April 27, 2000

UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
APRIL 2000--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 not received or been given 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: K1.02
QID: P2501 (Rev)

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

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

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

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

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

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

ANSWER: C.

QUESTION: 2
TOPIC: 191001
KNOWLEDGE: K1.03
QID: P2102 (B2101)

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

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

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

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

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

ANSWER: B.

QUESTION: 3
TOPIC: 191001
KNOWLEDGE: K1.06
QID: P1702 (Rev)

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

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

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

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

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

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

ANSWER: B.

QUESTION: 4
TOPIC: 191001
KNOWLEDGE: K1.08
QID: P1602 (B1404)

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

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

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

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

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

ANSWER: C.

QUESTION: 5

DELETED

QUESTION: 6
TOPIC: 191002
KNOWLEDGE: K1.07
QID: P1807 (B1211)

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

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

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense

ANSWER: D.

QUESTION: 7
TOPIC: 191002
KNOWLEDGE: K1.04
QID: P2307 (B2307)

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

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

DETECTOR	TAPS
AD	A and D
BD	B and D
CD	C and D

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

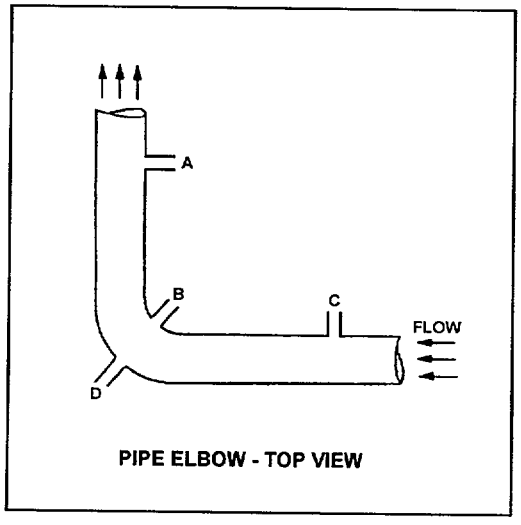
A. All detectors will indicate higher flow.

B. Only two detectors will indicate higher flow.

C. Only one detector will indicate higher flow.

D. Detector indication will not change.

ANSWER: D.



PIPE ELBOW - TOP VIEW

QUESTION: 8
TOPIC: 191002
KNOWLEDGE: K1.09
QID: P2609 (Rev)

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

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

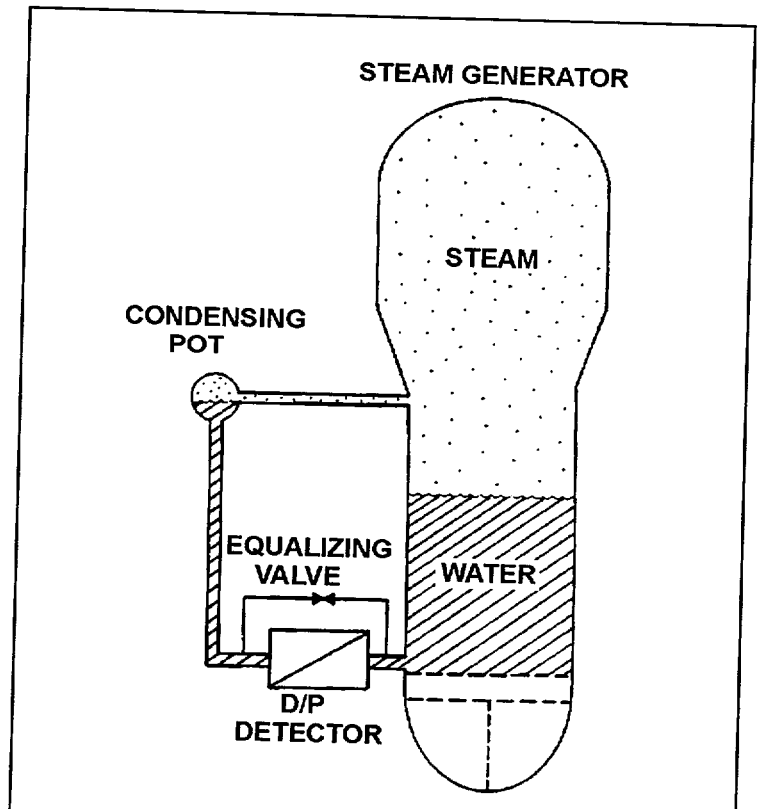
A. Actual S/G water level decreases by 6 inches.

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

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

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

ANSWER: D.



STEAM GENERATOR DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 9
TOPIC: 191002
KNOWLEDGE: K1.10
QID: P413 (B410)

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

A. increase; inner

B. decrease; inner

C. increase; outer

D. decrease; outer

ANSWER: D.

QUESTION: 10
TOPIC: 191002
KNOWLEDGE: K1.12
QID: P1011

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

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

A. 0 psia.

B. 15 psia.

C. 60 psia.

D. 100 psia.

ANSWER: B.

PROOF: 75 psia →□← 15 psia (atmosphere)

Diaphragm rupture ⇒ System pressure not seen.

With diaphragm pressure detector equalized with atmosphere, indicated pressure would be atmospheric or 15 psia.

QUESTION: 11
TOPIC: 191002
KNOWLEDGE: K1.13
QID: P1510 (Rev)

Unlike a resistance temperature detector, a typical thermocouple:

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

B. requires a temperature-controlled reference junction.

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

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

ANSWER: B.

QUESTION: 12
TOPIC: 191002
KNOWLEDGE: K1.16
QID: P813 (B812)

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

A. Reed switch

B. Limit switch

C. Servo transmitter

D. Linear variable differential transformer

ANSWER: B.

QUESTION: 13
TOPIC: 191002
KNOWLEDGE: K1.17
QID: P1910 (Rev)

During a reactor refueling outage, the fuel assemblies were reconfigured to reduce the radial power peak at the center of the core while maintaining the same rated thermal power. Excore power range detectors were calibrated at 50% power just prior to the outage.

How will actual reactor power compare to indicated reactor power when the plant is stabilized at 50% following the outage?

A. Actual reactor power will be higher than indicated reactor power due to increased core neutron leakage.

B. Actual reactor power will be higher than indicated reactor power due to decreased core neutron leakage.

C. Actual reactor power will be lower than indicated reactor power due to decreased core neutron leakage.

D. Actual reactor power will be lower than indicated reactor power due to increased core neutron leakage.

ANSWER: D.

QUESTION: 14

DELETED

QUESTION: 15
TOPIC: 191003
KNOWLEDGE: K1.01
QID: P1615 (B715)

An automatic flow controller is being used to position a valve in a cooling water system. A signal from the valve, which is proportional to valve position, is returned to the controller. This signal is referred to as:

A. gain.

B. bias.

C. feedback.

D. error.

ANSWER: C.

QUESTION: 16
TOPIC: 191003
KNOWLEDGE: K1.05
QID: P2417 (Rev)

An air-operated isolation valve requires 3,600 lbf applied to the top of the actuator diaphragm to open. The actuator diaphragm has a diameter of 8 inches.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the approximate air pressure at which the valve will begin to open?

A. 32 psig

B. 45 psig

C. 56 psig

D. 72 psig

ANSWER: D.

PROOF: $F = P \times A$
$P = F/A = 3600 \text{ lbf}/50.27 \text{ in}^2 = 71.6 \text{ lbf/in}^2$

QUESTION: 17

DELETED

QUESTION: 18
TOPIC: 191003
KNOWLEDGE: K1.09
QID: P818 (B1317)

The level in a tank is being controlled by an automatic level controller and is initially at the controller set-point. A drain valve is then opened, causing tank level to begin to decrease. The decreasing level causes the controller to begin to open a makeup supply valve. After a few minutes, a new steady-state tank level below the original level is established, with the supply rate equal to the drain rate.

The controller in this system uses _____ control.

A. proportional, integral, and derivative

B. proportional and integral

C. proportional only

D. bistable

ANSWER: C.

QUESTION: 19
TOPIC: 191003
KNOWLEDGE: K1.11
QID: P19 (B315)

Why must an operator pay particular attention to auto/manual valve controllers placed in the manual mode?

A. Manual valve controller operation can result in excessive valve cycling.

B. The valve can only be operated locally during manual controller operation.

C. System parameters will no longer automatically change in response to changes in valve position.

D. Valve position will no longer automatically change in response to changes in system parameters.

ANSWER: D.

QUESTION: 20
TOPIC: 191004
KNOWLEDGE: K1.01
QID: P1021

Which one of the following will result in immediate cavitation of a centrifugal pump operating at normal rated flow?

A. Recirculation flow path is aligned.

B. Recirculation flow path is isolated.

C. Pump suction valve is fully closed.

D. Pump discharge valve is fully closed.

ANSWER: C.

QUESTION: 21
TOPIC: 191004
KNOWLEDGE: K1.04
QID: P2322 (Rev)

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose. Which one of the following will cause the pump to operate at shutoff head?

A. A firefighter inadvertently severs the fire hose.

B. The fire hose becomes completely crimped in a fire door.

C. Fire water storage tank level drops below the pump suction tap.

D. A firefighter adjusts the fire hose nozzle spray pattern from "deluge" to "fog."

ANSWER: B.

QUESTION: 22
TOPIC: 191004
KNOWLEDGE: K1.06
QID: P1623 (Rev)

A centrifugal pump is operating at maximum design flow rate, taking suction on a vented water storage tank and discharging through two parallel valves. Valve "A" is fully open and valve "B" is half open.

Which one of the following will occur if valve B is fully closed?

A. The pump will operate at shutoff head.

B. The pump will operate at runout conditions.

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

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

ANSWER: C.

QUESTION: 23
TOPIC: 191004
KNOWLEDGE: K1.14
QID: New

Refer to the drawing showing two operating points for the same centrifugal pump (see figure below).

Operating point A was generated from pump performance data taken six months ago. Current pump performance data was used to generate operating point B. Which one of the following would cause the observed difference between operating points A and B?

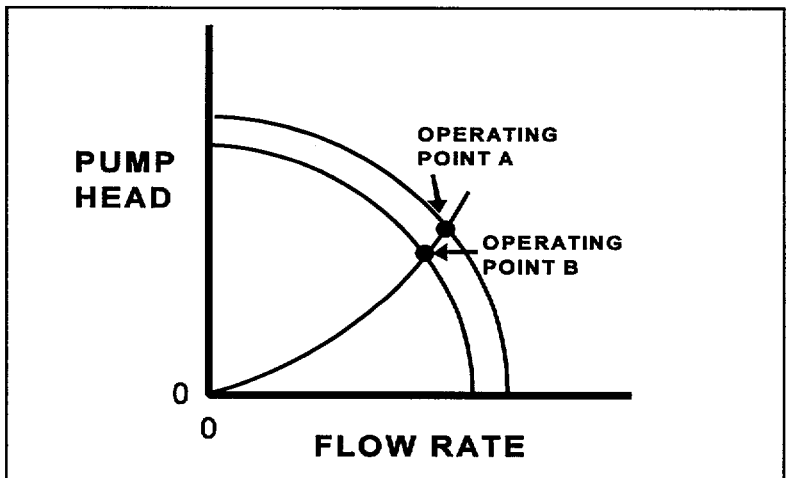
A. The pump discharge valve was more open when data was collected for operating point A.

B. The pump discharge valve was more closed when data was collected for operating point A.

C. The pump internal components have worn since data was collected for operating point A.

D. The system piping head loss has increased since data was collected for operating point A.

ANSWER: C.



CENTRIFUGAL PUMP OPERATING POINTS

QUESTION: 24
TOPIC: 191004
KNOWLEDGE: K1.07
QID: P2124 (B2423)

A centrifugal pump is circulating water at 180°F with a motor current of 200 amps. After several hours, system temperature has changed such that the water density has increased by 3%.

Assuming pump head and volumetric flow rate do not change, which one of the following is the new pump motor current?

A. 203 amps

B. 206 amps

C. 218 amps

D. 236 amps

ANSWER: B.

PROOF:

$W_{pump} = \dot{m}\Delta P\upsilon$

$\Delta P\upsilon$ = pump head

Pump head is ↔

$\therefore W_{pump} \propto \dot{m}$

$\dot{m}$ increases by 3%,

$\therefore W_{pump}$ increases by 3%

200 + 6 = 206 amps

QUESTION: 25
TOPIC: 191004
KNOWLEDGE: K1.21
QID: P1425 (B1125)

Which one of the following describes the proper location for a relief valve that will be used to prevent exceeding the design pressure of a positive displacement pump and associated piping?

A. On the pump suction piping upstream of the suction isolation valve

B. On the pump suction piping downstream of the suction isolation valve

C. On the pump discharge piping downstream of the discharge isolation valve

D. On the pump discharge piping upstream of the discharge isolation valve

ANSWER: D.

QUESTION: 26
TOPIC: 191004
KNOWLEDGE: K1.22
QID: P2526 (Rev)

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

A. Increasing pump speed to 700 rpm

B. Decreasing pump discharge pressure to 40 psig

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

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

ANSWER: A.

QUESTION: 27
TOPIC: 191005
KNOWLEDGE: K1.02
QID: P528

Which one of the following will provide motor protection against electrical damage caused by gradual bearing degradation?

A. Thermal overload device

B. Overcurrent trip relay

C. Underfrequency relay

D. Undervoltage device

ANSWER: A.

QUESTION: 28
TOPIC: 191005
KNOWLEDGE: K1.03
QID: P928 (Rev)

A main generator is operating in parallel with the power grid. If the voltage supplied to the generator field is slowly and continuously increased, the generator will experience high current due to: (Assume no generator protective actuations occur.)

A. generator reverse power.

B. excessive generator MWe.

C. excessive generator KVAR (VARs in).

D. excessive generator KVAR (VARs out).

ANSWER: D.

QUESTION: 29
TOPIC: 191005
KNOWLEDGE: K1.04
QID: P2130

A centrifugal pump is operating at 600 rpm with the following parameters:

Motor current	= 100 amperes
Pump head	= 50 psid
Pump flow rate	= 880 gpm

Which one of the following will be the approximate value of pump head if pump speed is increased to 1200 rpm?

A. 71 psid

B. 126 psid

C. 172 psid

D. 200 psid

ANSWER: D.

PROOF:

$$H_1/H_2 = (S_1/S_2)^2$$

$$H_2 = H_1 \div (S_1/S_2)^2$$

$$H_2 = 50 \div 0.25$$

$$H_2 = 200 \text{ psid}$$

QUESTION: 30
TOPIC: 191005
KNOWLEDGE: K1.05
QID: P2230 (Rev)

Two identical 4160 Vac induction motors are connected to identical centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

If each motor is then started, the longest time period required to stabilize motor current will be experienced by motor _____ and the higher stable motor current will be experienced by motor _____.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: D.

QUESTION: 31
TOPIC: 191005
KNOWLEDGE: K1.06
QID: P1031

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

A. windings; low

B. windings; high

C. commutator and/or slip rings; low

D. commutator and/or slip rings; high

ANSWER: A.

QUESTION: 32
TOPIC: 191006
KNOWLEDGE: K1.04
QID: P1231 (Rev)

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 4, the operator can adjust valve _____ in the _____ direction.

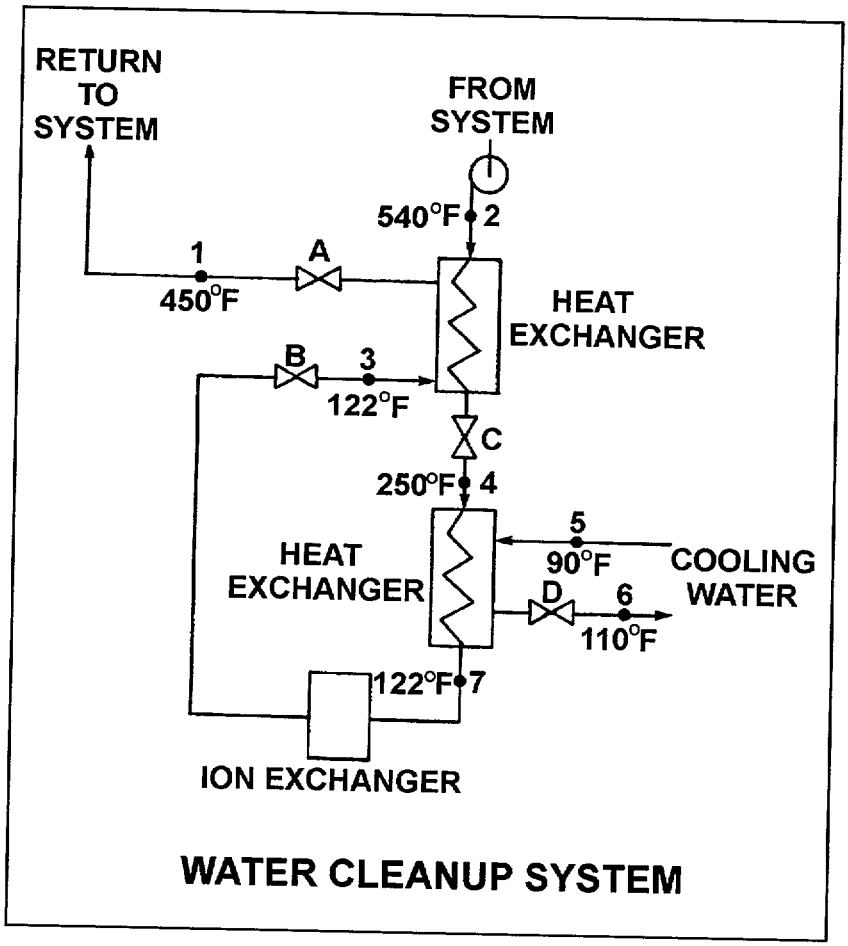
A. A; shut

B. B; shut

C. C; open

D. D; open

ANSWER: C.



QUESTION: 33
TOPIC: 191006
KNOWLEDGE: K1.07
QID: P2434 (Rev)

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

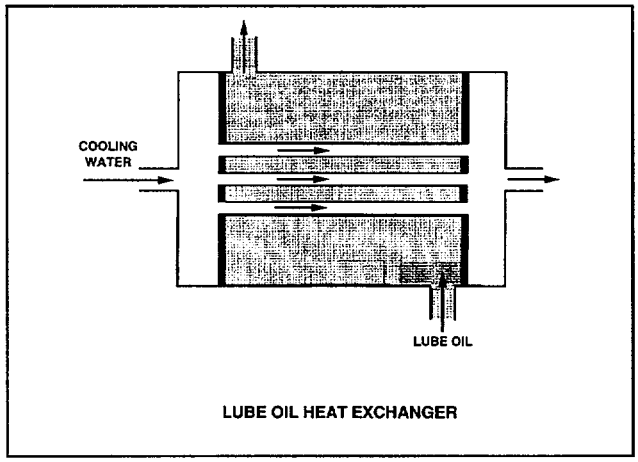
The lube oil heat exchanger is in service with the following inlet temperatures:

Lube oil inlet temperature: 130°F
Cooling water inlet temperature: 70°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is not possible? (Assume both fluids have the same specific heat.)

	Lube Oil Outlet Temp	Cooling Water Outlet Temp
A.	90°F	86°F
B.	100°F	85°F
C.	110°F	84°F
D.	120°F	83°F

ANSWER: D.



PROOF:

D. is the only option that shows a cooling water temp. increase that is greater than the lube oil temp. decrease. This is not possible since cooling water flow rate is higher and the fluids are assumed to have the same specific heat.

QUESTION: 34
TOPIC: 191006
KNOWLEDGE: K1.12
QID: P32 (B1234)

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

If scaling occurs inside the cooling water tubes, cooling water outlet temperature will _____ and lube oil outlet temperature will _____. (Assume oil and cooling water flow rates remain the same.)

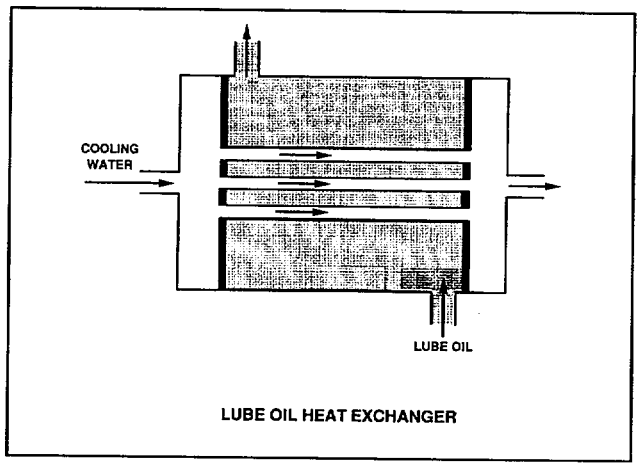
A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase

ANSWER: B.



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

What percentage of impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 25?

A. 99%

B. 96%

C. 88%

D. 75%

ANSWER: B.

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.

QUESTION: 36
TOPIC: 191007
KNOWLEDGE: K1.11
QID: P1436 (Rev)

A nuclear plant was operating at steady-state100% power when the reactor coolant system experienced a crud burst. One hour later, the operators began to record parameters for the in-service coolant purification ion exchanger.

Assuming no additional operator actions, what trend will the recorded parameters show during the next few hours?

A. Increasing ion exchanger outlet water conductivity

B. Increasing pressure drop across the ion exchanger

C. Increasing flow rate through the ion exchanger

D. Increasing ion exchanger decontamination factor

ANSWER: B.

QUESTION: 37
TOPIC: 191007
KNOWLEDGE: K1.14
QID: P337

The plant is operating at 70% steady-state power level when the temperature of the reactor coolant letdown passing through a boron-saturated mixed bed ion exchanger is decreased by 20°F.

As a result, the boron concentration in the effluent of the ion exchanger will _____ because the affinity of the ion exchanger for boron atoms has _____.

A. decrease; increased

B. decrease; decreased

C. increase; increased

D. increase; decreased

ANSWER: A.

QUESTION: 38
TOPIC: 191008
KNOWLEDGE: K1.03
QID: P40 (B1943)

Loss of breaker control power will cause:

A. inability to operate the breaker locally and remotely.

B. breaker line voltage to indicate zero regardless of actual breaker position.

C. failure of the closing spring to charge following local closing of the breaker.

D. the remote breaker position to indicate open regardless of actual breaker position.

ANSWER: C.

QUESTION: 39
TOPIC: 191008
KNOWLEDGE: K1.06
QID: P2640 (Rev)

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: "LS" contacts are not necessarily shown in their current condition.)

An operator takes the control switch to "Open" momentarily and the valve begins to open. Five seconds later, the operator places and holds the switch in the "Close" position. Which one of the following describes the valve response with the switch held in the "Close" position?

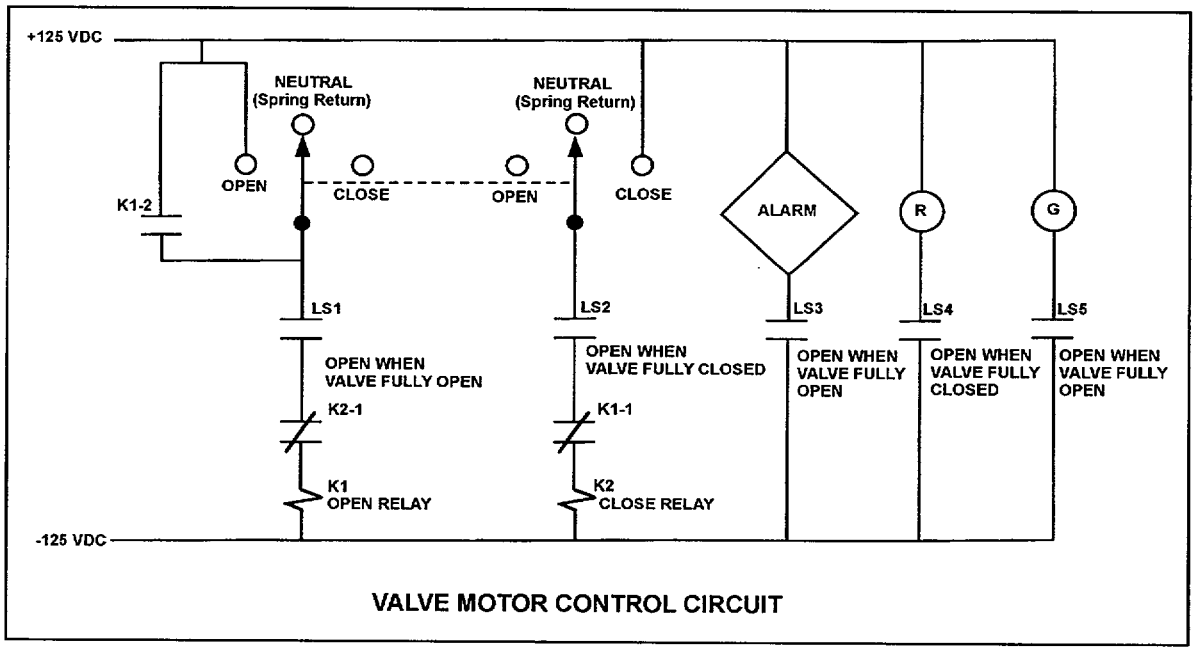
A. The valve will stop opening and remain partially open.

B. The valve will stop opening and then go fully closed.

C. The valve will open fully and remain fully open.

D. The valve will open fully and then go fully closed.

ANSWER: D.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 40
TOPIC: 191008
KNOWLEDGE: K1.04
QID: P2041

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
4160 Volts	4160 Volts
60.2 Hertz	60.2 Hertz
100 Mw	100 Mw
25 MVAR (VARs out)	50 MVAR (VARs out)

A malfunction causes the voltage regulator setpoint for generator B to slowly increase continuously toward a maximum of 4400 volts. If no operator action is taken, which one of the following describes the current indications for generator A?

A. Current will initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

B. Current will initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

C. Current will decrease continuously until the output breaker for generator B trips on reverse power.

D. Current will decrease continuously until the output breaker for generator A trips on reverse power.

ANSWER: A.

QUESTION: 41
TOPIC: 191008
KNOWLEDGE: K1.08
QID: P1842 (B1240)

A main generator is being prepared for paralleling with the grid. Which one of the following indicates that the main generator and the grid are in phase?

A. The synchroscrope pointer is at the 12 o'clock position.

B. The frequency of the generator is equal to the frequency of the grid.

C. The synchroscope pointer is turning slowly in the clockwise direction.

D. The synchroscope pointer is turning slowly in the counterclockwise direction.

ANSWER: A.

QUESTION: 42
TOPIC: 191008
KNOWLEDGE: K1.10
QID: New

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?

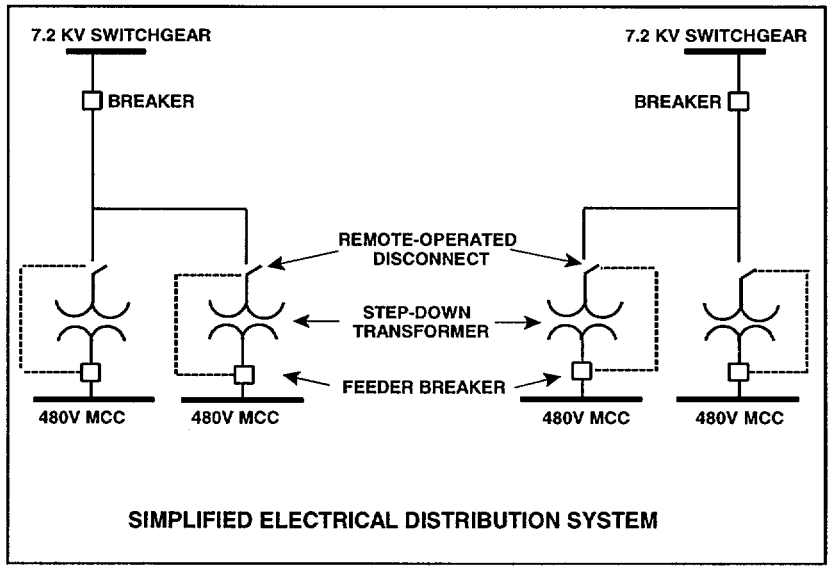
A. Prevent damage to the disconnect.

B. Prevent damage to the transformer.

C. Prevent damage to the feeder breaker.

D. Prevent injury to personnel at the remote operating station.

ANSWER: A.



SIMPLIFIED ELECTRICAL DISTRIBUTION SYSTEM

QUESTION: 43
TOPIC: 191008
KNOWLEDGE: K1.08
QID: P1642 (Rev)

A main generator is being paralleled to the grid with the following conditions:

Generator frequency:	59.9 Hz
Grid frequency:	60.1 Hz
Generator voltage:	114.8 kV
Grid voltage:	115.1 kV

When the generator output breaker is closed, the generator will:

A. acquire real load and reactive load.

B. acquire real load, but become a reactive load to the grid.

C. become a real load to the grid, but acquire reactive load.

D. become a real load and a reactive load to the grid.

ANSWER: D.

QUESTION: 44
TOPIC: 191008
KNOWLEDGE: K1.11
QID: P1140

The following indications are observed in the control room for a normally-open breaker that directly starts/stops a 480 Vac motor:

Red position indicating light is on.
Green position indicating light is off.
Load current indicates 50 amps.
Supply voltage indicates 480 volts.

What is the condition of the breaker?

A. Open and racked in

B. Closed and racked in

C. Open and racked to "test" position

D. Closed and racked to "test" position

ANSWER: B.

QUESTION: 45
TOPIC: 192001
KNOWLEDGE: K1.02
QID: P2345 (B2345)

A neutron that is born 10^{-10} seconds after the associated fission event is classified as a _____ fission neutron.

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: A.

QUESTION: 46
TOPIC: 192002
KNOWLEDGE: K1.08
QID: P2046 (Rev)

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of water at a temperature of 105°F and a boron concentration of 2200 ppm.

Which one of the following will increase core K_{eff}?

A. A new neutron source is installed in the core.

B. Refueling water temperature decreases to 100°F.

C. A spent fuel assembly is replaced with a new fuel assembly.

D. Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER: C.

QUESTION: 47
TOPIC: 192002
KNOWLEDGE: K1.14
QID: P547 (Rev)

Reactors A and B are identical except that reactor A is operating at steady-state 80% power while reactor B is operating at steady-state 100% power. Initial control rod positions are the same for each reactor.

How will the shutdown margins (SDM) compare for the two reactors following a reactor scram? (Assume no post-scram operator actions are taken that would affect SDM.)

A. Reactor A will have the greater SDM.

B. Reactor B will have the greater SDM.

C. When sufficient time has passed to allow both cores to become xenon-free, the SDMs will be equal.

D. Within a few minutes after the scrams, when all parameters have returned to normal post-scram conditions, the SDMs will be equal.

ANSWER: A.

QUESTION: 48
TOPIC: 192003
KNOWLEDGE: K1.06
QID: New

A reactor is exactly critical at 10^{-8}% power during a reactor startup. $\bar{\beta}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable startup rate of 1 dpm?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

PROOF:

From the equation sheet:

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

The $\frac{\ell^*}{\tau}$ term is negligible compared to the second term

Since SUR = 26.06/τ, for a 1 dpm SUR, τ = 26.06 sec

Therefore, $\rho = \frac{.0072}{1 + 0.1\ (26.06)}$

So, $\rho = \frac{.0072}{3.606} \cong .002\ \Delta K/K = 0.2\%\ \Delta K/K$

QUESTION: 49
TOPIC: 192003
KNOWLEDGE: K1.07
QID: P2249 (B2250)

Which one of the following distributions of fission percentages in a reactor will result in the largest reactor core effective delayed neutron fraction?

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

ANSWER: A.

QUESTION: 50
TOPIC: 192004
KNOWLEDGE: K1.06
QID: P751 (Rev)

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

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

C. less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.

D. more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.

ANSWER: A.

QUESTION: 51
TOPIC: 192004
KNOWLEDGE: K1.07
QID: P2352 (Rev)

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

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

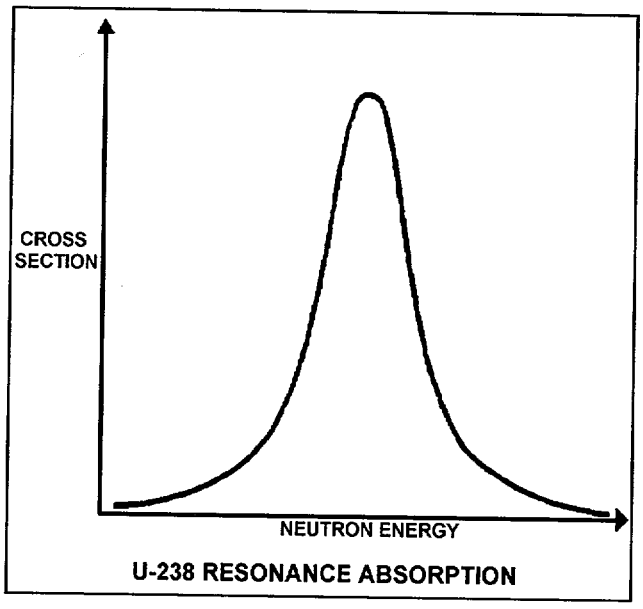
A. decrease; fewer neutrons will be absorbed by U-238 overall

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

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

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

ANSWER: C.



QUESTION: 52
TOPIC: 192004
KNOWLEDGE: K1.08
QID: P1353

A reactor has been taken critical following a four-day shutdown at the beginning of core life. Reactor power is ramped to 50% over the next 8 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the:

A. buildup of core Xe-135.

B. increased fuel temperature.

C. burnout of burnable poisons.

D. increased reactor coolant temperature.

ANSWER: B.

QUESTION: 53
TOPIC: 192004
KNOWLEDGE: K1.12
QID: P1753

Given the following initial parameters:

Total power coefficient	= -0.020% ΔK/K/%
Boron worth	= -0.010% ΔK/K/ppm
Rod worth	= -0.025% ΔK/K/inch inserted
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30% to 80% by boration/dilution with 10 inches of outward control rod motion? (Assume no change in xenon reactivity.)

A. 425 ppm

B. 450 ppm

C. 550 ppm

D. 575 ppm

ANSWER: A.

PROOF: Δk/k from rods = 10" x (-0.025% Δk/k/in) = +0.25% Δk/k (out)

Δk/k from P.D. = 50 x (-0.020% Δk/k/%) = -1.0% Δk/k (Pwr ↑)

Total $\Delta k/k = \Delta k/k$ rods + $\Delta k/k_{PD}$
= +0.25 Δk/k - 1.0% Δk/k = -0.75%Δk/k

Boron change to balance reactivity change from power and rods:

$$\frac{+0.75\%\ \Delta k/k}{-0.010\%\ \Delta k/k/ppm} = -75 \text{ ppm dilution}$$

500 - 75 ppm = 425 ppm

QUESTION: 54
TOPIC: 192005
KNOWLEDGE: K1.03
QID: P1754

A reactor is exactly critical at the point of adding heat (POAH) during a reactor startup at the end of core life. Then, control rods are manually withdrawn for 5 seconds.

Assuming only ambient heat removal from the reactor coolant system (RCS), when conditions stabilize, reactor power will be _____ the POAH and RCS average temperature will be _____.

A. at; the same

B. at; higher

C. greater than; the same

D. greater than; higher

ANSWER: B.

QUESTION: 55
TOPIC: 192005
KNOWLEDGE: K1.07
QID: P2156

A reactor is operating at 80% power near the end of a fuel cycle with the controlling group of control rods inserted 5% into the core. Which one of the following will cause group differential rod worth to become less negative? (Consider only the direct effect of the indicated change.)

A. Burnable poison rods become increasingly depleted.

B. Core Xe-135 concentration decreases toward an equilibrium value.

C. Reactor coolant temperature is allowed to decrease from 575°F to 570°F.

D. Reactor power is decreased to 70% using control rods for control of RCS temperature.

ANSWER: C.

QUESTION: 56

DELETED

QUESTION: 57
TOPIC: 192005
KNOWLEDGE: K1.16
QID: P1657

A reactor is operating at 75% power with all control rods fully withdrawn. Assuming reactor power does not change, which one of the following compares the effects of dropping (full insertion) a single center control rod to the effects of partially inserting (50%) the same control rod?

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

B. A partially inserted rod causes a greater change in radial power distribution.

C. A partially inserted rod causes a greater change in shutdown margin.

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

ANSWER: A.

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. Uranium-235

B. Boron-10

C. Samarium-149

D. Xenon-135

ANSWER: D.

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

QUESTION: 59
TOPIC: 192006
KNOWLEDGE: K1.05
QID: P1158 (B1160)

A reactor has been operating at 25% power for 24 hours following a power reduction from steady-state full power. Which one of the following describes the current status of core xenon?

A. At equilibrium

B. Increasing toward a peak

C. Decreasing toward a valley

D. Decreasing toward equilibrium

ANSWER: D.

QUESTION: 60
TOPIC: 192006
KNOWLEDGE: K1.06
QID: P2559 (Rev)

A reactor is initially operating at 80% power with equilibrium core xenon-135. Power is increased to 100% over a 2-hour period and average reactor coolant temperature is adjusted to 585°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 24 hours after the power change is completed?

A. Greater than 585°F and decreasing slowly

B. Greater than 585°F and increasing slowly

C. Less than 585°F and decreasing slowly

D. Less than 585°F and increasing slowly

ANSWER: C.

QUESTION: 61
TOPIC: 192006
KNOWLEDGE: K1.09
QID: P2260

A reactor is initially shut down with no xenon in the core. The reactor is brought critical and 4 hours later power level is at the point of adding heat. The shift supervisor has directed that power be maintained constant at this level for 12 hours for testing.

To accomplish this, control rods will have to be:

A. inserted periodically for the duration of the 12 hours.

B. withdrawn periodically for the duration of the 12 hours.

C. inserted periodically for 4 to 6 hours, then withdrawn periodically.

D. withdrawn periodically for 4 to 6 hours, then inserted periodically.

ANSWER: B.

QUESTION: 62
TOPIC: 192006
KNOWLEDGE: K1.11
QID: P63 (Rev)

A reactor that has been operating at 100% power for about two months is shutdown over a 2-hour period. Following the shutdown, core xenon-135 will first reach a new steady-state concentration in _____ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

ANSWER: D.

QUESTION: 63
TOPIC: 192007
KNOWLEDGE K1.04
QID: P464 (Rev)

During continuous full-power reactor operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically to compensate for fuel depletion. What other core age-related factor requires a decrease in coolant boron concentration?

A. Decreasing control rod worth

B. Buildup of fission product poisons

C. Burnout of burnable poisons

D. Decreasing fuel temperature

ANSWER: B.

QUESTION: 64
TOPIC: 192006
KNOWLEDGE: K1.14
QID: P563 (Rev)

A reactor is operating at 80% power at the beginning of core life with equilibrium core xenon-135. Reactor power is increased, over a 2-hour period, to 100%. The following information is provided:

	PRIOR TO POWER CHANGE	AFTER POWER CHANGE
Reactor power:	80%	100%
Reactor coolant system boron concentration:	780 ppm	760 ppm
Control rod position:	Fully Withdrawn	Fully Withdrawn

What is the effect on power distribution in the core during the first 4 hours following the power increase?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: B.

QUESTION: 65
TOPIC: 192008
KNOWLEDGE: K1.03
QID: P2467

A reactor startup is in progress. The reactor is slightly subcritical with a constant startup rate of 0.0 decades per minute (dpm). A short control rod insertion will cause the reactor startup rate indication to rapidly decrease (become negative), and then:

A. gradually become less negative and return to 0.0 dpm.

B gradually become more negative until neutron population reaches equilibrium, then stabilize.

C. stabilize until neutron population reaches the prestartup equilibrium level, then return to 0.0 dpm.

D. stabilize at -1/3 dpm until delayed neutrons are no longer a significant contributor to the neutron population, and then return to 0.0 dpm.

ANSWER: A.

QUESTION: 66
TOPIC: 192008
KNOWLEDGE: K1.04
QID: P2265 (Rev)

During a reactor startup, source range indication is stable at 120 cps with K_{eff} at 0.95. After a period of control rod withdrawal, source range indication stabilizes at 600 cps. Which one of the following is the approximate new K_{eff}?

A. 0.96

B. 0.97

C. 0.98

D. 0.99

ANSWER: D.

PROOF:

$CR_1 (1-K_1) = CR_2 (1-K_2)$
$CR_2/CR_1 = (1-K_1)/(1-K_2)$
$600/120 = 0.05/1-K_2$
$1-K_2 = 0.05/5$
$K_2 = 1-0.01$
$K_2 = 0.99$

QUESTION: 67
TOPIC: 192008
KNOWLEDGE: K1.07
QID: P268

To predict critical control rod position prior to performing a reactor startup, the operator must determine the amount of reactivity added by post-shutdown changes in:

A. reactor coolant boron concentration, moderator voids, and burnable poisons.

B. control rod positions, core xenon-135 concentration, and moderator temperature.

C. power defect, reactor coolant boron concentration, and control rod positions.

D. moderator temperature, burnable poisons, and core xenon-135 concentration.

ANSWER: B.

QUESTION: 68
TOPIC: 192008
KNOWLEDGE: K1.23
QID: New

Reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the longest reactor period five minutes after the scram?

A. Reactor A due to the greater shutdown reactivity.

B. Reactor B due to the smaller shutdown reactivity.

C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

QUESTION: 69
TOPIC: 192008
KNOWLEDGE: K1.14
QID: P1669

A reactor is critical at 10^{-5}% power and critical data is being taken when a steam generator relief valve fails open. The reactor is at middle of core life and control rods are in manual.

Assuming no operator actions and no reactor trip, when the reactor stabilizes, average coolant temperature will be _____ the initial coolant temperature and final reactor power will be _____ the point of adding heat.

A. equal to; greater than

B. equal to; equal to

C. less than; greater than

D. less than; equal to

ANSWER: C.

QUESTION: 70
TOPIC: 192008
KNOWLEDGE: K1.17
QID: P2069 (Rev)

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the shortest amount of time to occur?

A. 3% power to 5% power

B. 5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

ANSWER: A.

PROOF: $P_f = P_o e^{t/\tau}$

$\tau \ln P_f/P_o = t$

$(\ln 5/3)(180) = 0.51(180) = t = 91.8$ seconds

$(\ln 15/5)(180) = 1.1(180) = t = 198$ seconds

$(\ln 30/15)(180) = 0.693(180) = t = 124.8$ seconds

$(\ln 60/30)(180) = 0.693(180) = t = 124.8$ seconds

QUESTION: 71
TOPIC: 192008
KNOWLEDGE: K1.21
QID: P1570 (Rev)

A nuclear plant is operating at 80% power and 580°F average reactor coolant temperature (T_{ave}) at the end of core life with manual rod control. A turbine control system malfunction partially closes the turbine control valves resulting in 5% less steam flow to the main turbine. No operator actions occur and no protective system actuations occur.

Following the transient, reactor power will stabilize _____ 80% and T_{ave} will stabilize _____ 580°F.

A. at; above

B. at; below

C. below; above

D. below; below

ANSWER: C.

QUESTION: 72
TOPIC: 192008
KNOWLEDGE: K1.26
QID: P369 (B370)

Reactor coolant temperature is being maintained at 500°F one week following a normal shutdown from several months of operation at 100% power. All reactor coolant pumps are operating.

The primary source of heat input to the reactor coolant is from:

A. fission product decay.

B. reactor coolant pumps.

C. subcritical fast fission of U-238.

D. subcritical thermal fission of U-235 and Pu-239.

ANSWER: B.

QUESTION: 73
TOPIC: 193001
KNOWLEDGE: K1.01
QID: P2073 (Rev)

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: K1.08
QID: P774 (N/A)

A pressurizer is operating in a saturated condition at 636°F. If a sudden pressurizer level decrease of 10% occurs, pressurizer pressure will _____ and pressurizer temperature will _____.

A. remain the same; decrease

B. remain the same; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: C.

QUESTION: 75
TOPIC: 193003
KNOWLEDGE: K1.25
QID: New

With the plant operating near rated power, air inleakage into the main condenser causes main condenser pressure to increase from 1.0 psia to 2.0 psia.

Given the following:

- Initial main condenser condensate depression was 4°F.
- After the plant stabilizes, with main condenser pressure at 2.0 psia, main condenser condensate depression is 2°F.

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

A. 2 Btu/lbm

B. 4 Btu/lbm

C. 8 Btu/lbm

D. 16 Btu/lbm

ANSWER: A.

PROOF: The condensate must be cooled an additional 2°F to restore condensate depression to 4°F. Steam tables can be used but they are not required. Per the definition for specific heat (1.0 Btu/lbm -°F for water), an additional 2°F decrease in condensate temperature requires an additional 2 Btu/lbm heat rejection from the main condenser.

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

Condensate is collecting in the main condenser hotwell at 90°F with a condenser pressure of 28 inches Hg vacuum. Which one of the following will improve steam cycle efficiency?

A. Main condenser cooling water flow decreases by 5% with no change in condenser vacuum.

B. Main condenser cooling water inlet temperature decreases by 10°F with no change in condenser vacuum.

C. Main condenser vacuum decreases to 27 inches Hg due to buildup of noncondensible gases.

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

ANSWER: A.

QUESTION: 77
TOPIC: 193004
KNOWLEDGE: K1.15
QID: P276

A reactor coolant system is being maintained at 1000 psia. A pressurizer safety/relief valve is slowly discharging to a collection tank, which is maintained at 5 psig.

Assuming 100% quality steam in the pressurizer vapor space, what is the enthalpy of the fluid entering the tank?

A. 1,210 Btu/lbm

B. 1,193 Btu/lbm

C. 1,178 Btu/lbm

D. 1,156 Btu/lbm

ANSWER: B.

QUESTION: 78
TOPIC: 193005
KNOWLEDGE: K1.03
QID: New

The theoretical maximum efficiency of a steam cycle is given by the equation:

$$Eff_{thmax} = (1 - T_{out}/T_{in}) \times 100\%,$$

where T_{out} is the absolute temperature for heat rejection and T_{in} is the absolute temperature for heat addition. (Fahrenheit temperature is converted to absolute temperature by adding 460°.)

A plant is operating with a stable steam generator pressure of 900 psia. What is the approximate theoretical maximum steam cycle efficiency this plant can achieve by establishing its main condenser vacuum at 1.0 psia?

A. 35%

B. 43%

C. 57%

D. 65%

ANSWER: B.

PROOF:

At 1.0 psia, $T_{out} = 460 + 101.74 = 561.74°R$
At 900 psia, $T_{in} = 460 + 531.95 = 991.95°R$
Therefore, $T_{out}/T_{in} = .566$, which is subtracted from 1 to get .434, or 43.4%

QUESTION: 79
TOPIC: 193006
KNOWLEDGE: K1.05
QID: P1580 (Rev)

An 80 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A. 20 gpm

B. 40 gpm

C. 49 gpm

D. 57 gpm

ANSWER: D.

PROOF: $DP \propto f^2$

$DP_1/DP_2 = (f_1/f_2)^2$

$1.414 = 80/f_2$

$f_2 = 80/1.414$

$f_2 = 56.58$ gpm

QUESTION: 80
TOPIC: 193006
KNOWLEDGE: K1.10
QID: P381 (B380)

The major concern with starting a feed water pump with downstream fluid in a saturated condition is:

A. cavitation.

B. water hammer.

C. thermal shock.

D. positive reactivity addition.

ANSWER: B.

QUESTION: 81
TOPIC: 193006
KNOWLEDGE: K1.15
QID: P2282 (B2281)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec. The pipe then splits into two pipes, a 4-inch diameter pipe and an 8-inch diameter pipe. Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 4-inch and 8-inch diameter pipes?

	4-inch Pipe (lbm/sec)	8-inch Pipe (lbm/sec)
A.	20	80
B.	25	75
C.	30	70
D.	33	67

ANSWER: A.

PROOF:

$m = pAv$
$m1 + m2 = 100$
$pA1v + pA2v = 100$
$pv(A1 + A2) = 100$
$pv(80) = 100$
$pv = 100/80$

$m1 = pvA1$
$m1 = 100/80\ (16)$
$m1 = 1600/80 = 20$ lbm/sec

$m2 = pvA2$
$m2 = 100/80\ (64)$
$m1 = 6400/80 = 80$ lbm/sec

QUESTION: 82
TOPIC: 193006
KNOWLEDGE: K1.11
QID: P2680 (B280)

Cavitation is the formation of vapor bubbles in the _____ pressure area of a pump followed by the _____ of these bubbles within the pump casing.

A. low; expansion

B. low; collapse

C. high; expansion

D. high; collapse

ANSWER: B.

QUESTION: 83
TOPIC: 193006
KNOWLEDGE: K1.15
QID: P2383 (Rev)

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1200 psig.

Given the following information:

Centrifugal Pumps

Shutoff head:	1500 psig
Maximum design pressure:	2000 psig
Flow rate with no backpressure:	180 gpm

Positive Displacement Pumps

Maximum design pressure:	2000 psig

Which one of the following pump configurations will supply the highest makeup flow rate to the cooling water system if system pressure is at 1700 psig?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One PDP and one CP in series (CP supplying PDP)

ANSWER: C.

PROOF:

Two CPs in series results in between 100 gpm and 180 gpm flow rate. Two CPs in parallel results in no flow. Two PDPs in parallel results in about 200 gpm. One PDP and one CP in series results in about 100 gpm.

QUESTION: 84
TOPIC: 193007
KNOWLEDGE: K1.06
QID: P1384

A secondary heat balance calculation has been performed to calibrate reactor power instrumentation. Which one of the following will result in a calculated reactor power that is less than actual reactor power?

A. Steam generator pressure is indicating above actual steam generator pressure.

B. Steam generator water level is indicating below actual steam generator water level.

C. Feedwater flow rate is indicating above actual feedwater flow rate.

D. Feedwater temperature is indicating below actual feedwater temperature.

ANSWER: A.

QUESTION: 85
TOPIC: 193007
KNOWLEDGE: K1.08
QID: P1485

During a plant outage, 5% of all steam generator (S/G) tubes were plugged due to wall thinning. Full-power reactor coolant system flow rate and average coolant temperature (T_{ave}) have not changed. Given the following 100% power conditions before the outage:

T_{ave} = 578°F
$T_{S/G}$ = 538°F

Which one of the following will be the approximate S/G pressure when the plant is returned to 100% power after the outage?

A. 960 psia

B. 930 psia

C. 900 psia

D. 870 psia

ANSWER: B.

PROOF:

$UA\Delta T_{before} = UA\Delta T_{after}$

If A decreases by 5%, then ΔT must increase by 5%. If Tave is constant, then $T_{S/G}$ must decrease by (0.05) (40°F), or 2°F

TS/G: 538°F - 2 = 536°F

P_{sat} for 536°F = 931.17 psia

QUESTION: 86
TOPIC: 193008
KNOWLEDGE: K1.02
QID: P2386 (B2385)

Subcooled water enters the bottom of a fuel assembly in an operating reactor core. As the water flows upward past the fuel assembly, boiling occurs and the coolant exits the fuel assembly at saturation temperature.

If the coolant had remained subcooled, average fuel temperature would have been _____ because single-phase convection is a _____ efficient method of heat transfer.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

ANSWER: B.

QUESTION: 87
TOPIC: 193008
KNOWLEDGE: K1.03
QID: P286 (Rev)

A reactor is operating at 100% power. Which one of the following will increase the likelihood of vapor bubble formation in the reactor coolant?

A. Surface scratches or cavities in the fuel clad

B. Subsurface void defect in the fuel clad

C. Increased coolant velocity past the fuel rods

D. Chemically inert material dissolved in the coolant

ANSWER: A.

QUESTION: 88
TOPIC: 193008
KNOWLEDGE: K1.05
QID: P2387 (Rev)

A plant is operating with the following initial conditions:

Reactor power is 45% in the middle of a fuel cycle.
Axial and radial power distributions are peaked in the center of the core.

Which one of the following will increase the steady-state departure from nucleate boiling ratio?

A. Core Xe-135 decays with no change in the axial and radial power distributions.

B. A reactor trip occurs and one control rod remains fully withdrawn from the core.

C. The operator decreases reactor coolant boron concentration by 5 ppm with no control rod motion.

D. A pressurizer malfunction decreases reactor coolant system pressure by 20 psig with no control rod motion.

ANSWER: B.

QUESTION: 89
TOPIC: 193008
KNOWLEDGE: K1.08
QID: P2189 (B687)

Which one of the following describes the relative contributions of the convective and radiative heat transfer mechanisms during stable film boiling heat transfer in the core?

A. Both heat transfer mechanisms are significant and ΔT increases exponentially with heat flux.

B. Both heat transfer mechanisms are significant and ΔT increases in direct proportion to heat flux.

C. Only the radiative heat transfer mechanism is significant and ΔT increases exponentially with heat flux.

D. Only the radiative heat transfer mechanism is significant and ΔT increases in direct proportion to heat flux.

ANSWER: C.

QUESTION: 90
TOPIC: 193008
KNOWLEDGE: K1.15
QID: P2591 (Rev)

Which one of the following is most likely to result in steam bubble formation in a reactor vessel head while maintaining a 40°F subcooling margin in the hottest RCS hot leg?

A. Performing a 25°F/Hr RCS cooldown on natural circulation

B. Performing a 25°F/Hr RCS cooldown on forced circulation

C. Performing a 50°F/Hr RCS cooldown on natural circulation

D. Performing a 50°F/Hr RCS cooldown on forced circulation

ANSWER: C.

QUESTION: 91
TOPIC: 193008
KNOWLEDGE: K1.21
QID: P1692

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 16°F.

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

A. 2°F.

B. 4°F.

C. 8°F.

D. 10°F.

ANSWER: D.

PROOF:

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

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

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

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

$$\Delta T_2 = \frac{16}{(1/.5)^{2/3}}$$

$$\Delta T_2 = \frac{16}{1.587}$$

$$\Delta T_2 = 10.1°F$$

QUESTION: 92
TOPIC: 193008
KNOWLEDGE: K1.18
QID: P1790 (B1789)

Single-phase coolant flow resistance (head loss) in a reactor core is directly proportional to coolant _____ and inversely proportional to _____.

A. temperature; coolant channel cross-sectional area

B. temperature; fuel assembly length

C. velocity; coolant channel cross-sectional area

D. velocity; fuel assembly length

ANSWER: C.

QUESTION: 93

DELETED

QUESTION: 94
TOPIC: 193009
KNOWLEDGE: K1.01
QID: P1294 (Rev)

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: 193010
KNOWLEDGE: K1.01
QID: P2496 (B2499)

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

A. greater than; greater than

B. greater than; less than

C. less than; greater than

D. less than; less than

ANSWER: D.

QUESTION: 96
TOPIC: 193009
KNOWLEDGE: K1.05
QID: New

Given the following initial core parameters for a segment of a fuel rod:

Power density = 3 kW/ft
$T_{coolant}$ = 579°F
$T_{fuel\ centerline}$ = 2400°F

Reactor power is increased such that the following core parameters now exist for the same fuel rod segment:

Power density = 5 kW/ft
$T_{coolant}$ = 590°F
$T_{fuel\ centerline}$ = ?°F

Assuming no boiling occurs and coolant flow rate is unchanged, what will be the new stable $T_{fuel\ centerline}$?

A. 3035°F

B. 3614°F

C. 3625°F

D. 4590°F

ANSWER: C.

PROOF:

Use $Q = UA\Delta T$, where the product UA is constant.

If Q is increased by 5/3, ΔT is increased by 5/3.

$\Delta T_2 = 5/3 \times \Delta T_1 = 5/3 \times (2400°F - 579°F) = 3035°F$

Adding 3035°F to 590°F = 3625°F

QUESTION: 97
TOPIC: 193010
KNOWLEDGE: K1.07
QID: P1500 (Rev) (B2300)

A plant heatup is in progress using reactor coolant pumps. The heatup stress applied to the reactor vessel is:

A. tensile across the entire wall.

B. tensile at the inner wall and compressive at the outer wall.

C. compressive across the entire wall.

D. compressive at the inner wall and tensile at the outer wall.

ANSWER: D.

QUESTION: 98
TOPIC: 193010
KNOWLEDGE: K1.04
QID: P2397 (B2399)

Reactor coolant system pressure-temperature limit curves are derived by using a conservative value for the reactor vessel reference temperature for nil ductility transition (RT_{NDT}).

Early in core life, the assumed value of RT_{NDT} is _____ than actual RT_{NDT}; and actual RT_{NDT} is verified periodically over core life by _____.

A. higher; removing and testing irradiated specimens of reactor vessel material

B. higher; inservice inspection and analysis of the reactor vessel wall

C. lower; removing and testing irradiated specimens of reactor vessel material

D. lower; inservice inspection and analysis of the reactor vessel wall

ANSWER: A.

QUESTION: 99
TOPIC: 193010
KNOWLEDGE: K1.05
QID: P2098 (Rev)

Two identical reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 20 heatup/cooldown cycles and has an average power capacity of 80%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature and why?

A. Reactor A due to the greater number of heatup/cooldown cycles

B. Reactor A due to the lower average power capacity

C. Reactor B due to the fewer number of heatup/cooldown cycles

D. Reactor B due to the higher average power capacity

ANSWER: D.

QUESTION: 100
TOPIC: 193010
KNOWLEDGE: K1.06
QID: P99 (Rev)

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

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

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

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

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

ANSWER: C.

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

APRIL 2000 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	A	51	79	C	76	4	A
2	30	B	27	55	A	52	80	B	77	5	B
3	31	B	28	56	D	53	81	A	78	6	B
4	32	C	29	57	D	54	82	B	79	7	D
5	33	A/B	30	58	D	55	83	C	80	8	B
6	34	D	31	59	A	56	84	A/B	81	9	A
7	35	D	32	60	C	57	85	A	82	10	B
8	36	D	33	61	D	58	86	D	83	11	C
9	37	D	34	62	B	59	87	D	84	12	A
10	38	B	35	63	B	60	88	C	85	13	B
11	39	B	36	64	B	61	89	B	86	14	B
12	40	B	37	65	A	62	90	D	87	15	A
13	41	D	38	66	C	63	91	B	88	16	B
14	42	A/C	39	67	D	64	92	B	89	17	C
15	43	C	40	68	A	65	93	A	90	18	C
16	44	D	41	69	A	66	94	D	91	19	D
17	45	B/D	42	70	A	67	95	B	92	20	C
18	46	C	43	71	D	68	96	D	93	21	A/B
19	47	D	44	72	B	69	97	C	94	22	D
20	48	C	45	73	A	70	98	A	95	23	D
21	49	B	46	74	C	71	99	C	96	24	C
22	50	C	47	75	A	72	100	B	97	25	D
23	51	C	48	76	A	73	1	B	98	26	A
24	52	B	49	77	A	74	2	C	99	27	D
25	53	D	50	78	A	75	3	A	100	28	C

April 27, 2000

UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
APRIL 2000--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 not received or been given 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}

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

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

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

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

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

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

$1/M = CR_I/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

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 hp = 2.54×10^3 Btu/hr

1 Btu = 778 ft-lbf

°C = (5/9)(°F - 32)

°F = (9/5)(°C) + 32

1 Curie = 3.7×10^{10} dps

1 kg = 2.21 lbm

1 gal_{water} = 8.35 lbm

1 ft^3_{water} = 7.48 gal

USNRC GENERIC FUNDAMENTALS EXAMINATION
APRIL 2000 BWR--FORM A

QUESTION: 1
TOPIC: 291001
KNOWLEDGE: K1.02
QID: B2501 (Rev)

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

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

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

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

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

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

ANSWER: C.

QUESTION: 2
TOPIC: 291001
KNOWLEDGE: K1.03
QID: B2101 (P2102)

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

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

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

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

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

ANSWER: B.

QUESTION 3
TOPIC: 291001
KNOWLEDGE: K1.05
QID: B1404 (P1602)

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

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

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

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

D. Compare an upstream and downstream pressure gauge to ensure zero differential pressure.

ANSWER: C.

QUESTION: 4
TOPIC: 291001
KNOWLEDGE: K1.08
QID: B1605 (Rev)

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

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

A. The handwheel will not turn, and the valve stem will not move.

B. The handwheel will turn, but the valve stem will not move.

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

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

ANSWER: B.

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

When comparing a typical gate valve to a typical globe valve in the same application with both valves 50% open, the globe valve has a _____ pressure drop and is the better choice for _____ flow in high-pressure fluid systems.

A. higher; throttling

B. higher; isolating

C. lower; throttling

D. lower; isolating

ANSWER: A.

QUESTION: 6
TOPIC: 291002
KNOWLEDGE: K1.01
QID: B2106 (P908)

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

A. Venturi

B. Flow nozzle

C. Pipe elbow

D. Orifice

ANSWER: D.

QUESTION: 7

DELETED

QUESTION: 8
TOPIC: 291002
KNOWLEDGE: K1.07
QID: B1211 (P1807)

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

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

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense

ANSWER: D.

QUESTION: 9
TOPIC: 291002
KNOWLEDGE: K1.09
QID: B1410 (Rev)

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

The reactor vessel is supplying steam at normal operating temperature and pressure with accurate level indication. Which one of the following events will result in a vessel level indication that is less than actual level?

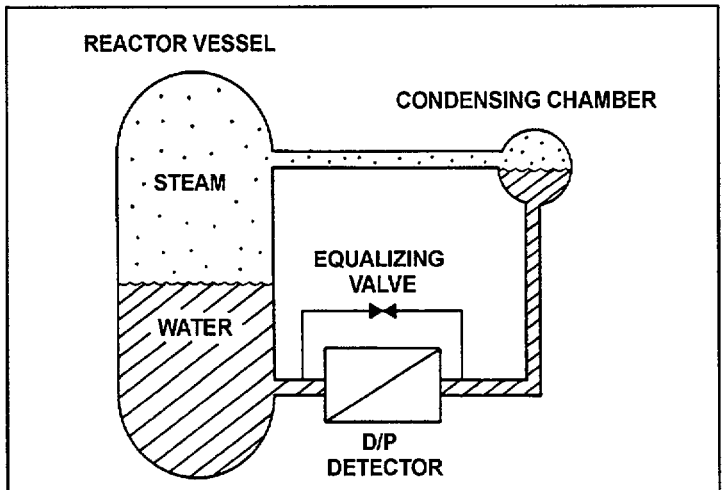
A. Actual RV water level decreases by 6 inches.

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

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

D. RV pressure increases by 50 psi with no change in actual water level.

ANSWER: D.



REACTOR VESSEL DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 10
TOPIC: 291002
KNOWLEDGE: K1.11
QID: B711 (P710)

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

A. increase by 20 psig.

B. decrease by 20 psig.

C. increase by the square root of 20 psig.

D. decrease by the square root of 20 psig.

ANSWER: B.

QUESTION: 11
TOPIC: 291002
KNOWLEDGE: K1.13
QID: B212 (P211)

A bourdon-tube pressure detector that is indicating 50% of scale is suddenly exposed to a high-pressure transient that permanently distorts the detector. Actual pressure returns to its original value.

Assuming the detector remains intact, the affected pressure indication will initially go off-scale high, and then:

A. return to 50% of scale.

B. return to a value below 50% of scale.

C. return to a value above 50% of scale.

D. become unpredictable until the instrument is calibrated.

ANSWER: C.

QUESTION: 12
TOPIC: 291002
KNOWLEDGE: K1.15
QID: B309 (Rev)

Unlike a resistance temperature detector, a typical thermocouple:

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

B. requires a temperature-controlled reference junction.

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

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

ANSWER: B.

QUESTION: 13
TOPIC: 291002
KNOWLEDGE: K1.19
QID: B1214

A reactor scrammed due to a loss-of-coolant accident 1 hour ago. To verify adequate reactor vessel water level, the source range monitors (SRMs) are inserted. As the SRMs enter the core, count rate begins to increase and then stabilizes.

If the SRMs enter a voided section of the core, count rate will suddenly:

A. increase due to increased neutron migration length.

B. increase due to decreased moderator neutron absorption.

C. decrease due to increased neutron leakage.

D. decrease due to decreased fast fission.

ANSWER: C.

QUESTION: 14

DELETED

QUESTION: 15
TOPIC: 291003
KNOWLEDGE: K1.01
QID: B715 (P1615)

An automatic flow controller is being used to position a valve in a cooling water system. A signal from the valve, that is proportional to valve position, is returned to the controller. This signal is referred to as:

A. gain.

B. bias.

C. feedback.

D. error.

ANSWER: C.

QUESTION: 16
TOPIC: 291003
KNOWLEDGE: K1.05
QID: B2416 (Rev)

An air-operated isolation valve requires 3,600 lbf applied to the top of the actuator diaphragm to open. The actuator diaphragm has a diameter of 8 inches.

If control air pressure to the valve actuator begins to increase from 0 psig, which one of the following is the approximate air pressure at which the valve will begin to open?

A. 32 psig

B. 45 psig

C. 56 psig

D. 72 psig

ANSWER: D.

PROOF: $F = P \times A$
$P = F/A = 3600 \text{ lbf}/50.27 \text{ in}^2 = 71.6 \text{ lbf/in}^2$

QUESTION: 17

DELETED

QUESTION: 18
TOPIC: 291004
KNOWLEDGE: K1.05
QID: New

Refer to the drawing showing two operating points for the same centrifugal pump (see figure below).

Operating point A was generated from pump performance data taken six months ago. Current pump performance data was used to generate operating point B. Which one of the following would cause the observed difference between operating points A and B?

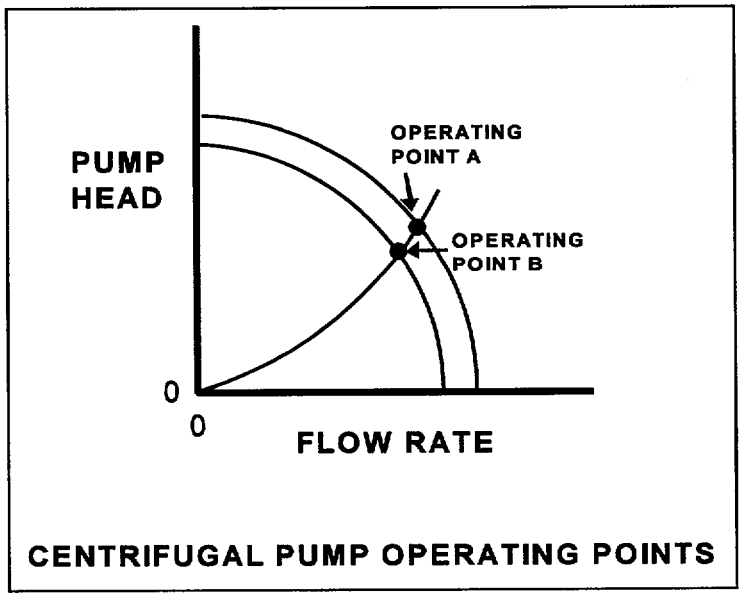
A. The pump discharge valve was more open when data was collected for operating point A.

B. The pump discharge valve was more closed when data was collected for operating point A.

C. The pump internal components have worn since data was collected for operating point A.

D. The system piping head loss has increased since data was collected for operating point A.

ANSWER: C.



CENTRIFUGAL PUMP OPERATING POINTS

QUESTION: 19
TOPIC: 291004
KNOWLEDGE: K1.01
QID: B2118 (P1021)

Which one of the following will result in immediate cavitation of a centrifugal pump operating at normal rated flow?

A. Recirculation flow path is aligned.

B. Recirculation flow path is isolated.

C. Pump suction valve is fully closed.

D. Pump discharge valve is fully closed.

ANSWER: C.

QUESTION: 20
TOPIC: 291004
KNOWLEDGE: K1.07
QID: B2423 (P2124)

A centrifugal pump is circulating water at 180°F with a motor current of 200 amps. After several hours, system temperature has changed such that the water density has increased by 3%.

Assuming pump head does not change, which one of the following is the new pump motor current?

A. 203 amps

B. 206 amps

C. 218 amps

D. 236 amps

ANSWER: B.

PROOF:

$W_{pump} = \dot{m}\Delta P\upsilon$

$\Delta P\upsilon$ = pump head

Pump head is ↔

$\therefore W_{pump} \propto \dot{m}$

$\dot{m}$ increases by 3%,

$\therefore W_{pump}$ increases by 6 amps

200 + 6 = 206 amps

QUESTION: 21
TOPIC: 291004
KNOWLEDGE: K1.11
QID: B520 (Rev)

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose. Which one of the following will cause the pump to operate at shutoff head?

A. A firefighter inadvertently severs the fire hose.

B. The fire hose becomes completely crimped in a fire door.

C. Fire water storage tank level drops below the pump suction tap.

D. A firefighter adjusts the fire hose nozzle spray pattern from "deluge" to "fog."

ANSWER: B.

QUESTION: 22
TOPIC: 291004
KNOWLEDGE: K1.14
QID: B1323 (Rev)

A centrifugal pump is operating at maximum design flow rate, taking suction on a vented water storage tank and discharging through two parallel valves. Valve "A" is fully open and valve "B" is half open.

Which one of the following will occur if valve B is fully closed?

A. The pump will operate at shutoff head.

B. The pump will operate at runout conditions.

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

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

ANSWER: C.

QUESTION: 23
TOPIC: 291004
KNOWLEDGE: K1.13
QID: B2324 (Rev)

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1200 psig.

Given the following information:

Centrifugal Pumps

Shutoff head:	1500 psig
Maximum design pressure:	2000 psig
Flow rate with no backpressure:	180 gpm

Positive Displacement Pumps

Maximum design pressure:	2000 psig

Which one of the following pump configurations will supply the highest makeup flow rate to the cooling water system if system pressure is at 1700 psig?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One PDP and one CP in series (CP supplying PDP)

ANSWER: C.

PROOF:

Two CPs in series results in between 100 gpm and 180 gpm flow rate. Two CPs in parallel results in no flow. Two PDPs in parallel results in about 200 gpm. One PDP and one CP in series results in about 100 gpm.

QUESTION: 24
TOPIC: 291004
KNOWLEDGE: K1.16
QID: B2525 (Rev)

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

A. Increasing pump speed to 700 rpm

B. Decreasing pump discharge pressure to 40 psig

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

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

ANSWER: A.

QUESTION: 25
TOPIC: 291004
KNOWLEDGE: K1.18
QID: B1125 (P1425)

Which one of the following describes the proper location for a relief valve that will be used to prevent exceeding the design pressure of a positive displacement pump and associated piping?

A. On the pump discharge piping upstream of the discharge isolation valve

B. On the pump discharge piping downstream of the discharge isolation valve

C. On the pump suction piping upstream of the suction isolation valve

D. On the pump suction piping downstream of the suction isolation valve

ANSWER: A.

QUESTION: 26
TOPIC: 291005
KNOWLEDGE: K1.02
QID: B1927 (P528)

Which one of the following will provide motor protection against electrical damage caused by gradual bearing degradation?

A. Thermal overload device

B. Overcurrent trip relay

C. Underfrequency relay

D. Undervoltage device

ANSWER: A.

QUESTION: 27
TOPIC: 291005
KNOWLEDGE: K1.05
QID: B2227 (Rev)

Two identical 4160 Vac induction motors are connected to identical centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for pump A is fully shut and the discharge valve for pump B is fully open.

If each motor is then started, the longest time period required to stabilize motor current will be experienced by motor _____ and the higher stable motor current will be experienced by motor _____.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: D.

QUESTION: 28
TOPIC: 291005
KNOWLEDGE: K1.06
QID: B1928 (P1031)

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

A. windings; high

B. windings; low

C. commutator and/or slip rings; high

D. commutator and/or slip rings; low

ANSWER: B.

QUESTION: 29
TOPIC: 291005
KNOWLEDGE: K1.08
QID: B2128 (Rev)

A main generator is operating in parallel with the power grid. If the voltage supplied to the generator field is slowly and continuously increased, the generator will experience high current due to: (Assume no generator protective actuations occur.)

A. generator reverse power.

B. excessive generator MWe.

C. excessive generator KVAR (VARs in).

D. excessive generator KVAR (VARs out).

ANSWER: D.

QUESTION: 30
TOPIC: 291005
KNOWLEDGE: K1.09
QID: B1529 (P2228)

A diesel generator (D/G) is supplying an electrical bus in parallel with the grid. Assuming D/G terminal voltage and bus frequency do not change, if the D/G governor setpoint is increased from 60 Hz to 60.1 Hz, then D/G KVAR will be _____ and D/G amps will be _____.

A. the same; higher

B. the same; the same

C. higher; higher

D. higher; the same

ANSWER: A.

QUESTION: 31
TOPIC: 291006
KNOWLEDGE: K1.03
QID: B2033 (P2333)

A parallel-flow heat exchanger and a counter-flow heat exchanger are being used in the same water-to-water cooling application. Each heat exchanger has the same mass flow rates and inlet temperatures. Each heat exchanger is constructed of the same materials and has the same heat transfer area.

Under these conditions, the parallel-flow heat exchanger will have the _____ heat transfer rate because _____.

A. higher; the average ΔT across the tubes is greater

B. higher; the average outlet temperature of the two fluids is higher

C. lower; the average ΔT across the tubes is smaller

D. lower; the average outlet temperature of the two fluids is lower

ANSWER: C.

QUESTION: 32
TOPIC: 291006
KNOWLEDGE: K1.07
QID: B1231 (Rev)

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 4, the operator can adjust valve _____ in the _____ direction.

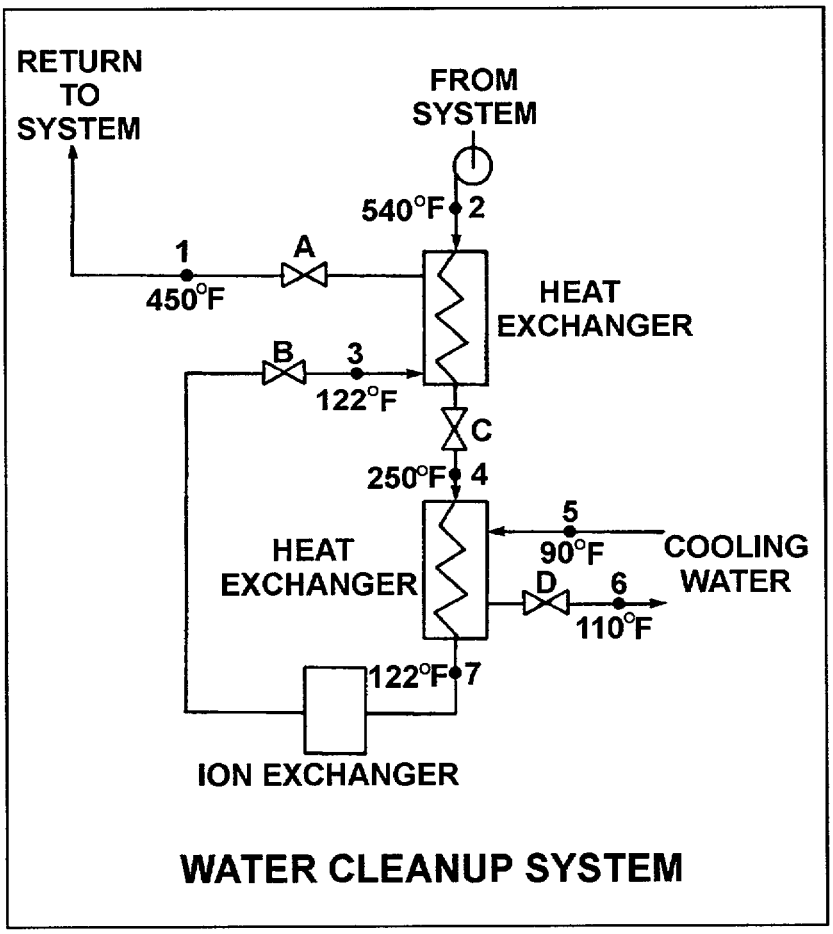
A. A; shut

B. B; shut

C. C; open

D. D; open

ANSWER: C.



QUESTION: 33
TOPIC: 291006
KNOWLEDGE: K1.08
QID: B2233 (Rev)

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

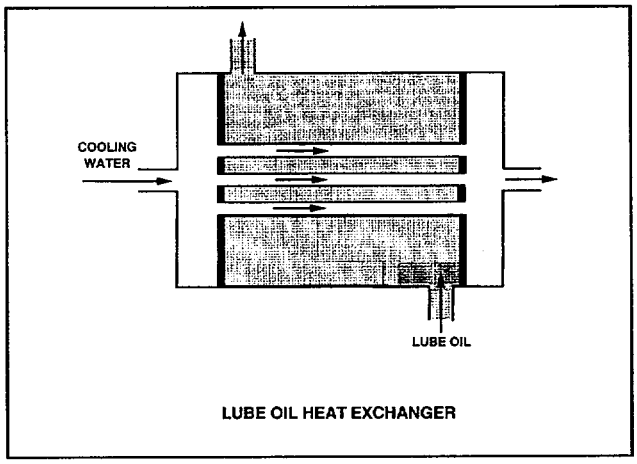
The lube oil heat exchanger is in service with the following inlet temperatures:

Lube oil inlet temperature: 130°F
Cooling water inlet temperature: 70°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following pairs of heat exchanger outlet temperatures is not possible? (Assume both fluids have the same specific heat.)

	Lube Oil Outlet Temp	Cooling Water Outlet Temp
A.	90°F	86°F
B.	100°F	85°F
C.	110°F	84°F
D.	120°F	83°F

ANSWER: D.



PROOF: D. is the only option that shows a cooling water temp. increase that is greater than the lube oil temp. decrease. This is not possible since cooling water flow rate is higher and the fluids are assumed to have the same specific heat.

QUESTION: 34
TOPIC: 291006
KNOWLEDGE: K1.16
QID: B1234 (P32)

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

If scaling occurs inside the cooling water tubes, cooling water outlet temperature will _____ and lube oil outlet temperature will _____. (Assume oil and cooling water flow rates remain the same.)

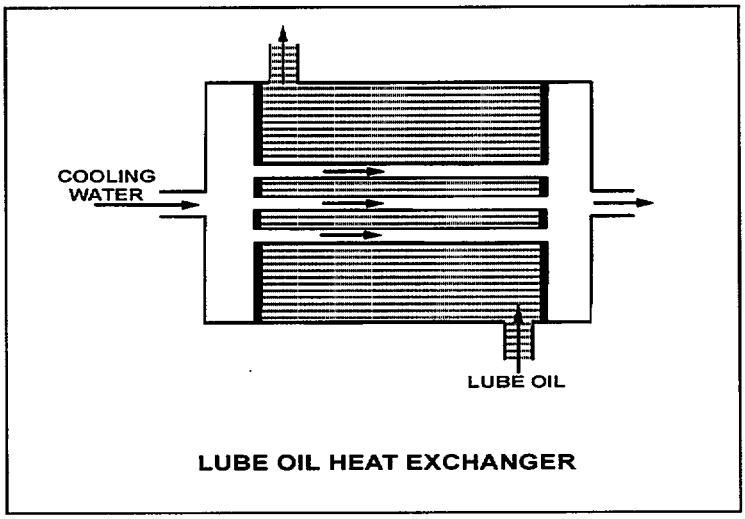
A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase

ANSWER: B.



LUBE OIL HEAT EXCHANGER

QUESTION: 35
TOPIC: 291006
KNOWLEDGE: K1.13
QID: B534

Which one of the following is the state of water at 20 psia and 250°F?

A. Subcooled liquid

B. Saturated liquid

C. Mixture of saturated liquid and vapor

D. Superheated vapor

ANSWER: D.

PROOF: T_{sat} for 20 psia is 228°F.

QUESTION: 36
TOPIC: 291006
KNOWLEDGE: K1.10
QID: New

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. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: A..

QUESTION: 37
TOPIC: 291007
KNOWLEDGE: K1.02
QID: New

What percentage of impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 25?

A. 99%

B. 96%

C. 88%

D. 75%

ANSWER: B.

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.

QUESTION: 38
TOPIC: 291007
KNOWLEDGE: K1.05
QID: B1736 (P1736)

A condensate demineralizer differential pressure (D/P) gauge indicates 6 psid at 50% flow rate. Which one of the following combinations of condensate flow and demineralizer D/P observed later at various power levels indicates an increase in the accumulation of insoluble corrosion products in the demineralizer?

	CONDENSATE FLOW	DEMINERALIZER D/P (PSID)
A.	100%	23.5
B.	75%	16.5
C.	60%	8.5
D.	25%	1.5

ANSWER: B.

PROOF:

$F \propto N$; $H \propto N^2$

$H_1/H_2 = (F_1/F_2)^2$

$H_2 = H_1(F_2/F_1)^2$

@25% flow, D/P should be 1.5 psid

@60% flow, D/P should be 8.64 psid

@75% flow, D/P should be 13.5 psid

@100% flow, D/P should be 24.0 psid

Only choiceB exceeds the expected D/P.

QUESTION: 39
TOPIC: 291007
KNOWLEDGE: K1.07
QID: B2138

Which one of the following will decrease the time required for a demineralizer to reduce the ionic impurities in a closed process water system?

A. Decrease the temperature of the process water passing through the demineralizer from 110°F to 100°F

B. Increase the flow rate of the process water passing through the demineralizer from 95 gpm to 105 gpm

C. Divert 50% of the process water flow to bypass the demineralizer

D. Reverse the flow of process water through the demineralizer

ANSWER: B.

QUESTION: 40
TOPIC: 291008
KNOWLEDGE: K1.03
QID: B1440 (P1438)

While remotely investigating the condition of a normally-open motor control center (MCC) feeder breaker, an operator observes the following indications:

Green breaker position indicating light is out.
Red breaker position indicating light is lit.
MCC voltmeter indicates normal voltage.
MCC ammeter indicates zero amperes.

Based on these indications, the operator should report that the circuit breaker is _____ and racked _____.

A. open; in

B. closed; in

C. open; out

D. closed; out

ANSWER: B.

USNRC GENERIC FUNDAMENTALS EXAMINATION
APRIL 2000 BWR--FORM A

QUESTION: 41
TOPIC: 291008
KNOWLEDGE: K1.06
QID: B2542 (Rev)

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: "LS" contacts are not necessarily shown in their current condition.)

An operator takes the control switch to "Open" momentarily and the valve begins to open. Five seconds later, the operator places and holds the switch in the "Close" position. Which one of the following describes the valve response with the switch held in the "Close" position?

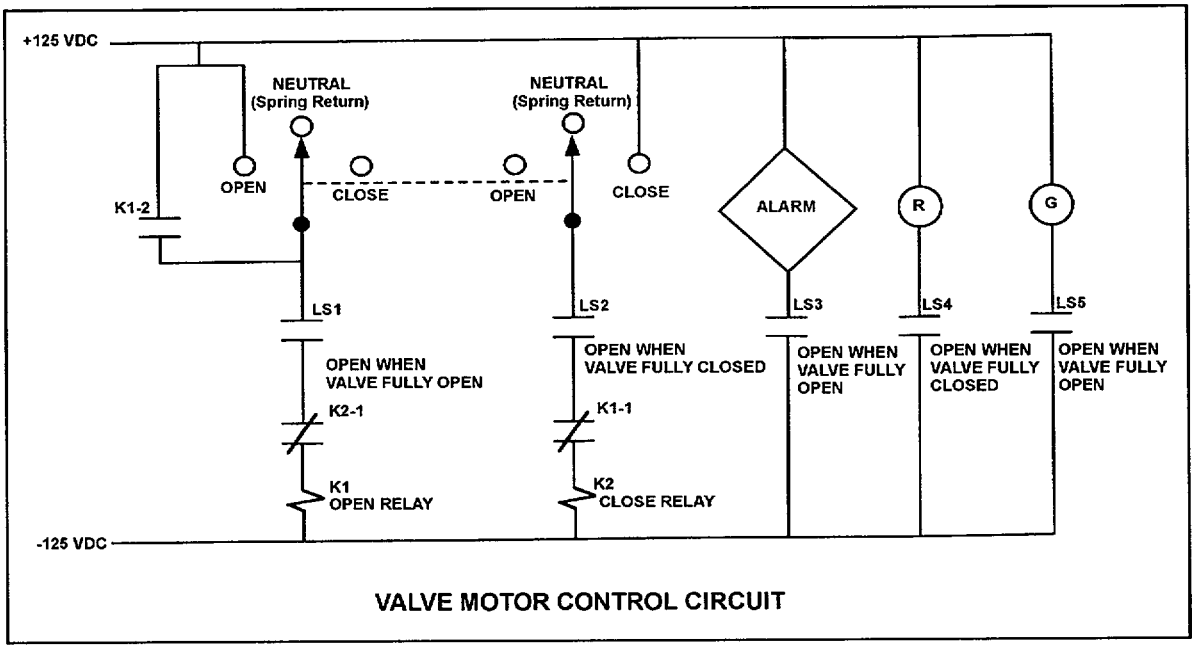
A. The valve will stop opening and remain partially open.

B. The valve will stop opening and then go fully closed.

C. The valve will open fully and remain fully open.

D. The valve will open fully and then go fully closed.

ANSWER: D.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 42
TOPIC: 291008
KNOWLEDGE: K1.08
QID: B1143 (Rev)

A main generator is being paralleled to the grid with the following conditions:

Generator frequency:	59.9 Hz
Grid frequency:	60.1 Hz
Generator voltage:	114.8 kV
Grid voltage:	115.1 kV

When the generator output breaker is closed, the generator will:

A. acquire real load and reactive load.

B. acquire real load, but become a reactive load to the grid.

C. become a real load to the grid, but acquire reactive load.

D. become a real load and a reactive load to the grid.

ANSWER: D.

QUESTION: 43
TOPIC: 291008
KNOWLEDGE: K1.09
QID: B1943 (P40)

Loss of breaker control power will cause:

A. inability to operate the breaker locally and remotely.

B. breaker line voltage to indicate zero regardless of actual breaker position.

C. failure of the closing spring to charge following local closing of the breaker.

D. the remote breaker position to indicate open regardless of actual breaker position.

ANSWER: C.

QUESTION: 44
TOPIC: 291008
KNOWLEDGE: K1.10
QID: New

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?

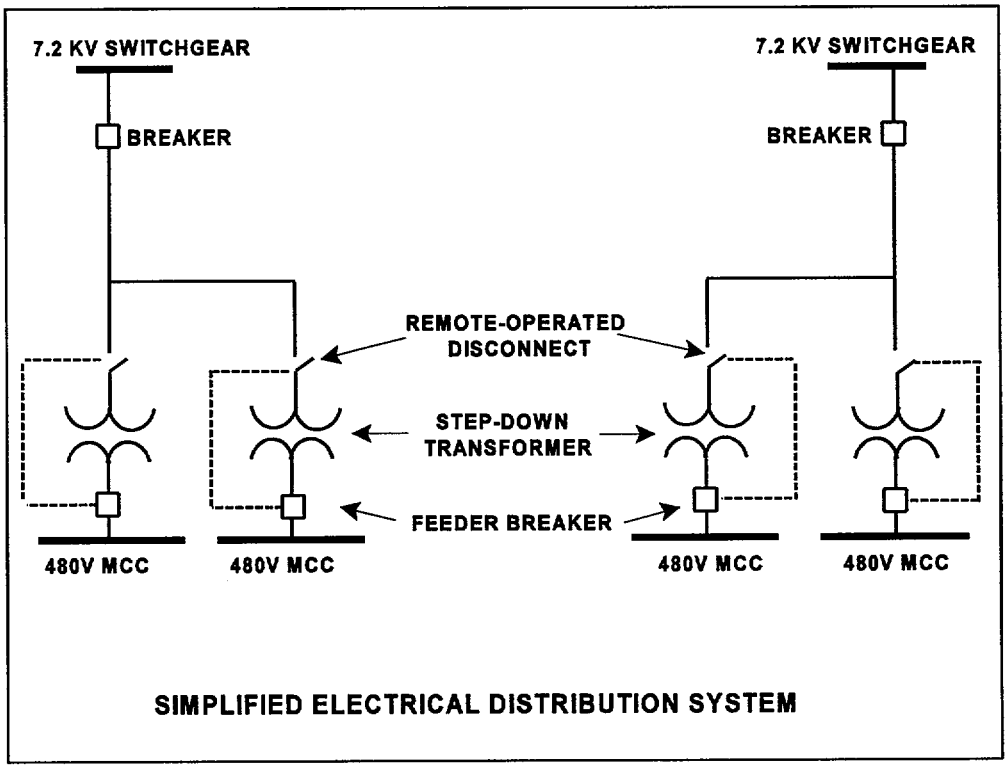
A. Prevent damage to the disconnect.

B. Prevent damage to the transformer.

C. Prevent damage to the feeder breaker.

D. Prevent injury to personnel at the remote operating station.

ANSWER: A.



SIMPLIFIED ELECTRICAL DISTRIBUTION SYSTEM

QUESTION: 45
TOPIC: 292001
KNOWLEDGE: K1.02
QID: B2345 (P2345)

A neutron that is born 10^{-10} seconds after the associated fission event is classified as a _____ fission neutron.

A. spontaneous

B. delayed

C. prompt

D. thermal

ANSWER: B.

QUESTION: 46
TOPIC: 292001
KNOWLEDGE: K1.04
QID: B246 (Rev)

A fast neutron will lose the greatest amount of energy during a scattering reaction in the moderator if it interacts with:

A. an oxygen nucleus.

B. a hydrogen nucleus.

C. a deuterium nucleus.

D. an electron surrounding a nucleus.

ANSWER: B.

QUESTION: 47
TOPIC: 292002
KNOWLEDGE: K1.09
QID: New

A reactor is operating at full power at the beginning of a fuel cycle. A neutron has just been absorbed by a U-238 nucleus at a resonance energy of 6.7 electron volts.

Which one of the following describes the most likely reaction for the newly formed U-239 nucleus and the effect of this reaction on K_{excess}?

A. Decays over several days to Pu-239, which increases K_{excess}.

B. Decays over several days to Pu-240, which increases K_{excess}.

C. Immediately undergoes fast fission, which decreases K_{excess}.

D. Immediately undergoes thermal fission, which decreases K_{excess}.

ANSWER: A.

QUESTION: 48
TOPIC: 292002
KNOWLEDGE: K1.14
QID: B2148

A reactor scrammed from 100% steady-state power 36 hours ago due to an instrument malfunction. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (-) as appropriate and choose the current value of core reactivity.

Xenon	= ( ) 1.0% ΔK/K
Fuel temperature	= ( ) 2.0% ΔK/K
Control rods	= ( ) 14.0% ΔK/K
Voids	= ( ) 3.0% ΔK/K

A. -8.0% ΔK/K

B. -10.0% ΔK/K

C. -14.0% ΔK/K

D. -20.0% ΔK/K

ANSWER: A.

PROOF:

Xenon	=	+1.0% ΔK/K
Fuel temperature	=	+2.0% ΔK/K
Control rods	=	-14.0% ΔK/K
Voids	=	+3.0% ΔK/K
Sum	=	-8.0% ΔK/K

QUESTION: 49
TOPIC: 292003
KNOWLEDGE: K1.01
QID: B565 (Rev) (P2149)

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation following a reactor shutdown without installed neutron sources. This is because a sufficient source of neutrons is being produced by:

A. spontaneous neutron emission from control rods.

B. photo-neutron reactions in the moderator.

C. low-level thermal fission in the fuel.

D. alpha-neutron reactions in the fuel.

ANSWER: B.

QUESTION: 50
TOPIC: 292003
KNOWLEDGE: K1.04
QID: B2250 (P2249)

Which one of the following distributions of fission percentages in a reactor will result in the largest reactor core effective delayed neutron fraction?

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

ANSWER: A.

QUESTION: 51
TOPIC: 292003
KNOWLEDGE: K1.05
QID: New

A reactor is exactly critical at 10^{-8}% power during a reactor startup. $\bar{\beta}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable reactor period of 26 seconds?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

PROOF:

From the equation sheet:

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

Therefore, $\rho = \dfrac{0.0072}{1 + 0.1\ (26)}$

The $\dfrac{\ell^*}{\tau}$ term is negligible compared to the second term

So, $\rho = \dfrac{0.0072}{3.6} \cong 0.002\ \Delta K/K = 0.2\%\ \Delta K/K$

QUESTION: 52
TOPIC: 292004
KNOWLEDGE: K1.02
QID: B852

Which one of the following conditions will cause the moderator temperature coefficient (MTC) to become more negative? (Consider only the direct effect of the indicated change on MTC.)

A. Recirculation flow increases by 10%.

B. Fuel temperature decreases from 1500°F to 1200°F.

C. Moderator temperature decreases from 500°F to 450°F.

D. Control rods are inserted from 50% rod density to 75% rod density.

ANSWER: D.

QUESTION: 53
TOPIC: 292004
KNOWLEDGE: K1.05
QID: B2453 (Rev)

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

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

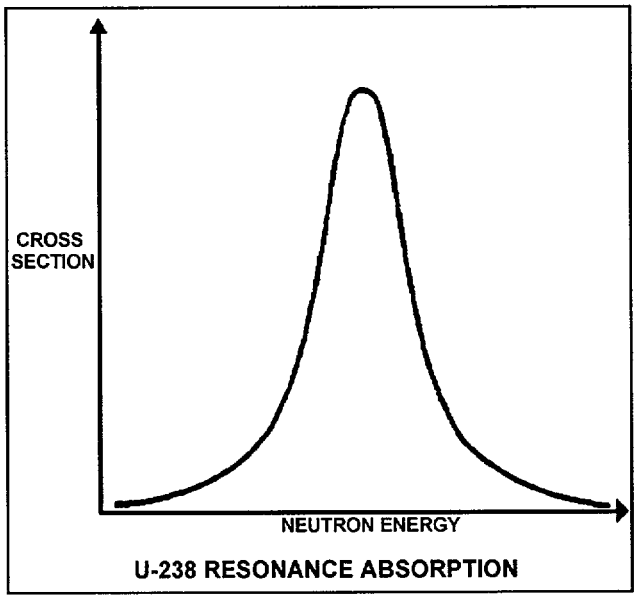
A. decrease; fewer neutrons will be absorbed by U-238 overall

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

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

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

ANSWER: C.



QUESTION: 54
TOPIC: 292005
KNOWLEDGE: K1.04
QID: B356 (P354)

A reactor is critical below the point of adding heat. If control rods are manually inserted for 5 seconds, reactor power will decrease:

A. to a shutdown power level determined by subcritical multiplication.

B. temporarily, then return to the original value due to subcritical multiplication.

C. temporarily, then return to the original value due to the resulting decrease in moderator temperature.

D. until inherent positive reactivity feedback causes the reactor to become critical at a lower neutron level.

ANSWER: A.

QUESTION: 55
TOPIC: 292005
KNOWLEDGE: K1.07
QID: B856 (Rev) (P1384)

Integral rod worth is the:

A. change in reactivity per unit change in rod position.

B. rod worth associated with the most reactive control rod.

C. change in worth of a control rod per unit change in reactor power.

D. reactivity added by moving a control rod from a reference point to another point.

ANSWER: D.

QUESTION: 56
TOPIC: 292005
KNOWLEDGE: K1.09
QID: B2356 (P2356)

A reactor startup is in progress from a cold shutdown condition. During the heatup phase of the startup, control rod differential reactivity worth (ΔK/K per inch insertion) becomes _____ negative, and during the power increase from 20% to full power, control rod differential reactivity worth becomes _____ negative.

A. more; less

B. more; more

C. less; less

D. less; more

ANSWER: A.

QUESTION: 57
TOPIC: 292005
KNOWLEDGE: K1.12
QID: B1856

A reactor is operating at 50% power at the beginning of a fuel cycle. Assuming the reactor does not scram, which one of the following compares the effects of dropping a deep control rod to the effects of dropping the same control rod if it is shallow?

A. Dropping a deep control rod causes a greater change in shutdown margin.

B. Dropping a deep control rod causes a smaller change in shutdown margin.

C. Dropping a deep control rod causes a greater change in axial power distribution.

D. Dropping a deep control rod causes a greater change in radial power distribution.

ANSWER: D.

QUESTION: 58
TOPIC: 292006
KNOWLEDGE: K1.02
QID: B1058 (P1858)

Which one of the following is a characteristic of xenon-135 in a reactor core?

A. Thermal neutron flux level affects both the production and removal of xenon-135.

B. Thermal neutrons interact with xenon-135 primarily through scattering reactions.

C. Xenon-135 is primarily a resonant absorber of epithermal neutrons.

D. Xenon-135 is produced from the radioactive decay of barium-135.

ANSWER: A.

QUESTION: 59
TOPIC: 292006
KNOWLEDGE: K1.05
QID: B58 (P61)

A reactor has been operating at 50% power for one week when power is ramped in 4 hours to 100%. Which one of the following describes the new equilibrium xenon concentration?

A. Twice the 50% value

B. Less than twice the 50% value

C. More than twice the 50% value

D. Remains the same because it is independent of power

ANSWER: B.

QUESTION: 60
TOPIC: 292006
KNOWLEDGE: K1.05
QID: New

Reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating near the end of core life and reactor B is operating near the beginning of core life.

Which reactor is experiencing the most negative reactivity from equilibrium core Xe-135?

A. Reactor A due to a greater concentration of equilibrium core Xe-135

B. Reactor A due to lower competition from the fuel for thermal neutrons

C. Reactor B due to a greater thermal neutron flux in the core

D. Reactor B due to a smaller accumulation of stable fission product poisons

ANSWER: B.

PROOF:

Although reactor A has a lower concentration of core Xe-135 than reactor B, its Xe-135 negative reactivity is greater because of a significantly reduced fuel concentration (due to burnup). Therefore, reactor A has significantly reduced competition from the fuel for thermal neutrons.

QUESTION: 61
TOPIC: 292006
KNOWLEDGE: K1.06
QID: B1860 (Rev) (P2261)

A reactor has been operating at steady-state 50% power for 12 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

A. Increasing toward a peak

B. Decreasing toward an upturn

C. Increasing toward equilibrium

D. Decreasing toward equilibrium

ANSWER: D.

QUESTION: 62
TOPIC: 292006
KNOWLEDGE: K1.11
QID: B2561 (Rev)

A reactor is initially operating at 60% power with equilibrium core xenon-135. Power is increased to 80% over a 2-hour period. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 24 hours after the power change is completed?

A. Greater than 80% and decreasing slowly

B. Greater than 80% and increasing slowly

C. Less than 80% and decreasing slowly

D. Less than 80% and increasing slowly

ANSWER: C.

QUESTION: 63
TOPIC: 292006
KNOWLEDGE: K1.12
QID: B1462 (Rev)

A reactor that has been operating at 100% power for about two months is shutdown over a 2-hour period. Following the shutdown, core xenon-135 will first reach a new steady-state concentration in _____ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

ANSWER: D.

QUESTION: 64
TOPIC: 292007
KNOWLEDGE: K1.03
QID: B1163 (P1264)

Refer to the drawing of K_{eff} versus core age (see figure below).

The decrease in K_{eff} from point 1 to point 2 is primarily caused by:

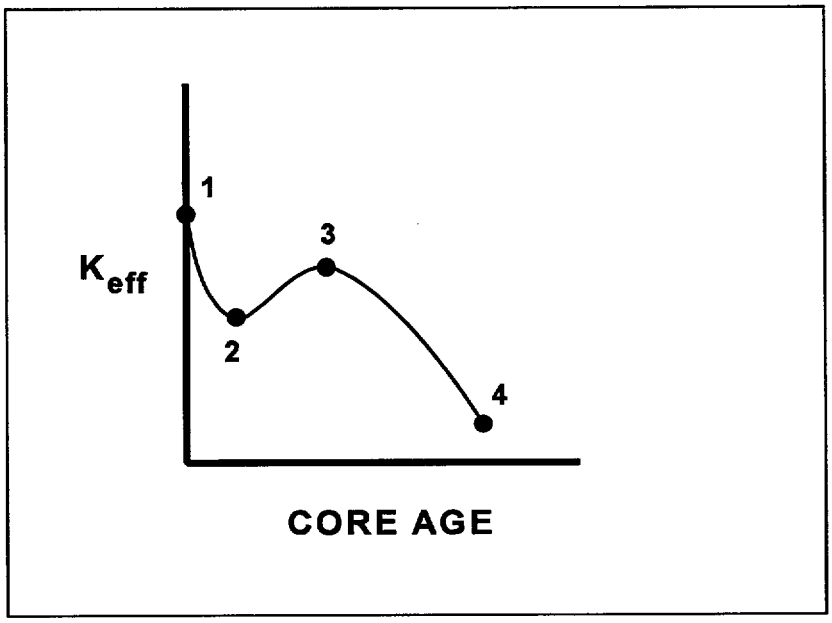
A. depletion of fuel.

B. burnout of burnable poisons.

C. initial heat-up of the reactor.

D. buildup of fission product poisons.

ANSWER: D.



QUESTION: 65
TOPIC: 292008
KNOWLEDGE: K1.04
QID: B366 (Rev)

During a reactor startup, source range indication is stable at 120 cps with K_{eff} at 0.95. After a period of control rod withdrawal, source range indication stabilizes at 600 cps.

Which one of the following is the approximate new K_{eff}?

A. 0.96

B. 0.97

C. 0.98

D. 0.99

ANSWER: D.

PROOF:

$CR_1 (1-K_1)$	$= CR_2 (1-K_2)$
CR_2/CR_1	$= (1-K_1)/(1-K_2)$
600/120	$= 0.05/1-K_2$
$1-K_2$	$= 0.05/5$
K_2	$= 1-0.01$
K_2	$= 0.99$

QUESTION: 66
TOPIC: 292008
KNOWLEDGE: K1.12
QID: 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 positive 30-second reactor period. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds.

During the insertion, the reactor period will become:

A. infinity 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 before the control rods pass through the critical rod height.

ANSWER: D.

QUESTION: 67
TOPIC: 292008
KNOWLEDGE: K1.06
QID: B1567 (Rev) (P1167)

The following data was obtained during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
0	180
10	210
15	250
20	300
25	360
30	420

Assuming uniform differential rod worth, at what approximate rod height will criticality occur?

A. 35 to 45 units withdrawn

B. 46 to 55 units withdrawn

C. 56 to 65 units withdrawn

D. 66 to 75 units withdrawn

ANSWER: B.

QUESTION: 68
TOPIC: 292008
KNOWLEDGE: K1.07
QID: B667

When a reactor is exactly critical, reactivity is:

A. greater than 1.0% $\Delta K/K$.

B. equal to 1.0% $\Delta K/K$.

C. less than 1.0% $\Delta K/K$.

D. undefined.

ANSWER: C.

QUESTION: 69
TOPIC: 292008
KNOWLEDGE: K1.25
QID: B771 (Rev)

Reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the longest reactor period five minutes after the scram?

A. Reactor A due to the greater shutdown reactivity.

B. Reactor B due to the smaller shutdown reactivity.

C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

QUESTION: 70
TOPIC: 292008
KNOWLEDGE: K1.18
QID: B2072 (Rev)

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the shortest amount of time to occur?

A. 3% power to 5% power

B. 5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

ANSWER: A.

PROOF:

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

$\tau \ln P_f/P_o = t$

(ln 5/3)(180) = 0.51(180) = t = 91.8 seconds

(ln 15/5)(180) = 1.1(180) = t = 198 seconds

(ln 30/15)(180) = 0.693(180) = t = 124.8 seconds

(ln 60/30)(180) = 0.693(180) = t = 124.8 seconds

QUESTION: 71
TOPIC: 292008
KNOWLEDGE: K1.20
QID: B1469

Reactor power is increased from 70% to 90% by changing recirculation flow. Which one of the following describes the effect on the plant?

A. Core void fraction increases.

B. Feedwater temperature decreases.

C. Reactor vessel outlet steam pressure increases.

D. Condensate depression in the main condenser hotwell increases.

ANSWER: C.

QUESTION: 72

DELETED

QUESTION: 73
TOPIC: 293001
KNOWLEDGE: K1.03
QID: B2373 (Rev) (P2473)

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

The tanks are identical and are being maintained at 30 psia and a water level of 20 feet. They are surrounded by standard atmospheric pressure. The water in the tank and reference leg is at 70°F.

If each detector experiences a ruptured diaphragm, which detector(s) will cause indicated tank level to increase? (Assume actual tank water level remains constant.)

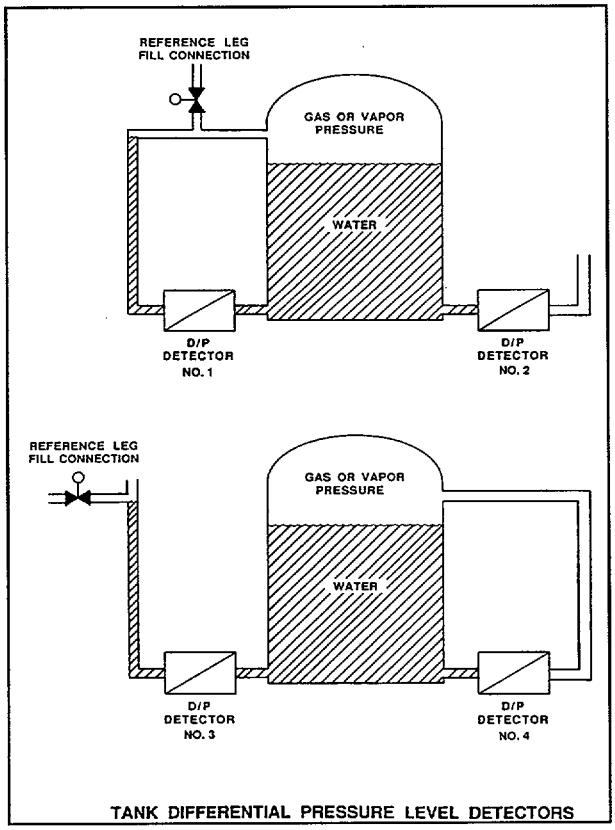
A. No. 1 only

B. No. 2 only

C. No. 1 and 3

D. No. 2 and 4

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 74
TOPIC: 293003
KNOWLEDGE: K1.23
QID: New

The theoretical maximum efficiency of a steam cycle is given by the equation:

$$Eff_{thmax} = (1 - T_{out}/T_{in}) \times 100\%,$$

where T_{out} is the absolute temperature for heat rejection and T_{in} is the absolute temperature for heat addition. (Fahrenheit temperature is converted to absolute temperature by adding 460°.)

A plant is operating with a stable reactor vessel pressure of 900 psia. What is the approximate theoretical maximum steam cycle efficiency this plant can achieve by establishing its main condenser vacuum at 1.0 psia?

A. 35%

B. 43%

C. 65%

D. 81%

ANSWER: B.

PROOF:

At 1.0 psia, $T_{out} = 460 + 101.74 = 561.74°R$
At 900 psia, $T_{in} = 460 + 531.95 = 991.95°R$
Therefore, $T_{out}/T_{in} = .566$, which is subtracted from 1 to get .434, or 43.4%

QUESTION: 75
TOPIC: 293004
KNOWLEDGE: K1.12
QID: B78 (Rev) (P1977)

Condensate is collecting in the main condenser hotwell at 90°F with a condenser pressure of 28 inches Hg vacuum. Which one of the following will improve steam cycle efficiency?

A. Main condenser cooling water flow decreases by 5% with no change in condenser vacuum.

B. Main condenser cooling water inlet temperature decreases by 10°F with no change in condenser vacuum.

C. Main condenser vacuum decreases to 27 inches Hg due to buildup of noncondensible gases.

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

ANSWER: A.

QUESTION: 76
TOPIC: 293003
KNOWLEDGE: K1.23
QID: New

With the plant operating near rated power, air inleakage into the main condenser causes main condenser pressure to increase from 1.0 psia to 2.0 psia.

Given the following:

- Initial main condenser condensate depression was 4°F.
- After the plant stabilizes, with main condenser pressure at 2.0 psia, main condenser condensate depression is 2°F.

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

A. 2 Btu/lbm

B. 4 Btu/lbm

C. 8 Btu/lbm

D. 16 Btu/lbm

ANSWER: A.

PROOF: The condensate must be cooled an additional 2°F to restore condensate depression to 4°F. Steam tables can be used but they are not required. Per the definition for specific heat (1.0 Btu/lbm -°F for water), an additional 2°F decrease in condensate temperature requires an additional 2 Btu/lbm heat rejection from the main condenser.

QUESTION: 77
TOPIC: 293004
KNOWLEDGE: K1.14
QID: B1577

Saturated steam undergoes an ideal expansion process in an ideal turbine from 294 psig to 27 inches Hg vacuum. Approximately how much specific work is being performed by the turbine?

A. 1203 Btu/lbm

B. 418 Btu/lbm

C. 343 Btu/lbm

D. 308 Btu/lbm

ANSWER: C.

PROOF:

h_{stm} at 309 psia = 1203 Btu/lbm

h_{stm} at 3" Hg abs = 860 Btu/lbm (after isentropic expansion)

1203 - 860 = 343 Btu/lbm

QUESTION: 78
TOPIC: 293005
KNOWLEDGE: K1.05
QID: B278

Which one of the following is the most probable location for superheated steam in a boiling water reactor steam cycle that uses moisture separator reheaters?

A. The outlet of the high pressure turbine

B. The inlet of the low pressure turbines

C. The inlet of the high pressure turbine

D. The outlet of the low pressure turbines

ANSWER: B.

QUESTION: 79
TOPIC: 293006
KNOWLEDGE: K1.05
QID: B2081 (Rev) (P1879)

Which one of the following describes why steam lines are gradually warmed instead of admitting full steam flow?

A. To minimize the possibility of stress corrosion cracking of the steam lines

B. To minimize the total thermal expansion of the steam lines

C. To minimize the potential for water hammer in the steam lines

D. To minimize the heat loss from the steam lines

ANSWER: C.

QUESTION: 80
TOPIC: 293006
KNOWLEDGE: K1.13
QID: B1878 (P1324)

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

A centrifugal pump is operating in a cooling water system. Another identical centrifugal pump is started in series with the first. Which set of curves illustrates the resulting change in system parameters?

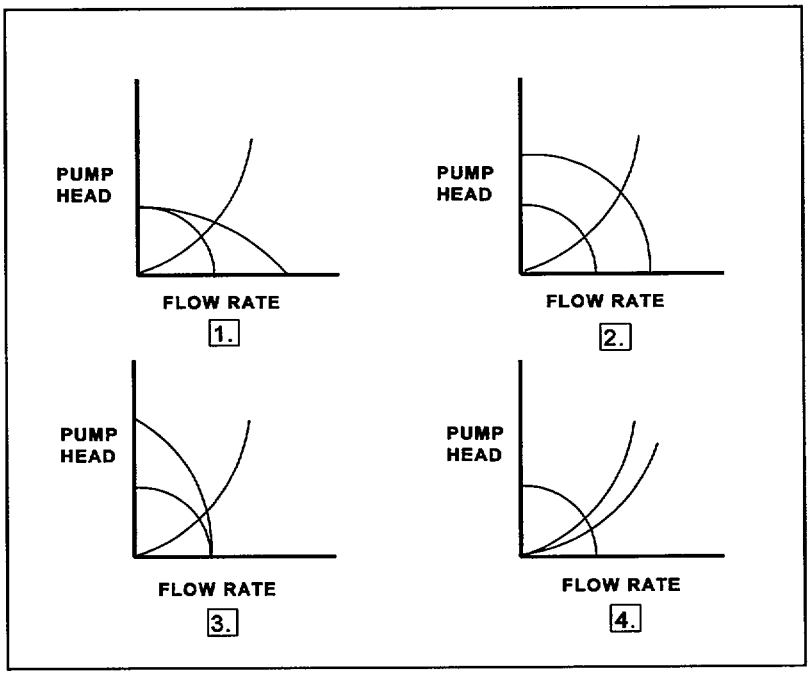
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: C.



QUESTION: 81
TOPIC: 293006
KNOWLEDGE: K1.29
QID: B1979 (Rev)

An 80 gpm leak to atmosphere has developed in a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A. 20 gpm

B. 40 gpm

C. 49 gpm

D. 57 gpm

ANSWER: D.

PROOF:

$DP \propto f^2$

$DP_1/DP_2 = (f_1/f_2)^2$

$1.414 = 80/f_2$

$f_2 = 80/1.414$

$f_2 = 56.58$ gpm

QUESTION: 82
TOPIC: 293007
KNOWLEDGE: K1.03
QID: B86 (Rev)

The order of reactor coolant heat transfer mechanisms, from the least efficient to the most efficient, is:

A. transition boiling, stable film boiling, nucleate boiling.

B. transition boiling, nucleate boiling, stable film boiling.

C. stable film boiling, nucleate boiling, transition boiling.

D. stable film boiling, transition boiling, nucleate boiling.

ANSWER: D.

USNRC GENERIC FUNDAMENTALS EXAMINATION
APRIL 2000 BWR--FORM A

QUESTION: 83
TOPIC: 293007
KNOWLEDGE: K1.12
QID: B1384

Given the following data for a typical steam condenser, select the heat load rejected in megawatts thermal (MWt).

Total tube area	= 500,000 ft^2
Cooling water flow rate	= 200,000 gpm
Condenser pressure	= 1 psia
Specific heat of cooling water (c_p)	= 1 Btu/lbm-°F
Cooling water inlet temperature	= 60°F
Cooling water outlet temperature	= 80°F
Steam condensing rate	= 3,000,000 lbm/hr
Mass of cooling water	= 8.34 lbm/gal

A. 587 MWt

B. 629 MWt

C. 671 MWt

D. 733 MWt

ANSWER: A.

PROOF:

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

$$= \left(\frac{2 \times 10^5\,gal}{min}\right)\left(\frac{8.34\,lbm}{gal}\right)\left(\frac{1\,Btu}{lbm - °F}\right)\left(\frac{80°F - 60°F}{1}\right)\left(\frac{MW - hr}{3.41 \times 10^6\,Btu}\right)\left(\frac{60\,min}{hr}\right)$$

= 587 MWt

QUESTION: 84
TOPIC: 293008
KNOWLEDGE: K1.01
QID: B1888 (Rev)

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel rod if subcooled reactor coolant enters the coolant channel and exits as superheated steam?

A. Increases continuously

B. Increases, then decreases

C. Decreases continuously

D. Decreases, then increases

ANSWER: B.

QUESTION: 85
TOPIC: 293007
KNOWLEDGE: K1.13
QID: B2484 (Rev)

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 recirculation pump heat input term was omitted from the heat balance calculation.

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

C. The reactor vessel pressure used in the heat balance calculation was 30 psia higher than actual reactor vessel pressure.

D. The steam and feed water flow rates used in the heat balance calculation were 10% higher than actual flow rates.

ANSWER: C.

QUESTION: 86
TOPIC: 293008
KNOWLEDGE: K1.06
QID: B387

Which one of the following conditions must occur to sustain natural convection in a fluid system?

A. Subcooling of the fluid

B. A phase change in the fluid

C. An enthalpy change in the fluid

D. Radiative heat transfer to the fluid

ANSWER: C.

QUESTION: 87
TOPIC: 293008
KNOWLEDGE: K1.11
QID: B1987 (P889)

If the fission rate in a reactor core steadily increases, the heat transfer mechanism that initially will be achieved after the critical heat flux is reached is called:

A. transition boiling.

B. subcooled nucleate boiling.

C. saturated nucleate boiling.

D. stable film boiling.

ANSWER: A.

QUESTION: 88
TOPIC: 293008
KNOWLEDGE: K1.25
QID: B1189

Forced circulation through a reactor core is required at all times during power operation to prevent:

A. exceeding reactor vessel and core design steaming rates.

B. jet pump cavitation which would reduce the power generated by the core.

C. high fuel clad surface temperatures that would result in a crack or leak in the clad.

D. the core from becoming prompt critical due to high fuel and coolant temperatures.

ANSWER: C.

QUESTION: 89
TOPIC: 293008
KNOWLEDGE: K1.17
QID: B2589 (Rev)

A reactor is operating at steady-state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become closer to the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow increases.

B. Reactor pressure decreases.

C. Feed water temperature increases.

D. Associated bundle power decreases.

ANSWER: C.

QUESTION: 90
TOPIC: 293008
KNOWLEDGE: K1.30
QID: B990

Reactors A and B are operating at 100% power with neutron flux radially peaked in the center of each core. The reactors are identical except that reactor A has core orificing and reactor B does not.

Compared to the center fuel bundle in reactor B, the center fuel bundle in reactor A will have the _____ critical power and the _____ coolant flow rate.

A. lowest; lowest

B. lowest; highest

C. highest; lowest

D. highest; highest

ANSWER: D.

QUESTION: 91
TOPIC: 293008
KNOWLEDGE: K1.26
QID: B1389 (Rev)

Refer to the drawing of a core recirculation jet pump (see figure below).

The lowest pressure will exist at point _____, and the highest velocity will occur at point _____.

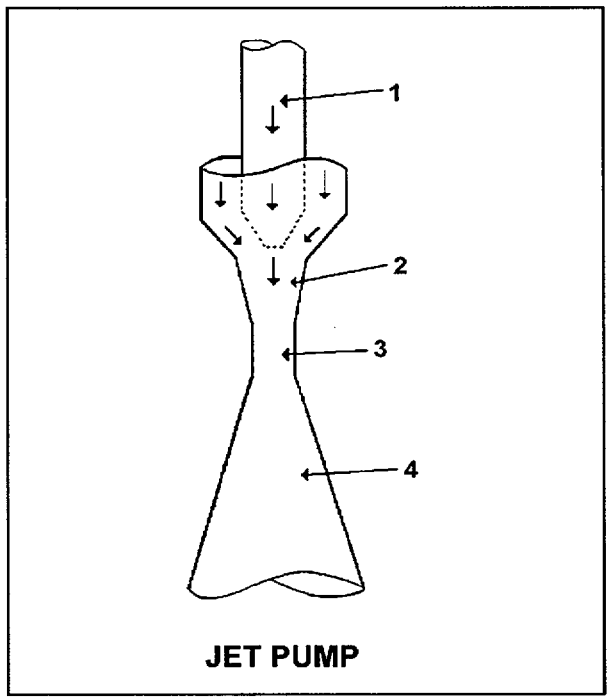
A. 3; 3

B. 3; 4

C. 4; 3

D. 4; 4

ANSWER: A.



JET PUMP

QUESTION: 92
TOPIC: 293009
KNOWLEDGE: K1.02
QID: B892

The axial peaking factor for a node of a fuel bundle is defined as:

A. $\frac{\text{core average bundle power}}{\text{peak nodal power}}$

B. $\frac{\text{peak nodal power}}{\text{core average bundle power}}$

C. $\frac{\text{bundle average nodal power}}{\text{nodal power}}$

D. $\frac{\text{nodal power}}{\text{bundle average nodal power}}$

ANSWER: D.

QUESTION: 93
TOPIC: 293009
KNOWLEDGE: K1.13
QID: B2595

If a reactor is operating above its Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) prior to a loss of coolant accident, fuel pellet centerline temperature may reach 4200°F and fuel cladding temperature may reach 2300°F during the accident.

Which one of the following describes the likely clad rupture mechanism?

A. Excessive fuel pellet expansion

B. Excessive embrittlement of the clad

C. Excessive internal fuel pin gas pressure

D. Excessive plastic strain in the clad

ANSWER: B.

QUESTION: 94
TOPIC: 293009
KNOWLEDGE: K1.16
QID: New

Given the following initial core parameters for a segment of a fuel rod:

Power density = 2 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 1200°F

Reactor power is increased such that the following core parameters now exist for the fuel rod segment:

Power density = 3 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = ?

Assuming void fraction surrounding the fuel rod segment does not change, what will be the new stable $T_{fuel\ centerline}$?

A. 1380°F

B. 1530°F

C. 1670°F

D. 1820°F

ANSWER: B.

PROOF:

Use $Q = UA\Delta T$, where the product UA is constant.

If Q is increased by 3/2, ΔT is increased by 3/2.

$\Delta T_2 = 3/2 \times \Delta T_1 = 3/2 \times (1200°F - 540°F) = 990°F$

Adding 990°F to 540°F = 1530°F

QUESTION: 95
TOPIC: 293009
KNOWLEDGE: K1.27
QID: B795

For what operational condition does the flow biasing correction factor (K_f) adjust the minimum critical power ratio?

A. Operation at less than rated steam flow rate

B. Operation at greater than rated steam flow rate

C. Operation at less than rated core flow rate

D. Operation at greater than rated core flow rate

ANSWER: C.

QUESTION: 96
TOPIC: 293009
KNOWLEDGE: K1.19
QID: B187 (Rev) (P2590)

If a reactor is being operated with minimum critical power ratio (MCPR) at its transient limit, which one of the following is indicated?

A. None of the fuel rods are experiencing critical heat flux.

B. A small fraction of the fuel rods may be experiencing critical heat flux.

C. All radioactive fission products are being contained within the reactor fuel.

D. All radioactive fission products are being contained within either the reactor fuel or the reactor vessel.

ANSWER: B.

QUESTION: 97
TOPIC: 293009
KNOWLEDGE: K1.30
QID: B2095

A step increase in reactor power results in a fuel cladding surface temperature increase from 560°F to 590°F. The fuel thermal time constant is 6 seconds.

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

A. 579°F

B. 575°F

C. 570°F

D. 567°F

ANSWER: A.

PROOF:

$T_f = T_i + .632(T_f - T_i)$ $T_f = 560 + 18.96$

$T_f = 560 + .632(590 - 560)$ $T_f = 579.0$

QUESTION: 98
TOPIC: 293009
KNOWLEDGE: K1.32
QID: B2195

Which one of the following is most likely to result in fuel failure due to pellet-clad interaction?

A. Increasing reactor power from 20% to 50% near the beginning of a fuel cycle

B. Increasing reactor power from 20% to 50% near the end of a fuel cycle

C. Increasing reactor power from 70% to 100% near the beginning of a fuel cycle

D. Increasing reactor power from 70% to 100% near the end of a fuel cycle

ANSWER: D.

QUESTION: 99
TOPIC: 293010
KNOWLEDGE: K1.02
QID: B1500 (P697)

The reference temperature for nil-ductility transition (RT_{NDT}) is the temperature above which:

A. a metal exhibits more ductile tendencies.

B. the probability of brittle fracture increases.

C. no appreciable deformation occurs prior to failure.

D. a large compressive stress can result in brittle fracture.

ANSWER: A.

QUESTION: 100
TOPIC: 293010
KNOWLEDGE: K1.05
QID: B2100 (Rev)

Two identical reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 20 heatup/cooldown cycles and has an average power capacity of 80%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature and why?

A. Reactor A due to the lower average power capacity

B. Reactor A due to the greater number of heatup/cooldown cycles

C. Reactor B due to the higher average power capacity

D. Reactor B due to the fewer number of heatup/cooldown cycles

ANSWER: C.

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

APRIL 2000 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	C	26	54	A	51	79	A	76	4	A
2	30	B	27	55	D	52	80	D	77	5	C
3	31	C	28	56	B	53	81	C	78	6	B
4	32	B	29	57	D	54	82	A	79	7	C
5	33	A	30	58	A	55	83	D	80	8	C
6	34	D	31	59	C	56	84	A	81	9	D
7	35	A/B	32	60	C	57	85	D	82	10	D
8	36	D	33	61	D	58	86	A	83	11	A
9	37	D	34	62	B	59	87	B	84	12	B
10	38	B	35	63	D	60	88	B	85	13	C
11	39	C	36	64	A	61	89	D	86	14	C
12	40	B	37	65	B	62	90	C	87	15	A
13	41	C	38	66	B	63	91	D	88	16	C
14	42	A/C	39	67	B	64	92	D	89	17	C
15	43	C	40	68	B	65	93	D	90	18	D
16	44	D	41	69	D	66	94	D	91	19	A
17	45	B/C	42	70	D	67	95	B	92	20	D
18	46	C	43	71	C	68	96	C	93	21	B
19	47	C	44	72	A	69	97	D	94	22	B
20	48	B	45	73	B	70	98	A	95	23	C
21	49	B	46	74	B	71	99	C	96	24	B
22	50	C	47	75	A	72	100	A/B	97	25	A
23	51	C	48	76	A	73	1	A	98	26	D
24	52	A	49	77	B	74	2	B	99	27	A
25	53	A	50	78	A	75	3	A	100	28	C