xenon concentration is _____.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

ANSWER: A.

QUESTION: 62
TOPIC: 192006
KNOWLEDGE: K1.12
QID: P360

Compare a 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. earlier; less negative

C. at the same time; the same

D. at the same time; less negative

ANSWER: B.

QUESTION: 63
TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2261 (Rev) (on BWR also)

A reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period using the control rods 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% position and inserting slowly

B. Above the initial 75% position and withdrawing slowly

C. Below the initial 75% position and inserting slowly

D. Below the initial 75% position and withdrawing slowly

ANSWER: C.

QUESTION: 64

DELETED

QUESTION: 65
TOPIC: 192008
KNOWLEDGE: K1.05
QID: P267

As criticality is approached during a reactor startup, equal insertions of positive reactivity result in a _____ absolute change in equilibrium count rate and a _____ time to reach each new equilibrium.

A. smaller; shorter

B. smaller; longer

C. greater; shorter

D. greater; longer

ANSWER: D.

QUESTION: 66
TOPIC: 192008
KNOWLEDGE: K1.09
QID: P469

A 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.

PROOF:

Reactivity added by dilution = -30 ppm x -0.025 %ΔK/K/ppm

$$\rho_{added} = 0.75\ \%\Delta K/K$$

$$\rho_{final} = \rho_{initial} + \rho_{added} = -1.0\%\Delta K/K + 0.75\%\Delta K/K$$

$$\rho_{final} = -0.25\%\Delta K/K$$

QUESTION: 67
TOPIC: 192008
KNOWLEDGE: K1.17
QID: P1070

A 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. Fuel temperature only

B. Moderator temperature only

C. Fuel temperature and voids

D. Moderator temperature and fuel temperature

ANSWER: D.

QUESTION: 68
TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P670 (Rev) (BWR also)

After taking critical data during a reactor startup, the operator establishes a stable 3/4 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.

PROOF: $\rho = \frac{\ell}{\tau} + \frac{\overline{\beta}}{1 + \lambda\tau}$

$\tau = \frac{26.06}{0.75} = 34.7$ sec

$\rho = \frac{0.0066}{1 + (0.1)(34.7)}$

$\rho = 0.00147 = 0.15$ %ΔK/K

QUESTION: 69
TOPIC: 192008
KNOWLEDGE: K1.20
QID: P571 (B2268)

A 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 1 dpm startup rate. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 30 seconds.

During the insertion, the startup rate will become:

A. zero during the entire period of control rod insertion.

B. negative 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 prior to control rods passing through the critical rod height.

ANSWER: D.

QUESTION: 70
TOPIC: 192008
KNOWLEDGE: K1.21
QID: P2372 (B2371)

A plant is operating at 90% 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 due to reduced neutron leakage out of the core.

B. decrease due to increased neutron leakage out of the core.

C. increase due to reduced neutron absorption in the moderator.

D. decrease due to increased neutron absorption in the moderator.

ANSWER: A.

QUESTION: 71
TOPIC: 192008
KNOWLEDGE: K1.25
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.

QUESTION: 72
TOPIC: 192008
KNOWLEDGE: K1.27
QID: P1272 (B1372)

Following a reactor shutdown from long-term operation at full power, core heat production will continue for a period of time. The rate of core heat production will depend on the:

A. intrinsic neutron source strength following shutdown.

B. amount of time that has elapsed since K_{eff} decreased below 1.0.

C. rate at which the reactor was brought subcritical during shutdown.

D. amount of time required for the reactor pressure vessel to cool down.

ANSWER: B.

QUESTION: 73
TOPIC: 193001
KNOWLEDGE: K1.01
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.

PROOF: A. is equivalent to 17 psia, 6 psia, 8 psia
B. is equivalent to 17 psia, 9 psia, 8 psia
C. is equivalent to 12 psia, 10 psia, 17 psia
D. is equivalent to 12 psia, 15 psia, 17 psia

QUESTION: 74
TOPIC: 193003
KNOWLEDGE: K1.25 [3.3/3.4]
QID: P1976 (Rev) (on BWR also)

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 ft^3/lbm

ANSWER: A.

QUESTION: 75
TOPIC: 193003
KNOWLEDGE: K1.08
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. result in 1 °F of superheat.

B. vaporize a portion of the water.

C. increase the density of the water.

D. raise the temperature of the water by 1 °F.

ANSWER: B.

QUESTION: 76
TOPIC: 193004
KNOWLEDGE: K1.11
QID: P1977

A plant is operating near full rated power. Condensate is collecting in the main condenser hotwell at 90°F with a condenser pressure of 28" Hg vacuum. Which one of the following will improve steam cycle efficiency?

A. Main condenser cooling water flow 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" Hg due to buildup of noncondensible gases.

D. Steam flow through the turbine decreases by 10% with no change in condenser vacuum.

ANSWER: A.

QUESTION: 77
TOPIC: 193004
KNOWLEDGE: K1.15 [2.8/2.8]
QID: New (on BWR also)

A reactor 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.

PROOF:
From the Mollier Diagram, the enthalpy of steam in the steam line is 1219 Btu/lbm. Assuming an isenthalpic expansion of the steam to atmospheric pressure, 1219 Btu/lbm intersects the atmospheric pressure line at approximately 358°F.

QUESTION: 78
TOPIC: 193005
KNOWLEDGE: K1.03 [2.5/2.6]
QID: P379 (Rev) (BWR also)

Which one of the following will be caused by a decrease in main condenser vacuum (higher absolute pressure) on a 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 noncondensable gas in the condenser

ANSWER: B.

QUESTION: 79
TOPIC: 193006
KNOWLEDGE: K1.04
QID: P78

The possibility of water hammer in a liquid system is minimized by:

A. venting systems prior to starting centrifugal pumps.

B. maintaining temperature above the saturation temperature.

C. starting centrifugal pumps with the casing vent valve fully open.

D. starting positive displacement pumps with the discharge valve closed.

ANSWER: A.

QUESTION: 80
TOPIC: 193006
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P680 (Rev)

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. 68.2 gpm

ANSWER: D.

PROOF:

$$DP \propto f_2$$

$$\frac{DP_1}{DP_2} = \left(\frac{f_1}{f_2}\right)^2$$

$$\frac{100}{80} = \left(\frac{75}{f_2}\right)^2$$

$$1.118 = \frac{75}{f_2}$$

$$f_2 = \frac{75}{1.118}$$

$$f_2 = 68.2 \text{ gpm}$$

QUESTION: 81
TOPIC: 193006
KNOWLEDGE: K1.12 [2.5/2.6]
QID: New (on BWR also)

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.

PROOF:

$m_{in} = m_{out}$
$\rho_{in}A_{in}V_{in} = \rho_{out}A_{out}V_{out}$
Since $A_{in} = A_{out}$, $\rho_{in}V_{in} = \rho_{out}V_{out}$ and $\rho_{in}/\rho_{out} = V_{out}/V_{in}$
Since $\rho = 1/\upsilon$, $\upsilon_{out}/\upsilon_{in} = V_{out}/V_{in}$
$\upsilon_{in} = 0.016099$ ft^3/lbm at 90°F
$\upsilon_{out} = 0.016395$ ft^3/lbm 160°F
Therefore, $V_{out}/V_{in} = 0.016395/0.016099 = 1.0184$

Since V (velocity) increased by a factor of 1.0184, V-dot (volumetric flow rate) also increases by 1.0184.
Therefore, V-dot$_{out}$ = 500(1.0184) ≈ 509 gpm

QUESTION: 82
TOPIC: 193006
KNOWLEDGE: K1.07
QID: P581

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

Prior to restarting an RCP, the steam generator (S/G) temperatures should be equal to or less than the associated reactor coolant system (RCS) loop temperature to avoid:

A. localized water hammer in the RCS.

B. pressurized thermal shock to the S/Gs.

C. a large pressure spike throughout the RCS.

D. inadvertently lifting a S/G atmospheric relief valve.

ANSWER: C.

QUESTION: 83
TOPIC: 193006
KNOWLEDGE: K1.08
QID: P279 (B143)

A centrifugal 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.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 84
TOPIC: 193007
KNOWLEDGE: K1.04 [2.8/3.0]
QID: New (on BWR also)

A reactor plant is operating at 100% rated power. Main turbine extraction steam is being supplied to a feedwater heater. Extraction steam parameters are as follows:

Steam pressure: 750 psia
Steam flow rate: 7.5×10^5 lbm/hr
Steam enthalpy: 1150 Btu/lbm

Saturated liquid condensate at 448°F leaves the feedwater heater via a drain line.

What is the approximate heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A. 3.8×10^7 Btu/hr

B. 8.6×10^7 Btu/hr

C. 5.4×10^8 Btu/hr

D. 7.2×10^8 Btu/hr

ANSWER C.

PROOF:

Enthalpy of steam is 1150 Btu/lbm (given). Enthalpy of condensate is approximately 428 Btu/lbm (from steam tables). Difference is heat transferred to feedwater.
1150 - 428 = 722 Btu/lbm

From equation sheet:

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

$\dot{Q}$ = Heat Transfer Rate = 7.5×10^5 lbm/hr x 722 Btu/lbm

$$\dot{Q} = 5.4 \times 10^8 \text{ Btu/hr}$$

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 PWR--FORM A

QUESTION: 85
TOPIC: 193007
KNOWLEDGE: K1.06
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 lower than actual reactor power?

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

B. The feed water flow rate used in the heat balance calculation was 10% higher than actual flow rate.

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

D. The feed water temperature used in the heat balance calculation was 20°F higher than actual feed water temperature.

ANSWER: D.

QUESTION: 86
TOPIC: 193008
KNOWLEDGE: K1.02
QID: P886

Convection heat transfer improves when nucleate boiling begins on the surface of a fuel rod because:

A. a steam blanket begins to form along the surface of the fuel rod.

B. steam bubble formation increases coolant flow along the fuel rod.

C. steam bubble formation decreases coolant flow along the fuel rod.

D. the motion of the steam bubbles causes rapid mixing of the coolant.

ANSWER: D.

QUESTION: 87
TOPIC: 193008
KNOWLEDGE: K1.06
QID: P2187

Which one of the following will be the initial cause of fuel damage if a fuel rod exceeds the critical heat flux at 100% power?

A. Excessive fuel clad temperature

B. Excessive fuel pellet temperature

C. Excessive fuel rod thermal stress

D. Excessive fuel rod internal pressure

ANSWER: A.

QUESTION: 88
TOPIC: 193008
KNOWLEDGE: K1.07
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. Nucleate boiling

B. Subcooled boiling

C. Partial film boiling

D. Total film boiling

ANSWER: C.

QUESTION: 89
TOPIC: 193008
KNOWLEDGE: K1.15
QID: P992

Which one of the following will directly increase the reactor coolant system (RCS) subcooling margin with the reactor operating at full power?

A. Increased coolant flow rate

B. Decreased RCS hot leg temperature

C. Decreased RCS cold leg temperature

D. Increased concentration of soluble gases in the RCS

ANSWER: B.

QUESTION: 90
TOPIC: 193008
KNOWLEDGE: K1.17
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. This is most likely caused by:

A. RCP runout.

B. RCP cavitation.

C. RCS hot leg saturation.

D. RCS loop water hammer.

ANSWER: B.

QUESTION: 91
TOPIC: 193008
KNOWLEDGE: K1.20
QID: P1391

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

A. Provides a means of measuring core flow

B. Prevents boron precipitation in the core baffle area

C. Prevents excessive reactor vessel wall differential temperature

D. Provides cooling to various reactor vessel internal components

ANSWER: D.

QUESTION: 92
TOPIC: 193008
KNOWLEDGE: K1.21
QID: P2392

A reactor is shut down with natural circulation core cooling. Decay heat generation is equivalent to 1.0% rated thermal power. Core ΔT has stabilized at 13°F.

When decay heat generation decreases to 0.5% rated thermal power, core ΔT will be approximately:

A. 4°F.

B. 6°F.

C. 8°F.

D. 10°F.

ANSWER: C.

PROOF:

$$\Delta T^{1/2} \propto \dot{Q}^{1/3}$$

$$\Delta T \propto \dot{Q}^{2/3}$$

$$\frac{\Delta T_1}{\Delta T_2} = \left(\frac{\dot{Q}_1}{\dot{Q}_2}\right)^{2/3}$$

$$\Delta T_2 = \frac{\Delta T_1}{(\dot{Q}_1/\dot{Q}_2)^{2/3}}$$

$$\Delta T_2 = \frac{13}{(1/.5)^{2/3}}$$

$$\Delta T_2 = \frac{13}{1.587}$$

$$\Delta T_2 = 8.2°F$$

QUESTION: 93
TOPIC: 193008
KNOWLEDGE: K1.24
QID: P786

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

A. Forced coolant flow

B. Natural circulation coolant flow

C. Radiation with total core voiding

D. Conduction with stagnant coolant flow

ANSWER: B.

QUESTION: 94
TOPIC: 193009
KNOWLEDGE: K1.01
QID: P2794

A 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.

QUESTION: 95
TOPIC: 193009
KNOWLEDGE: K1.02
QID: P2894

A reactor is operating steady-state at 80% power at the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. Moderator temperature coefficient is negative.

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

A. One bank of control rods is inserted 10%.

B. Power is maintained constant for one month.

C. Turbine load/reactor power is reduced by 20%.

D. Reactor coolant system boron concentration is increased by 50 ppm.

ANSWER: A.

QUESTION: 96
TOPIC: 193010
KNOWLEDGE: K1.01
QID: P2496 (B2499)

Brittle fracture of a low-carbon steel reactor vessel can only occur when the temperature of the vessel is _____ the nil ductility temperature, and will normally occur when the applied stress is _____ the steel's yield strength (or yield stress).

A. less than; less than

B. less than; greater than

C. greater than; less than

D. greater than; greater than

ANSWER: A.

QUESTION: 97
TOPIC: 193010
KNOWLEDGE: K1.04
QID: P96 (B100)

The likelihood of brittle fracture failure of the reactor vessel is reduced by:

A. increasing vessel age.

B. reducing vessel pressure.

C. reducing vessel temperature.

D. reducing gamma flux exposure.

ANSWER: B.

QUESTION: 98
TOPIC: 193010
KNOWLEDGE: K1.05
QID: P2599 (B2600)

Two identical 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 from a shut down core is not significant.

ANSWER: C.

QUESTION: 99
TOPIC: 193010
KNOWLEDGE: K1.06
QID: P2800 (N/A)

Which one of the following would be most likely to cause pressurized thermal shock of the reactor vessel?

A. Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a main steam line.

B. Starting a reactor coolant pump in an idle loop with the associated steam generator temperature less than RCS loop temperature.

C. Starting a reactor coolant pump in an idle loop with the associated steam generator temperature greater than RCS loop temperature.

D. Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a reactor vessel coolant outlet nozzle.

ANSWER: A.

QUESTION: 100
TOPIC: 193010
KNOWLEDGE: K1.07
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. Tensile across the entire wall

B. Compressive across the entire wall

C. Tensile at the inner wall, compressive at the outer wall

D. Compressive at the inner wall, tensile at the outer wall

ANSWER: C.

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

FEBRUARY 2001 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

FORM A	FORM B	ANS	FORM A	FORM B	ANS	FORM A	FORM B	ANS	FORM A	FORM B	ANS
1	29	C	26	54	C	51	79	A	76	4	A
2	30	B	27	55	D	52	80	C	77	5	D
3	31	C	28	56	C	53	81	C	78	6	B
4	32	A	29	57	D	54	82	B	79	7	A
5	33	B	30	58	A	55	83	B	80	8	D
6	34	B	31	59	C	56	84	A	81	9	D
7	35	B	32	60	B	57	85	D	82	10	C
8	36	A	33	61	D	58	86	B	83	11	C
9	37	C	34	62	A	59	87	B	84	12	C
10	38	C	35	63	B	60	88	A	85	13	D
11	39	D	36	64	C	61	89	A	86	14	D
12	40	C	37	65	D	62	90	B	87	15	A
13	41	D	38	66	B	63	91	C	88	16	C
14	42	D	39	67	A/C	64	92	B/D	89	17	B
15	43	B	40	68	D	65	93	D	90	18	B
16	44	A	41	69	C	66	94	A	91	19	D
17	45	D	42	70	A	67	95	D	92	20	C
18	46	B	43	71	B	68	96	C	93	21	B
19	47	A	44	72	D	69	97	D	94	22	D
20	48	D	45	73	C	70	98	A	95	23	A
21	49	C	46	74	D	71	99	C	96	24	A
22	50	B	47	75	D	72	100	B	97	25	B
23	51	A	48	76	A	73	1	B	98	26	C
24	52	C	49	77	A	74	2	A	99	27	A
25	53	B	50	78	D	75	3	B	100	28	C

March 8, 2001

UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001--FORM A (with answers and proofs)

Please Print

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided. Each item has equal point value. A score of at least 80% is required to pass this portion of the written licensing examination. All examination papers will be collected 3.0 hours after the examination starts. This examination applies to a typical boiling water reactor (BWR) power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 44		
REACTOR THEORY	45 - 72		
THERMODYNAMICS	73 - 100		
TOTALS	100		

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

_____
Applicant's Signature

RULES AND GUIDELINES FOR THE GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

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

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

2. Fill in the name of your facility.

3. Fill in your individual docket number.

4. Fill in your start and stop times at the appropriate time.

5. Two aids are provided for your use during the examination:

   (1) An equations and conversions sheet contained within the examination copy, and

   (2) Steam tables provided by your proctor.

6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.

7. Scrap paper will be provided for calculations.

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

9. Restroom trips are limited. Only **ONE** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside of the examination room.

10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination.

11. Turn in your examination materials, answer sheet on top, followed by the examination booklet, then examination aids - steam table booklets, handouts, and scrap paper used during the examination.

12. After turning in your examination materials, leave the examination area, as defined by the proctor. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

$\lambda_{eff} = 0.1$ seconds^{-1}

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

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

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

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

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

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

Eff. = Net Work Out/Energy In

$\upsilon(P_2 - P_1) + \dfrac{(\vec{v}_2^{\,2} - \vec{v}_1^{\,2})}{2g_c} + \dfrac{g(z_2 - z_1)}{g_c} = 0$

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

CONVERSIONS

1 Mw	= 3.41×10^6 Btu/hr	1 Curie	= 3.7×10^{10} dps
1 hp	= 2.54×10^3 Btu/hr	1 kg	= 2.21 lbm
1 Btu	= 778 ft-lbf	1 gal_{water}	= 8.35 lbm
°C	= (5/9)(°F - 32)	1 ft^3_{water}	= 7.48 gal
°F	= (9/5)(°C) + 32		

QUESTION: 1
TOPIC: 291001
KNOWLEDGE: K1.01
QID: B1101 (N/A)

Which one of the following statements describes the operation of reactor pressure vessel safety valves?

A. An open safety valve will close when the pilot valve senses a reduced reactor pressure and isolates reactor pressure to the main valve disk.

B. An open safety valve will close when reactor pressure decreases enough for gravity and spring tension to overcome the effect of reactor pressure on the main valve disk.

C. When reactor pressure reaches the lift set point, the safety valve begins to open and will modulate to a position that is directly proportional to reactor pressure.

D. When reactor pressure reaches the lift set point, a pilot valve closes to create a ΔP across the main valve disk which overcomes gravity and spring tension to open the valve.

ANSWER: B.

QUESTION: 2
TOPIC: 291001
KNOWLEDGE: K1.03 [2.7/2.8]
QID: B2601 (Rev)

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.

QUESTION: 3
TOPIC: 291001
KNOWLEDGE: K1.10
QID: B302 (P303)

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

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

ANSWER: B.

QUESTION: 4
TOPIC: 291001
KNOWLEDGE: K1.11
QID: B2504 (P2504)

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

A. ball; ball

B. ball; butterfly

C. butterfly; ball

D. butterfly; butterfly

ANSWER: A.

QUESTION: 5
TOPIC: 291001
KNOWLEDGE: K1.12
QID: B1205 (P2004)

In a comparison of a typical gate valve with a typical globe valve in the same application, the globe valve has a _____ pressure drop with both valves fully open and is the better choice for _____ flow in high-pressure fluid systems.

A. lower; isolating

B. lower; throttling

C. higher; isolating

D. higher; throttling

ANSWER: D.

QUESTION: 6
TOPIC: 291002
KNOWLEDGE: K1.01
QID: B407 (P1606)

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

A subcooled fluid is flowing through a convergent-divergent venturi. Compared to conditions at the inlet of the venturi (P1), pressure at the outlet of the venturi (P2) has _____ and system mass flow rate has _____. (Assume "real" conditions.)

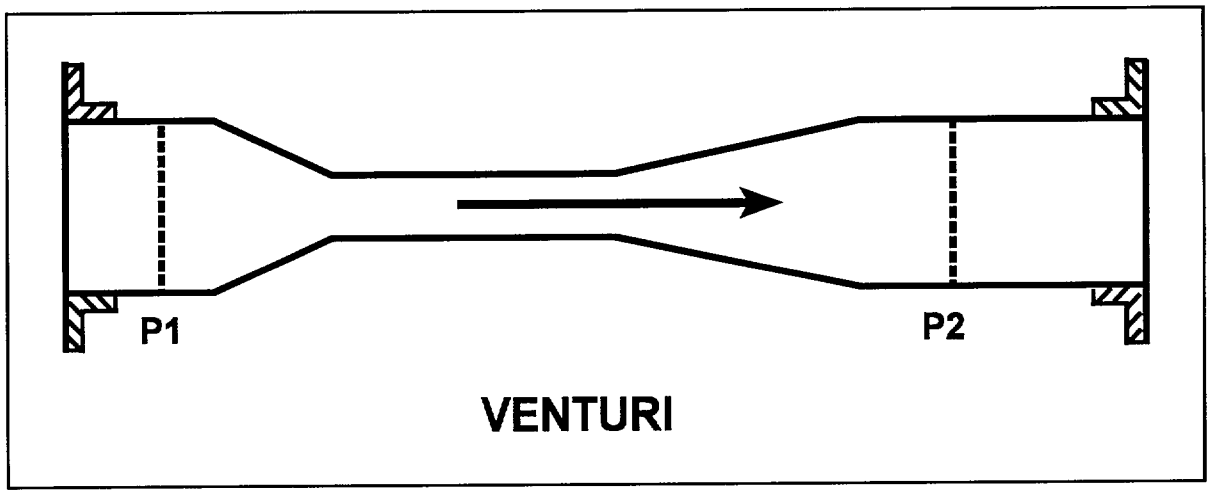
A. decreased slightly; decreased slightly

B. decreased slightly; remained the same

C. remained the same; decreased slightly

D. remained the same; remained the same

ANSWER: B.



QUESTION: 7
TOPIC: 291002
KNOWLEDGE: K1.02
QID: B2506 (P2506)

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 not 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 not affect the mass flow rate of main steam.

D. remain the same because the differential pressure across the flow rate measuring instrument has not changed.

ANSWER: A.

QUESTION: 8
TOPIC: 291002
KNOWLEDGE: K1.04
QID: B707 (P706)

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 orifice erodes over time.

B. Debris becomes lodged in the orifice.

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

D. The flow detector equalizing valve is inadvertently opened.

ANSWER: B.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 9
TOPIC: 291002
KNOWLEDGE: K1.05
QID: B2307 (P2307)

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
AD	A and D
BD	B and D
CD	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?

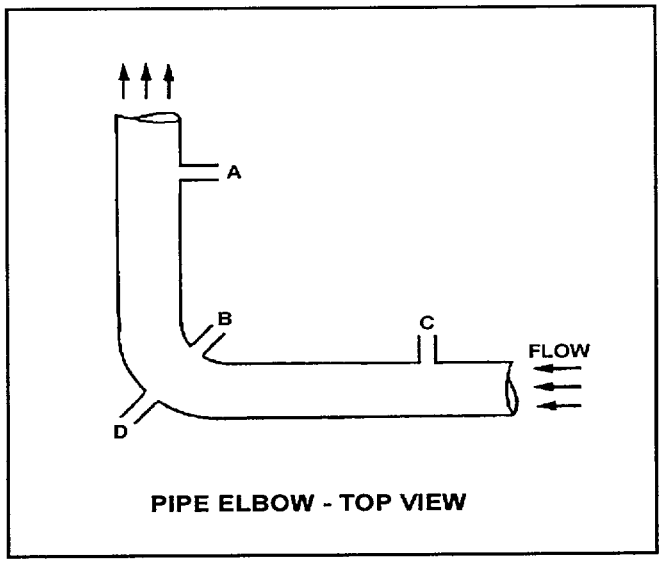
A. Detector indication will not change.

B. Only one detector will indicate higher flow.

C. Only two detectors will indicate higher flow.

D. All detectors will indicate higher flow.

ANSWER: A.



PIPE ELBOW - TOP VIEW

QUESTION: 10
TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B910 (Rev)

Refer to the drawing of a tank with differential pressure (D/P) level detector (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 not 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.

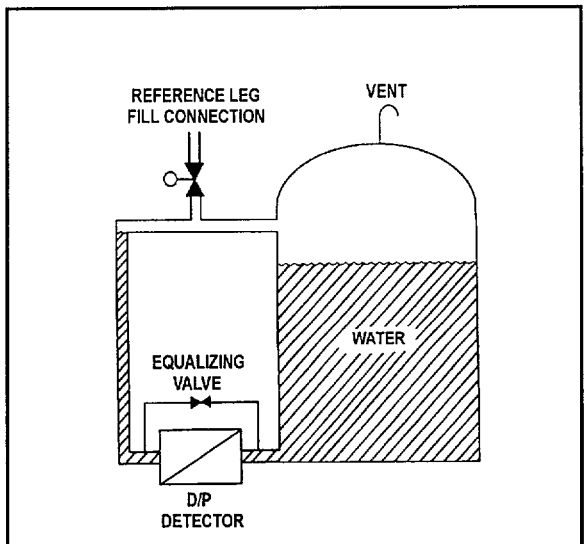
A. increase; level

B. decrease; level

C. increase; mass

D. decrease; mass

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 11
TOPIC: 291002
KNOWLEDGE: K1.08
QID: B12 (P609)

Refer to the drawing of four tank differential pressure 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 most accurate 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.)

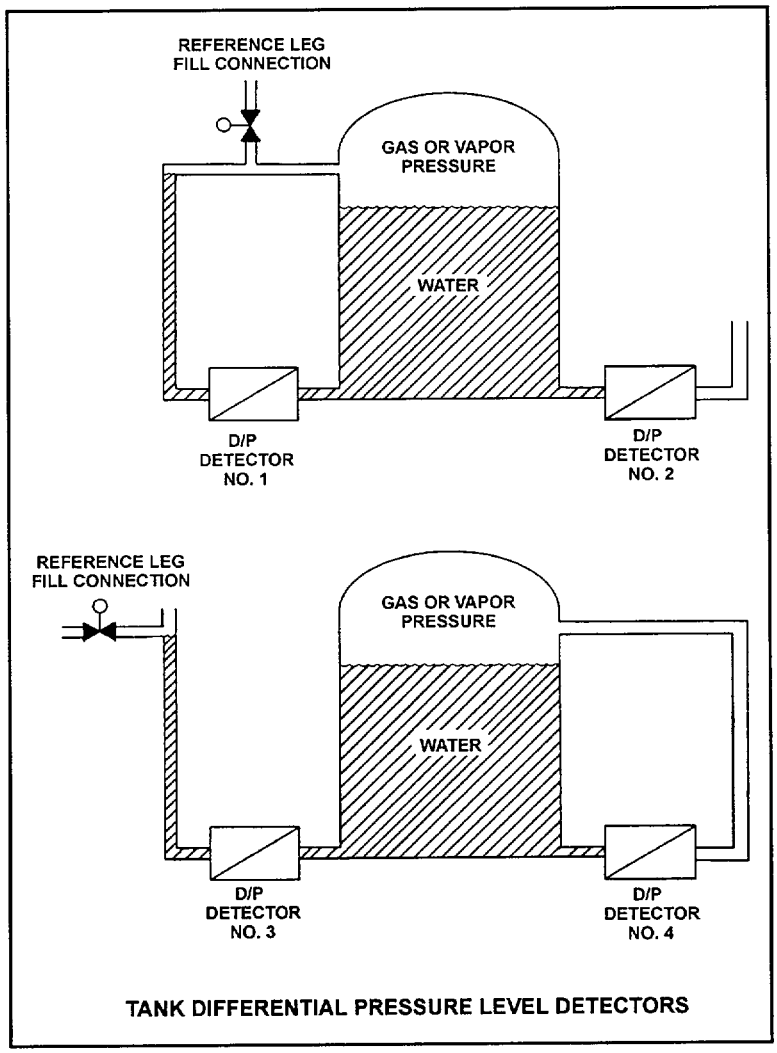
A. 1 and 3

B. 1 and 4

C. 2 and 3

D. 2 and 4

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 12
TOPIC: 291002
KNOWLEDGE: K1.11
QID: B2912

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

If a steam line rupture raises containment pressure by 20 psig, the water system pressure indication will:

(Disregard any temperature effect on the detector.)

A. decrease to 80 psig.

B. decrease by a small, but indeterminate amount.

C. increase by a small, but indeterminate amount.

D. increase to 120 psig.

ANSWER: A.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 13
TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B1510 (Rev)

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. If an ambient temperature decrease lowers reference junction temperature to 110°F, the new thermocouple temperature indication will be:

(Assume measuring junction temperature remains constant.)

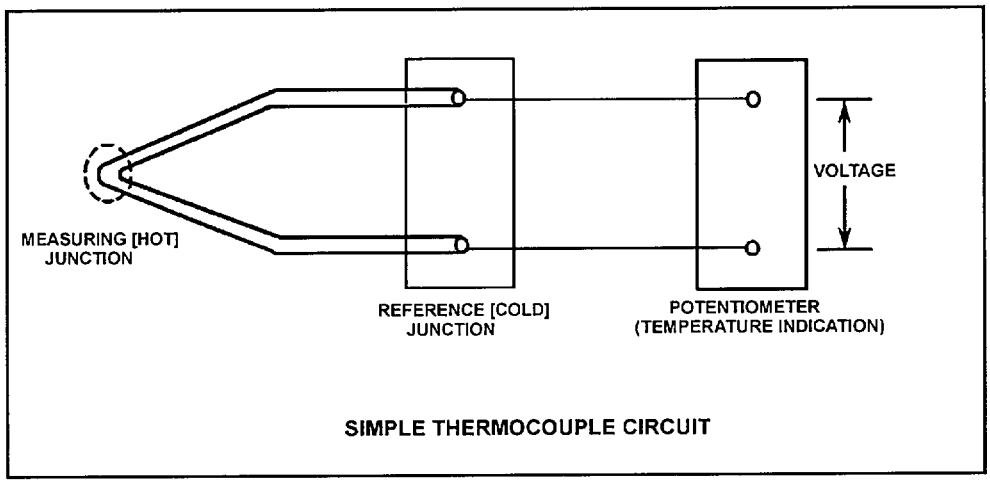
A. 380°F.

B. 395°F.

C. 410°F.

D. 425°F.

ANSWER: D.



SIMPLE THERMOCOUPLE CIRCUIT

PROOF: $T_{ind} = T_H - T_C$

If T_C decreases by 15°F, then T_{ind} increases by 15°F.

410°F + 15°F = 425°F

QUESTION: 14
TOPIC: 291002
KNOWLEDGE: K1.21
QID: B2413 (P2014)

What is the effect on a proportional neutron detector if it is operated at a voltage near the high end of the proportional (true proportional) region on the gas-filled detector characteristic curve?

A. Neutron 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 pulses, yielding a less accurate neutron count rate.

C. A high gamma radiation field will result in multiple small gamma pulses that combine to look like a larger pulse. The combined pulses will be counted as neutron 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.

QUESTION: 15
TOPIC: 291003
KNOWLEDGE: K1.01
QID: B1616 (P1518)

Which one of the following is used to describe the delay between a process parameter change and the sensing of that change by the process controller?

A. Gain

B. Offset

C. Dead time

D. Time constant

ANSWER: C.

QUESTION: 16
TOPIC: 291003
KNOWLEDGE: K1.04 [3.3/3.3]
QID: New

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

Assume the orientation of the bistable symbol indicates the characteristics of the bistable. 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?

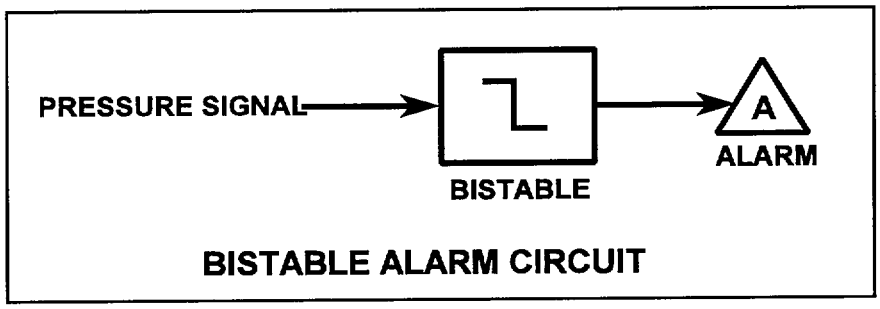
A. The alarm is currently actuated and will turn off at 95 psig.

B. The alarm is currently actuated and will turn off at 105 psig.

C. The alarm will actuate at 100 psig and will NOT turn off.

D. The alarm will actuate at 100 psig and will turn off at 105 psig.

ANSWER: B.



BISTABLE ALARM CIRCUIT

QUESTION: 17
TOPIC: 291003
KNOWLEDGE: K1.05
QID: B1416 (P1217)

The purpose of a valve positioner in a typical pneumatic control system is to:

A. convert the valve controller pneumatic output signal to a mechanical force to position the valve.

B. convert the valve controller pneumatic output signal to an electrical output to position the valve.

C. compare valve controller pneumatic output signal to setpoint error, and adjust valve actuator air supply pressure to position the valve.

D. compare valve controller pneumatic output signal to valve position, and adjust valve actuator air supply pressure to position the valve.

ANSWER: D.

QUESTION: 18
TOPIC: 291004
KNOWLEDGE: K1.01
QID: B1718 (P1820)

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.

QUESTION: 19
TOPIC: 291004
KNOWLEDGE: K1.05
QID: B102

The discharge head of a centrifugal pump will decrease if the:

A. speed of the pump increases.

B. pump suction pressure increases.

C. discharge valve is throttled closed.

D. temperature of the fluid being pumped increases.

ANSWER: D.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 20
TOPIC: 291004
KNOWLEDGE: K1.06
QID: B2621 (P2621)

A cooling water pump is operating with pump suction parameters as follows:

Suction Temperature: 124°F
Suction Pressure: 11.7 psia

What is the approximiate 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.

PROOF:

$NPSH_{avail} = (P - Psat) \times \nu$

from steam tables:

Psat = 1.89 psia @ 124° F $\quad \nu = 0.016221\ ft^3/lbm$

$11.7 - 1.89\ lbf/in^2 \times 0.016221\ ft^3/lbm \times 144\ in^2/ft^2 = NPSH_{avail}$

$NPSH_{avail}$ = 22.9 ft-lbF/lbm, = 22.9 feet

QUESTION: 21
TOPIC: 291004
KNOWLEDGE: K1.08
QID: B519

Many large centrifugal pumps are interlocked so that the pump will not start unless its discharge valve is at least 90% closed. This interlock is provided to minimize the:

A. pump discharge pressure.

B. required net positive suction head.

C. loading on the pump thrust bearing.

D. duration of the pump motor starting current.

ANSWER: D.

QUESTION: 22
TOPIC: 291004
KNOWLEDGE: K1.13 [2.6/2.7]
QID: New

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.

QUESTION: 23
TOPIC: 291004
KNOWLEDGE: K1.14
QID: B723 (P724)

A centrifugal pump is operating normally 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.

QUESTION: 24
TOPIC: 291004
KNOWLEDGE: K1.15
QID: B1623

Which one of the following describes the typical purpose of minimum flow piping for a centrifugal pump?

A. Prevent pump runout during high flow conditions

B. Ensure adequate pump cooling during low flow conditions

C. Prevent vortexing at the pump suction during high flow conditions

D. Ensure adequate net positive suction head during low flow conditions

ANSWER: B.

QUESTION: 25
TOPIC: 291004
KNOWLEDGE: K1.19 [2.6/2.6]
QID: New

A pump is needed to supply fuel oil from a day tank to a diesel 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 1900 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.

QUESTION: 26
TOPIC: 291005
KNOWLEDGE: K1.01
QID: 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. Increases due to increased pump work

B. Decreases due to decreased pump work

C. Increases due to decreased counter electromotive force

D. Decreases due to decreased counter electromotive force

ANSWER: B.

QUESTION: 27
TOPIC: 291005
KNOWLEDGE: K1.02
QID: B1526 (P1028)

Which one of the following will result from prolonged operation of ac motor windings at excessively high 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 ground resistance due to breakdown of winding insulation

D. Increased electrical ground resistance due to breakdown of winding insulation

ANSWER: C.

QUESTION: 28
TOPIC: 291005
KNOWLEDGE: K1.08
QID: B1030

The main generator is paralleled to the grid with VARs currently at zero. If generator field excitation increases, generator VARs will become _____ and generator power factor value will _____.

A. negative (VARs in); increase

B. negative (VARs in); decrease

C. positive (VARs out); increase

D. positive (VARs out); decrease

ANSWER: D.

QUESTION: 29
TOPIC: 291005
KNOWLEDGE: K1.05
QID: B2127 (P29)

The starting current in a typical ac induction motor is much higher than the full-load running current because:

A. starting torque is much lower than running torque.

B. starting torque is much higher than running torque.

C. rotor speed during start is too low to generate significant counter electromotive force in the stator.

D. rotor current during start is too low to generate significant counter electromotive force in the stator.

ANSWER: C.

QUESTION: 30
TOPIC: 291005
KNOWLEDGE: K1.09
QID: B2029 (P1128)

If the voltage supplied by an ac generator to an isolated electrical bus is held constant while loads (kW) are added to the bus, the current supplied by the generator will increase in direct proportion to the _____ of the change in kW. (Assume power factor does not change.)

A. cube

B. square

C. amount

D. square root

ANSWER: C.

QUESTION: 31
TOPIC: 291006
KNOWLEDGE: K1.04
QID: B2431 (P2433)

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

All valves are identical and are initially 50% open. To raise the temperature at point 1, the operator can adjust valve _____ in the _____ direction.

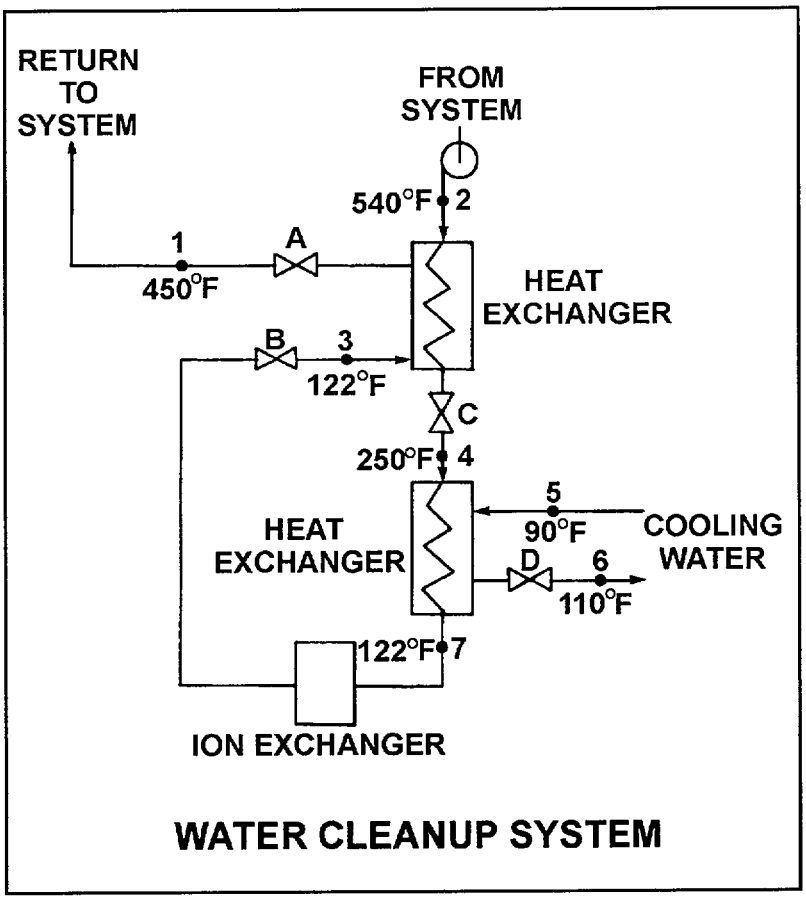
A. A; shut

B. B; open

C. C; shut

D. D; open

ANSWER: B.



QUESTION: 32
TOPIC: 291006
KNOWLEDGE: K1.08 [2.9/3.0]
QID: New

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.

PROOF:

$m_{in} = m_{out}$
$\rho_{in}A_{in}V_{in} = \rho_{out}A_{out}V_{out}$
Since $A_{in} = A_{out}$, $\rho_{in}V_{in} = \rho_{out}V_{out}$ and $\rho_{in}/\rho_{out} = V_{out}/V_{in}$
Since $\rho = 1/\upsilon$, $\upsilon_{out}/\upsilon_{in} = V_{out}/V_{in}$
$\upsilon_{in} = 0.016099$ ft^3/lbm at 90°F
$\upsilon_{out} = 0.016395$ ft^3/lbm 160°F
Therefore, $V_{out}/V_{in} = 0.016395/0.016099 = 1.0184$

Since V (velocity) increased by a factor of 1.0184, V-dot (volumetric flow rate) also increases by 1.0184.
Therefore, V-dot$_{out}$ = 500(1.0184) ≈ 509 gpm

QUESTION: 33
TOPIC: 291006
KNOWLEDGE: K1.09 [2.7/2.8]
QID: B2034 (Rev)

A counter-flow lube oil cooler is located inside a machinery room that is maintained at 80°F. The cooler has been isolated for several days. When the cooler is returned to service, it will be supplied with seawater at 45°F to cool lube oil from 125°F to 105°F.

To minimize the thermal shock experienced by the cooler when it is returned to service, the lube oil flow rate should be _____ increased to design flow rate, while the cooling water flow rate is _____ increased to design flow rate.

A. quickly; subsequently

B. quickly; simultaneously

C. gradually; subsequently

D. gradually; simultaneously

ANSWER: D.

QUESTION: 34
TOPIC: 291006
KNOWLEDGE: K1.10
QID: B1135 (P2480)

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. potential for a water hammer.

B. potential for pump cavitation.

C. motor running current requirements.

D. net positive suction head requirements.

ANSWER: A.

QUESTION: 35
TOPIC: 291006
KNOWLEDGE: K1.10
QID: B2736

A nuclear 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 mass flow rate of steam through the main turbine remains 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. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

ANSWER: D.

QUESTION: 36
TOPIC: 291006
KNOWLEDGE: K1.17
QID: B333 (P333)

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

A. Increased condenser vacuum

B. Increased condensate conductivity

C. Decreased condensate pump flow rate

D. Decreased condensate pump net positive suction head

ANSWER: B.

QUESTION: 37
TOPIC: 291007
KNOWLEDGE: K1.02
QID: B2737 (P2735)

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. 75%

B. 88%

C. 96%

D. 99%

ANSWER: C.

PROOF:

Per the definition above, DF = [Input impurities]/[Output impurities] = 25/1
If 1 part of 25 parts remain, then 24 of 25 parts were removed by the ion exchanger. Therefore, 24/25, or 96% is being removed.

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 38
TOPIC: 291007
KNOWLEDGE: K1.05
QID: B1138 (P1535)

A condensate demineralizer differential pressure (D/P) gauge indicates 4 psid at 50% flow. Over the next two days plant power changes have caused condensate flow 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 increase in the accumulation of corrosion products in the demineralizer?

CONDENSATE FLOW	DEMINERALIZER D/P (PSID)
A. 25%	2.0
B. 60%	5.0
C. 75%	9.0
D. 100%	15.0

ANSWER: A.

PROOF:

$H \propto F^2$ @25% flow, D/P should be 1.0 psid

$H_1/H_2 = (F_1/F_2)^2$ @60% flow, D/P should be 5.76 psid

$H_2 = H_1(F_2/F_1)^2$ @75% flow, D/P should be 9.0 psid

@100% flow, D/P should be 16.0 psid

Only 2.0 psid @ 25% flow exceeds the expected D/P.

QUESTION: 39
TOPIC: 291007
KNOWLEDGE: K1.07
QID: B1838

When a mixed-bed demineralizer resin is exhausted, the resin should be replaced or regenerated because:

A. particles previously filtered out of solution will be released.

B. ions previously removed by the resin will be released into solution.

C. the resin will fracture and possibly escape through the retention screens.

D. the resin will physically bond together, thereby causing a flow blockage.

ANSWER: B.

QUESTION: 40
TOPIC: 291008
KNOWLEDGE: K1.05
QID: B41

Which one of the following is the definition of a thermal overload device?

A. An in-line heater coil that, when subjected to a sustained high current, overheats and actuates a circuit-interrupting device.

B. A balanced circuit that compares actual current to a fixed overcurrent signal which, when exceeded, actuates a tripping relay.

C. A temperature monitor that senses the temperature of the operating load and trips the circuit breaker if the temperature exceeds preset limits.

D. An in-line induction coil that generates a secondary current proportional to the primary current, closing the trip circuit contacts for an overcurrent condition.

ANSWER: A.

QUESTION: 41
TOPIC: 291008
KNOWLEDGE: K1.06
QID: B2341 (P2239)

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 follow 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?

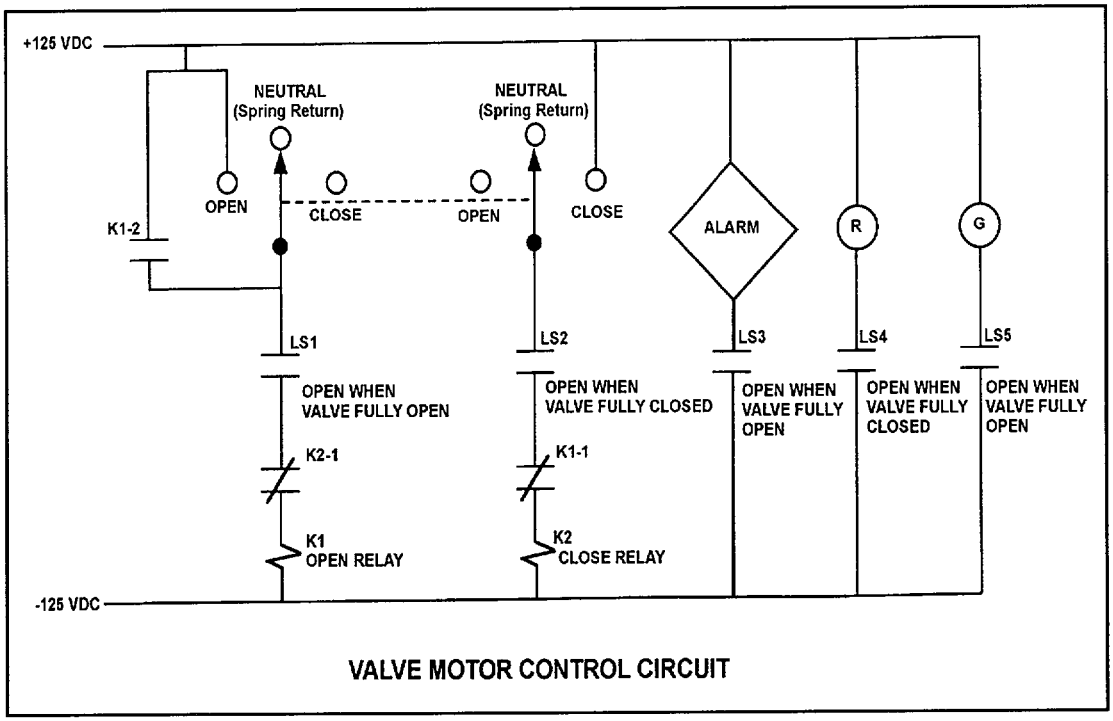
A. The valve will not move.

B. The valve will close fully.

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

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

ANSWER: D.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 42
TOPIC: 291008
KNOWLEDGE: K1.07
QID: B1142 (P1141)

Which one of the following is an unsafe practice if performed by an electrician working on or near energized electrical equipment?

A. Having a person stand by to deenergize the equipment in the event of an emergency.

B. Using two hands for balance and to prevent dropping tools onto energized equipment.

C. Covering exposed energized circuits with insulating material to prevent inadvertent contact.

D. Standing on insulating rubber material to increase the electrical resistance of the body to ground.

ANSWER: B.

QUESTION: 43
TOPIC: 291008
KNOWLEDGE: K1.08
QID: B2543 (P2540)

Two identical 1000 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. 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: C.

QUESTION: 44
TOPIC: 291008
KNOWLEDGE: K1.10
QID: B2244 (P943)

What is an advantage of using high voltage electrical disconnects instead of only breakers to isolate a plant's 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.

QUESTION: 45
TOPIC: 292001
KNOWLEDGE: K1.03
QID: B645 (N/A)

Which one of the following ranges contains the energy level of thermal neutrons in a reactor operating at full power?

A. 0.001 to 0.01 eV

B. 0.01 to 0.1 eV

C. 0.1 to 1 eV

D. 1 to 10 eV

ANSWER: B.

QUESTION: 46
TOPIC: 292001
KNOWLEDGE: K1.05
QID: B1046

The ideal moderator has a _____ macroscopic absorption cross section and a _____ average logarithmic energy decrement.

A. large; small

B. large; large

C. small; small

D. small; large

ANSWER: D.

QUESTION: 47
TOPIC: 292002
KNOWLEDGE: K1.08
QID: B46

Which one of the following does <u>not</u> affect K_{eff}?

A. core burnup.

B. core dimensions.

C. moderator-to-fuel ratio.

D. installed neutron sources.

ANSWER: D.

QUESTION: 48
TOPIC: 292002
KNOWLEDGE: K1.12
QID: B1947 (P2447)

With $K_{eff} = 0.985$, how much positive reactivity is required to make the 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.

PROOF:

$$\rho = \frac{1 - k_{eff}}{k_{eff}} = \frac{1 - 0.985}{0.985} = \frac{0.015}{0.985} = 0.0152284$$

$$\rho = 1.523\%$$

QUESTION: 49
TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: New

A 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.

PROOF:

Initial withdrawal of control rods caused the subcritical neutron population (also count rate) to double twice. Therefore, the first doubling occurred after 3.0 %ΔK/K was added (leaving the core subcritical by 3.0 %ΔK/K) and the second doubling occurred after the remaining 1.5 %ΔK/K was added. This left the core subcritical by 1.5 %ΔK/K. Therefore, an additional positive 1.5 %ΔK/K is necessary to make the reactor critical.

$CR_1(1-K_1) = CR_2(1-K_2)$
$20(1-K_1) = 80[1-(K_1+0.045)]$
$(1-K_1) = 80/20[1-(K_1+0.045)]$
$1-K_1 = 4-4K_1-0.18$
$4K_1-K_1 = 4-0.18-1$
$3K_1 = 2.82$, so $K_1 = 0.94$

Inserting 0.94 for K_1, in initial equations:

$20(1 - 0.94) = 80(1 - K_2)$
$20(0.06)/80 = 1 - K_2$
$0.015 = 1 - K_2$
$K_2 = 0.985$

so +0.015 ΔK/K or 1.5 %ΔK/K required to achieve 0.0 reactivity

USNRC GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2001 BWR--FORM A

QUESTION: 50
TOPIC: 292003
KNOWLEDGE: K1.04
QID: B1671 (P1672)

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 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-235 and Pu-239

C. U-238 and Pu-239

D. U-238 and Pu-241

ANSWER: B.

QUESTION: 51
TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: New

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent 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.

PROOF:

It will be necessary for the power coefficient to add -0.3 %ΔK/K to stabilize reactor power. With power coefficient equal to -0.04 %ΔK/K/% power, reactor power will have to increase by 7.5% [0.3/.04] to return core reactivity to zero.

QUESTION: 52
TOPIC: 292004
KNOWLEDGE: K1.04
QID: B1852

Which one of the following is a characteristic of Doppler broadening?

A. As reactor coolant temperature increases, less moderator molecules will be present in the core to thermalize neutrons.

B. As reactor fuel temperature increases, neutrons from a wider energy spectrum will be captured in the fuel.

C. As moderator void percentage increases, neutrons will travel farther in the core before being absorbed or scattered.

D. As control rods are withdrawn, additional reactor fuel will be exposed and result in a power increase.

ANSWER: B.

QUESTION: 53
TOPIC: 292004
KNOWLEDGE: K1.11
QID: B953

Which one of the following describes how and why the void coefficient changes as void fraction increases during a control rod withdrawal at power?

A. Becomes less negative due to the increased absorption of neutrons by U-238

B. Becomes less negative due to a greater fraction of neutrons lost to leakage from the core

C. Becomes more negative due to the reduction in the fast fission contribution to the neutron population

D. Becomes more negative due to a greater fractional loss of moderator for a 1% void increase at higher void fractions

ANSWER: D.

QUESTION: 54
TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
QID: B854 (Rev)

Rod position indication shows that a control rod is at position 22. If the control rod is then moved to position 12, it is being:

A. inserted 30 inches.

B. withdrawn 30 inches.

C. inserted 60 inches.

D. withdrawn 60 inches.

ANSWER: A.

PROOF: Control rod positions number from 00 (full insertion) to 48 (fully withdrawn) for 3-inch segments along the rod withdrawal length.
Position 22 - position 12 = 10 positions inserted.
10 positions x 3 inches/position = 30 inches inserted

QUESTION: 55
TOPIC: 292005
KNOWLEDGE: K1.04
QID: B2254

A reactor is 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 positive 30-second reactor period.

Reactor power will increase:

A. continuously until control rods are reinserted.

B. and stabilize at a value slightly below the POAH.

C. temporarily, and then stabilize at the original value.

D. and stabilize at a value equal to or above the POAH.

ANSWER: D.

QUESTION: 56
TOPIC: 292005
KNOWLEDGE: K1.05
QID: B1055

Rod density is a measure of the:

A. percentage of control rods inserted into the core.

B. percentage of control rods withdrawn from the core.

C. number of control rods fully inserted divided by the number of control rods fully withdrawn.

D. number of control rods fully withdrawn divided by the number of control rods fully inserted.

ANSWER: A.

QUESTION: 57
TOPIC: 292005
KNOWLEDGE: K1.12
QID: B1457

A reactor is operating at 60% power with thermal neutron flux peaked in the bottom half of the core. Partial withdrawal of a deep control rod will generally affect total (versus local) core power because _____ is relatively high in the area of withdrawal.

A. void content

B. fuel enrichment

C. thermal neutron flux

D. moderator temperature

ANSWER: A.

QUESTION: 58
TOPIC: 292006
KNOWLEDGE: K1.02
QID: B1658 (P2458)

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Boron-10

B. Xenon-135

C. Samarium-149

D. Uranium-235

ANSWER: B.

PROOF:

σ for B-10 is 3.0×10^3b
σ for Xe-135 is 2.5×10^6b
σ for Sm-149 is 4.1×10^4b
σ for U-235 is 6.9×10^2b

QUESTION: 59
TOPIC: 292006
KNOWLEDGE: K1.03
QID: B2558 (P2558)

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 end of core life and reactor B is operating at beginning of core life.

Which reactor has the greatest core Xe-135 concentration?

A. Reactor A due to the smaller 100% power thermal neutron flux

B. Reactor A due to the greater 100% power thermal neutron flux

C. Reactor B due to the smaller 100% power thermal neutron flux

D. Reactor B due to the greater 100% power thermal neutron flux

ANSWER: C.

QUESTION: 60
TOPIC: 292006
KNOWLEDGE: K1.04
QID: B860

Which one of the following values most closely approximates the half-life of Xe-135?

A. 19 seconds

B. 6.6 hours

C. 9.1 hours

D. 30 hours

ANSWER: C.

QUESTION: 61
TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: New

A 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 scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. 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-scram peak location, and the flux peak will be moving _____.

A. higher; upward

B. higher; downward

C. lower; upward

D. lower; downward

ANSWER: B.

QUESTION: 62
TOPIC: 292006
KNOWLEDGE: K1.07
QID: B861

Which one of the following reactor prescram conditions requires the greater amount of control rod withdrawal to perform a reactor startup during peak xenon conditions after a reactor scram?

A. Beginning of core life (BOL) and low power

B. End of core life (EOL) and low power

C. BOL and high power

D. EOL and high power

ANSWER: D.

QUESTION: 63
TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2062 (Rev)

A reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period and stabilized. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 30 hours after the power change?

A. Less than 75% and increasing slowly

B. Less than 75% and decreasing slowly

C. Greater than 75% and increasing slowly

D. Greater than 75% and decreasing slowly

ANSWER: C.

QUESTION: 64
TOPIC: 292007
KNOWLEDGE: K1.01
QID: B364 (P362)

Which one of the following functions is not performed by burnable poisons in an operating reactor?

A. Provide neutron flux shaping.

B. Provide more uniform power density.

C. Counteract the effects of control rod burnout.

D. Allow higher fuel enrichment of initial core load.

ANSWER: C.

QUESTION: 65
TOPIC: 292008
KNOWLEDGE: K1.10
QID: B2168 (P1870)

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a positive 80-second period and stops rod motion.

After an additional 30 seconds, 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.

QUESTION: 66
TOPIC: 292008
KNOWLEDGE: K1.11
QID: B568

After recording critical data during a cold reactor startup with main steam isolation valves open, the operator withdraws the control rods to continue the startup. Which one of the following pairs of parameters will provide the first indication of reaching the point of adding heat?

A. Reactor power and reactor period

B. Reactor pressure and turbine load

C. Reactor water level and core flow rate

D. Reactor pressure and reactor water level

ANSWER: A.

QUESTION: 67
TOPIC: 292008
KNOWLEDGE: K1.16
QID: B1972

A reactor is critical and a heat-up is in progress with reactor temperature currently at 140°F. If the point of adding heat was 1% reactor power, and reactor power is held constant at 3% during the heat-up, which one of the following describes the heat-up rate (HUR) from 140°F to 200°F?

A. HUR will initially increase and then decrease.

B. HUR will slowly decrease during the entire period.

C. HUR will slowly increase during the entire period.

D. HUR will remain the same during the entire period.

ANSWER: B.

QUESTION: 68
TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B2369 (Rev)

After taking critical data during a reactor startup, the operator establishes a stable 34-second reactor period 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.

PROOF: $\rho = \frac{\ell}{\tau} + \frac{\overline{\beta}}{1 + \lambda\tau}$

$\rho = \frac{0.0066}{1 + (0.1)(34)}$

$\rho = 0.0015 = 0.15$ %ΔK/K

QUESTION: 69
TOPIC: 292008
KNOWLEDGE: K1.21
QID: B1372 (P1272)

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.

QUESTION: 70
TOPIC: 292008
KNOWLEDGE: K1.22
QID: B971

A plant is operating at 85% power when a failure of the steam pressure 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.

How will reactor power respond? (Assume the valves remain in the failed position.)

A. Increase until reactor power matches the new steam demand

B. Increase continuously and exceed reactor protection set points

C. Decrease and stabilize at a lower power level and steaming rate

D. Decrease and stabilize at a critical power level below the point of adding heat

ANSWER: C.

QUESTION: 71
TOPIC: 292008
KNOWLEDGE: K1.23
QID: B2572

During continuous reactor power operation, rod pattern exchanges are performed periodically to:

A. increase the rod worth of control rods that are nearly fully withdrawn.

B. prevent the development of individual control rods with very high worths.

C. ensure some control rods remain inserted as deep control rods until late in the core cycle.

D. allow the local power range monitoring nuclear instruments to be asymmetrically installed in the core.

ANSWER: B.

QUESTION: 72
TOPIC: 292008
KNOWLEDGE: K1.26
QID: B672

A reactor is operating at 70% power when one recirculation pump trips. Reactor power will initially _____ because of the effects of the _____ coefficient.

A. increase; void

B. decrease; void

C. increase; moderator temperature

D. decrease; moderator temperature

ANSWER: B.

QUESTION: 73
TOPIC: 293001
KNOWLEDGE: K1.03
QID: B1773 (P1873)

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. Orifice

B. Flow restrictor

C. Divergent nozzle

D. Convergent nozzle

ANSWER: C.

QUESTION: 74
TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: New

A reactor 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.

PROOF:

From the Mollier Diagram, the enthalpy of steam in the steam line is 1219 Btu/lbm. Assuming an isenthalpic expansion of the steam to atmospheric pressure, 1219 Btu/lbm intersects the atmospheric pressure line at approximately 358°F.

QUESTION: 75
TOPIC: 293003
KNOWLEDGE: K1.12 [2.5/2.6]
QID: B2874 (Rev)

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 insufficient 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 ft^3/lbm

ANSWER: A.

QUESTION: 76
TOPIC: 293004
KNOWLEDGE: K1.04
QID: B376

Refer to the drawing of a steam-jet air ejector (see figure below).

In the figure of an operating steam jet air ejector, steam flowing from D to E undergoes a pressure _____ and a velocity _____.

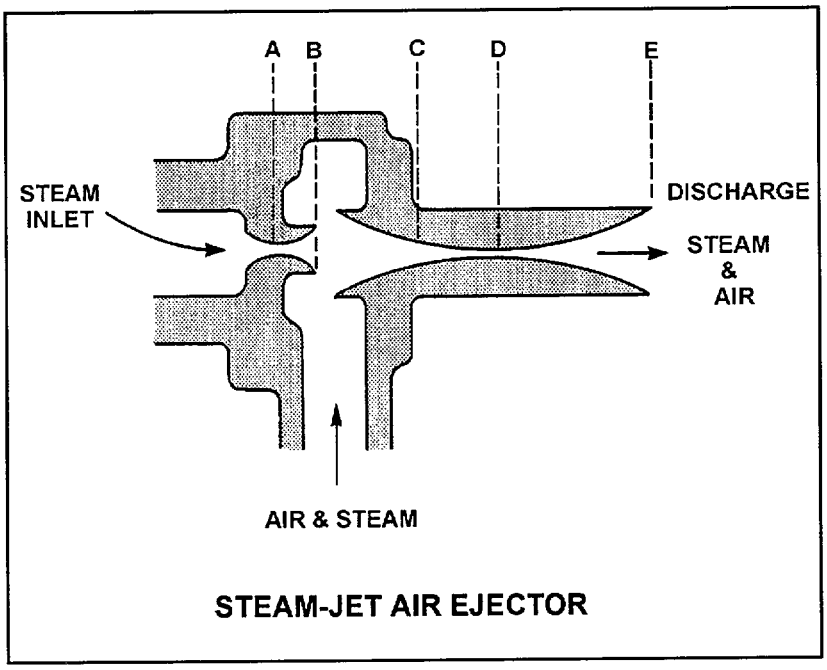
A. decrease; decrease

B. decrease; increase

C. increase; increase

D. increase; decrease

ANSWER: D.



STEAM-JET AIR EJECTOR

QUESTION: 77
TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B200 (Rev)

Which one of the following will be caused by a decrease in main condenser vacuum (higher absolute pressure) on a 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 noncondensable gas in the condenser

ANSWER: B.

QUESTION: 78
TOPIC: 293005
KNOWLEDGE: K1.03
QID: B2678

A steam plant main turbine consists of a high-pressure (HP) unit and several low-pressure (LP) units. The main turbine is most likely to experience stress-related failures of the _____ unit _____ stages.

A. HP; inlet

B. HP; outlet

C. LP; inlet

D. LP; outlet

ANSWER: D.

QUESTION: 79
TOPIC: 293006
KNOWLEDGE: K1.13
QID: B1780 (P1724)

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

A centrifugal pump is 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?

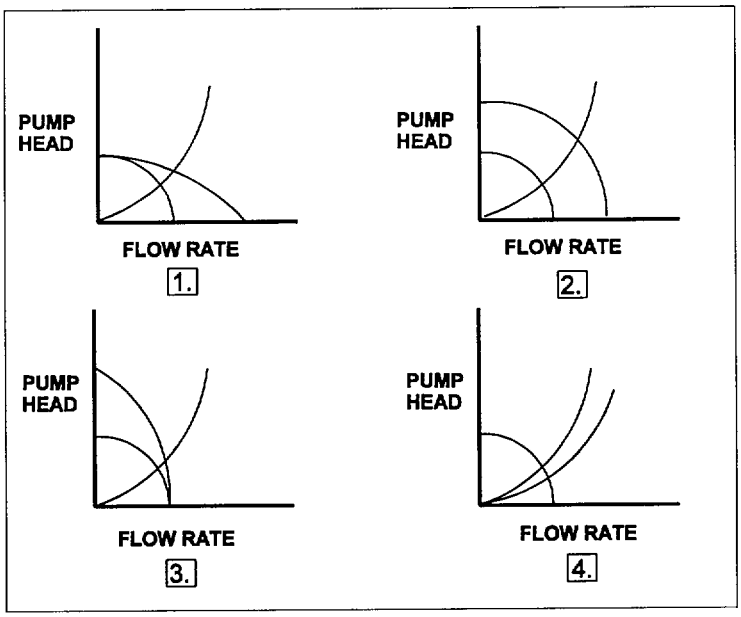
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: D.



QUESTION: 80
TOPIC: 293006
KNOWLEDGE: K1.19
QID: B1181 (P1222)

A plant is operating at full power when a 200 gpm reactor coolant leak occurs, which results in a reactor scram and initiation of emergency coolant injection. Reactor vessel pressure stabilizes at 900 psia and all injection pumps are operating with all pump miniflow paths isolated. The shutoff heads for the pumps are as follows:

High pressure coolant injection (HPCI) pumps:	1200 psia
Low pressure coolant injection (LPCI) pumps:	200 psia

Which pumps must be stopped quickly and why?

A. LPCI pumps to avoid pump overheating caused by low flow

B. LPCI pumps to avoid motor overheating caused by low flow

C. HPCI pumps to avoid pump overheating caused by high flow

D. HPCI pumps to avoid motor overheating caused by high flow

ANSWER: A.

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QUESTION: 81
TOPIC: 293006
KNOWLEDGE: K1.29
QID: B1783 (P1779)

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.

PROOF:

$$F \propto \sqrt{\Delta P}$$

$$\frac{F_1}{F_2} \propto \frac{\sqrt{\Delta P_1}}{\sqrt{\Delta P_2}}$$

$$F_2 = F_1 \left(\frac{\sqrt{\Delta P_2}}{\sqrt{\Delta P_1}} \right)$$

$$= 100 \left(\frac{\sqrt{30}}{\sqrt{45}} \right)$$

$$= 100 \frac{5.48}{6.71}$$

$$= 100 \ (0.817)$$

$$= 82 \text{ gpm}$$

QUESTION: 82
TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: New

Refer to the drawing of a 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 heat exchanger?

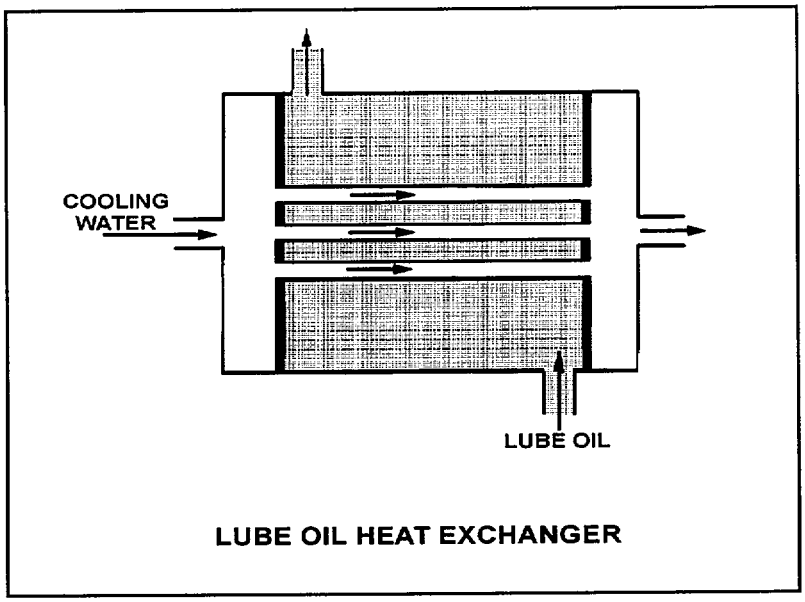
A. 76°F

B. 85°F

C. 92°F

D. 124°F

ANSWER A.



PROOF:

$Q_{oil} = m\ c_{p\text{-}oil}\ (T_{in} - T_{out})_{oil}$
$Q_{cw} = m\ c_{p\text{-}cw}\ (T_{out} - T_{in})_{cw}$
$Q_{oil} = Q_{cw}$
$m\ c_{p\text{-}oil}\ (T_{in} - T_{out})_{oil} = Q_{oil} = Q_{cw} = m\ c_{p\text{-}cw}\ (T_{out} - T_{in})_{cw}$

200 lbm/min x 0.8 BTU/lbm/°F x (140 °F – 100°F) = 400 lbm/min x 1.0 BTU/lbm/°F x (T_{out} – 60°F)

$T_{out} = 76$ °F

QUESTION: 83
TOPIC: 293007
KNOWLEDGE: K1.09
QID: B147

Which one of the following statements explains why condensate subcooling is necessary in the steam condensing phase of a plant cycle?

A. To increase overall secondary efficiency

B. To provide an improved condenser vacuum

C. To allow use of a higher circulating water temperature

D. To provide net positive suction head to the condensate pumps

ANSWER: D.

QUESTION: 84
TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: New

A reactor plant is operating at 100% rated power. Main turbine extraction steam is being supplied to a feedwater heater. Extraction steam parameters are as follows:

Steam pressure: 750 psia
Steam flow rate: 7.5×10^5 lbm/hr
Steam enthalpy: 1150 Btu/lbm

Saturated liquid condensate at 448°F leaves the feedwater heater via a drain line.

What is the approximate heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A. 3.8×10^7 Btu/hr

B. 8.6×10^7 Btu/hr

C. 5.4×10^8 Btu/hr

D. 7.2×10^8 Btu/hr

ANSWER C.

PROOF:

Enthalpy of steam is 1150 Btu/lbm (given). Enthalpy of condensate is approximately 428 Btu/lbm (from steam tables). Difference is heat transferred to feedwater.
1150 - 428 = 722 Btu/lbm

From equation sheet:

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

$\dot{Q}$ = Heat Transfer Rate = 7.5×10^5 lbm/hr x 722 Btu/lbm

$\dot{Q} = 5.4 \times 10^8$ Btu/hr

QUESTION: 85
TOPIC: 293008
KNOWLEDGE: K1.01
QID: B2784 (P1086)

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. Decreases continuously

C. Increases, then decreases

D. Decreases, then increases

ANSWER: C.

QUESTION: 86
TOPIC: 293008
KNOWLEDGE: K1.37 [3.2/3.4]
QID: B192 (Rev)

After operating at high power for several weeks, the reactor was shut down yesterday for steam line leak repairs. Shutdown cooling pumps are being used to maintain the reactor at normal operating temperature. The pumps will be stopped in 30 minutes to commence a 4-hour test.

What action, if any, should be taken to enhance natural circulation cooling during the test, and why?

A. No action necessary; the increase of density in the downcomer and the reduction of density in the core region will easily support circulation.

B. No action necessary; the density of the mixture in the core region increases, thereby allowing liquid in the downcomer to enter the core.

C. Raise vessel pressure to allow vessel relief valves to lift and create a heat sink for decay heat while control rod drive flow maintains inventory.

D. Raise vessel water level above the bottom of the steam separators to provide a liquid flow path from the inside to the outside of the core shroud.

ANSWER: D.

QUESTION: 87
TOPIC: 293008
KNOWLEDGE: K1.19
QID: B789

Core inlet subcooling is defined as the difference between the temperature of the fluid _____ and the saturation temperature of the fluid in the core inlet plenum.

A. in the downcomer area

B. in the core inlet plenum

C. in the lower fuel channel area

D. at the feedwater pump discharge

ANSWER: B.

QUESTION: 88
TOPIC: 293008
KNOWLEDGE: K1.28
QID: B1789 (P1790)

Single-phase coolant flow resistance in a reactor core is proportional to coolant _____ and inversely proportional to _____.

A. velocity; bundle length

B. velocity; orifice diameter

C. temperature; bundle length

D. temperature; orifice diameter

ANSWER: B.

QUESTION: 89
TOPIC: 293008
KNOWLEDGE: K1.30
QID: B1590

Two reactors have the same rated power level and are currently operating at 50% power with a normal neutron flux distribution in each core. The reactors are identical except that one core has core orifices and the other core does not. Each reactor has the same core mass flow rate.

The orificed core will have the _____ critical power and the _____ core differential pressure.

A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: A.

QUESTION: 90
TOPIC: 293008
KNOWLEDGE: K1.10
QID: B1888 (P1087)

How does critical heat flux vary from the bottom to the top of a typical fuel bundle during normal full power operation?

A. Increases continuously

B. Increases, then decreases

C. Decreases continuously

D. Decreases, then increases

ANSWER: C.

QUESTION: 91
TOPIC: 293008
KNOWLEDGE: K1.35
QID: B293

A reactor is shut down with all reactor recirculating pumps stopped. Which one of the following explains why it is important to monitor reactor vessel skin temperatures?

A. Significant differential temperature between the upper and lower elevation reactor vessel skin indicates that thermal stratification is occurring.

B. Significant differential temperature between the top and bottom reactor vessel heads will result in excessive thermal stresses in the reactor vessel wall.

C. These temperatures provide the best indication of the accuracy of the shutdown reactor water level instruments due to the temperature variance from instrument calibration conditions.

D. These temperatures provide a backup indication of reactor water level because the skin temperatures detected above vessel water level will be lower than those below vessel water level.

ANSWER: A.

QUESTION: 92
TOPIC: 293009
KNOWLEDGE: K1.01/K1.02
QID: B2096

A reactor is operating at 65% of rated thermal power with power distribution peaked radially in the center of the core and axially toward the bottom of the core. Reactor power is then increased to 75% over the next 2 hours using only shallow control rods that are centrally-located.

Neglecting any effect from reactor poisons, when power is stabilized at 75%, the radial peaking factors generally will have increased in the _____ half of the center fuel bundles and the axial peaking factors generally will have increased in the _____ half of the center fuel bundles.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

ANSWER: D.

QUESTION: 93
TOPIC: 293009
KNOWLEDGE: K1.05
QID: B1893 (P1395)

Thermal limits are established to protect the 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.

QUESTION: 94
TOPIC: 293009
KNOWLEDGE: K1.07
QID: B894

Which one of the following must be maintained within the technical specification limit to ensure that fuel cladding plastic strain (deformation) is limited to 1%?

A. Linear heat generation rate

B. Average planar linear heat generation rate

C. Minimum critical power ratio safety limit

D. Minimum critical power ratio operating limit

ANSWER: A.

QUESTION: 95
TOPIC: 293009
KNOWLEDGE: K1.09
QID: B95

The fraction of the limiting power density (FLPD) is equal to:

Where: LHGR = Linear heat generation rate
TPF = Total peaking factor

A. $\frac{\text{LHGR (limit)}}{\text{LHGR (actual)}}$

B. $\frac{\text{LHGR (actual)}}{\text{LHGR (limit)}}$

C. $\frac{\text{LHGR (limit) x TPF}}{\text{LHGR (actual)}}$

D. $\frac{\text{LHGR (actual)}}{\text{LHGR (limit) x TPF}}$

ANSWER: B.

QUESTION: 96
TOPIC: 293009
KNOWLEDGE: K1.30
QID: B1596

A step increase in reactor power results in a fuel cladding surface temperature increase from 550°F to 580°F at steady state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel cladding surface temperature 6 seconds after the power change?

A. 571°F

B. 569°F

C. 565°F

D. 561°F

ANSWER: B.

PROOF: $T_f = T_i + .632(T_f - T_i)$ $T_f = 550 + 18.96$

$T_f = 550 + .632(580 - 550)$ $T_f = 569.0$

QUESTION: 97
TOPIC: 293009
KNOWLEDGE: K1.33
QID: B1696

The primary purpose of the gap between a fuel pellet and the surrounding cladding is to:

A. allow insertion of fuel pellets into the fuel rods.

B. provide a collection volume for fission product gases.

C. maintain the design fuel thermal conductivity throughout the fuel cycle.

D. accommodate differential expansion of the pellet and cladding to preclude excessive cladding stress.

ANSWER: D.

QUESTION: 98
TOPIC: 293009
KNOWLEDGE: K1.40
QID: B1497

Gross fuel cladding failure during a design basis loss of coolant accident is prevented by adhering to the _____ limit.

A. linear heat generation rate

B. minimum critical power ratio

C. average planar linear heat generation rate

D. preconditioning interim operating management recommendations

ANSWER: C.

QUESTION: 99
TOPIC: 293010
KNOWLEDGE: K1.02
QID: B2199 (P2295)

Brittle fracture of the reactor vessel (RV) is least likely to occur during a _____ of the RV when RV temperature is _____ the reference temperature for nil-ductility transition (RT_{NDT}).

A. heatup; above

B. heatup; below

C. cooldown; above

D. cooldown; below

ANSWER: A.

QUESTION: 100
TOPIC: 293010
KNOWLEDGE: K1.05
QID: B1900 (P899)

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 has a smaller surface area than the outer wall.

B. the inner wall experiences more tensile stress than the outer wall.

C. there is a temperature gradient across the reactor pressure vessel wall.

D. the inner wall experiences more neutron-induced embrittlement than the outer wall.

ANSWER: D.

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

FEBRUARY 2001 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

FORM A	FORM B	ANS	FORM A	FORM B	ANS	FORM A	FORM B	ANS	FORM A	FORM B	ANS
1	29	B	26	54	B	51	79	D	76	4	D
2	30	C	27	55	C	52	80	B	77	5	B
3	31	B	28	56	D	53	81	D	78	6	D
4	32	A	29	57	C	54	82	A	79	7	D
5	33	D	30	58	C	55	83	D	80	8	A
6	34	B	31	59	B	56	84	A	81	9	D
7	35	A	32	60	D	57	85	A	82	10	A
8	36	B	33	61	D	58	86	B	83	11	D
9	37	A	34	62	A	59	87	C	84	12	C
10	38	A	35	63	D	60	88	C	85	13	C
11	39	D	36	64	B	61	89	B	86	14	D
12	40	A	37	65	C	62	90	D	87	15	B
13	41	D	38	66	A	63	91	C	88	16	B
14	42	C	39	67	B	64	92	C	89	17	A
15	43	C	40	68	A	65	93	C	90	18	C
16	44	B	41	69	D	66	94	A	91	19	A
17	45	D	42	70	B	67	95	B	92	20	D
18	46	C	43	71	C	68	96	C	93	21	C
19	47	D	44	72	B	69	97	B	94	22	A
20	48	A	45	73	B	70	98	C	95	23	B
21	49	D	46	74	D	71	99	B	96	24	B
22	50	D	47	75	D	72	100	B	97	25	D
23	51	B	48	76	C	73	1	C	98	26	C
24	52	B	49	77	A	74	2	D	99	27	A
25	53	C	50	78	B	75	3	A	100	28	D