UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
JUNE 2002--FORM A

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 4.0 hours after the examination starts. This examination applies to a typical boiling water reactor (BWR) power plant.

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

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

_____
Applicant's Signature

RULES AND GUIDELINES FOR THE GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

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

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

2. Fill in the name of your facility.

3. Fill in your individual docket number.

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

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

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

   (2) Steam tables provided by your proctor.

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

7. Scrap paper will be provided for calculations.

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

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

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

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

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

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

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

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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

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

Setpoint pressure (MSSV starts to open): 1200 psia
Maximum pressure (MSSV will be fully open): 1230 psia
Reseat pressure (MSSV will be fully closed): 1140 psia

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

A. 2.5%

B. 5.0%

C. 7.5%

D. 10.0%

QUESTION: 2

If a pressure control valve at the outlet of a heat exchanger opens farther, system flow rate will _____ and system head loss will _____.

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

QUESTION: 3

To verify the position of a fully open manual valve in an operating system, the operator should operate the valve handwheel:

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

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

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

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

QUESTION: 4

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

A. Decreased cooling flow to the valve internals

B. Separation of the valve disk from the valve stem

C. Misalignment of the valve position limit switches

D. Increased stroke time from fully open to fully closed

QUESTION: 5

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

A. ball; ball

B. ball; butterfly

C. butterfly; ball

D. butterfly; butterfly

QUESTION: 6

It is necessary to density-compensate the main steam line flow indication because the measured change in pressure across the flow elements is:

A. directly proportional to the square of the mass flow rate.

B. inversely proportional to the square of the mass flow rate.

C. directly proportional to the square of the volumetric flow rate.

D. inversely proportional to the square of the volumetric flow rate.

QUESTION: 7

A differential pressure (D/P) cell is being used to measure flow rate in a cooling water system. Flow rate is indicating 75% of scale. If the D/P cell diaphragm ruptures, indicated flow rate will go to:

A. 0% because low D/P is sensed.

B. 0% because high D/P is sensed.

C. 100% (full-scale) because low D/P is sensed.

D. 100% (full-scale) because high D/P is sensed.

QUESTION: 8

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

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

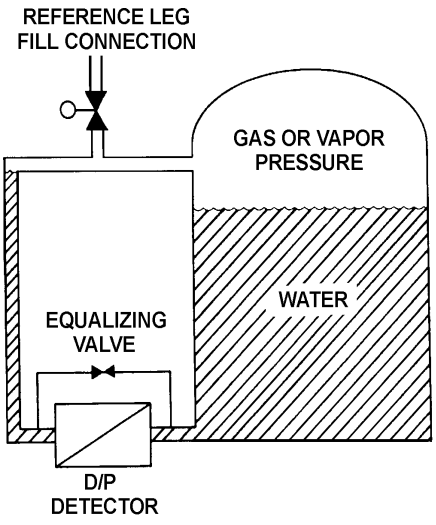
If the tank water temperature remains constant, but the tank pressure is increased by 10 psig, the level control system will cause actual tank level to:

A. remain at 75%.

B. increase and stabilize above 75%.

C. oscillate around 75%.

D. decrease and stabilize below 75%.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 9

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

QUESTION: 10

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

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

A. increase to 120 psig.

B. increase by a small, but indeterminate amount.

C. decrease by a small, but indeterminate amount.

D. decrease to 80 psig.

QUESTION: 11

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

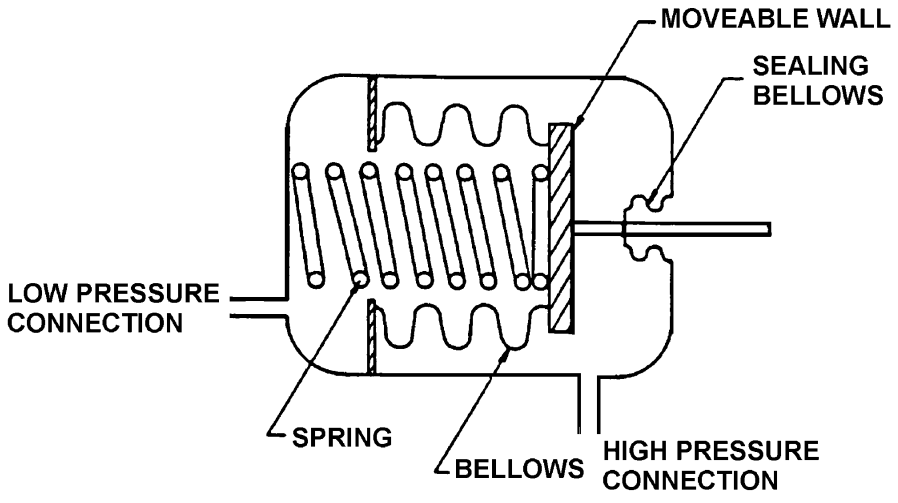
The spring in this detector (shown in a compressed state) has weakened from long-term use. If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

A. Increase, because the spring will expand more

B. Decrease, because the spring will expand more

C. Increase, because the spring will compress more

D. Decrease, because the spring will compress more



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR

QUESTION: 12

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

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

B. Ensures that only temperature changes at the thermocouple measuring junction affect thermocouple temperature indication.

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

D. Ensures that different lengths of thermocouple extension wires do not affect thermocouple temperature indication.

QUESTION: 13

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

A. Neutron pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.

B. The positive space charge effect will increase and prevent collection of both gamma and neutron pulses, yielding a less accurate neutron count rate.

C. A high rate of incident gamma radiation will result in multiple small gamma pulses that combine to look like larger pulses. The larger combined pulses will be counted as neutron pulses, yielding a less accurate neutron count rate.

D. Detection of any single ionizing event will result in ionizing nearly the entire detector gas volume. The resulting large pulses will prevent the detector from differentiating between radiation types, yielding a less accurate neutron count rate.

QUESTION: 14

Two identical fission chamber neutron detectors (operating in the proportional region) are being used to monitor the neutron flux during a reactor startup. Detector A has developed a tiny leak and the argon fill gas pressure has decreased to approximately 25% of the gas pressure in detector B. When the reactor reaches criticality, the neutron level indicated by detector A will be _____ than the neutron level indicated by detector B, primarily because the incident neutrons result in _____ .

A. larger; more fissions in detector A

B. smaller; fewer fissions in detector A

C. larger; more ionizations in the detector A gas

D. smaller; fewer ionizations in the detector A gas

QUESTION: 15

Refer to the drawing of a water storage tank with a level control system (see figure below). The tank water level is being automatically controlled at 50% by a proportional-integral (PI) controller that positions the drain valve. Tank water level is currently stable with 500 gpm entering the tank and the drain valve 50% open.

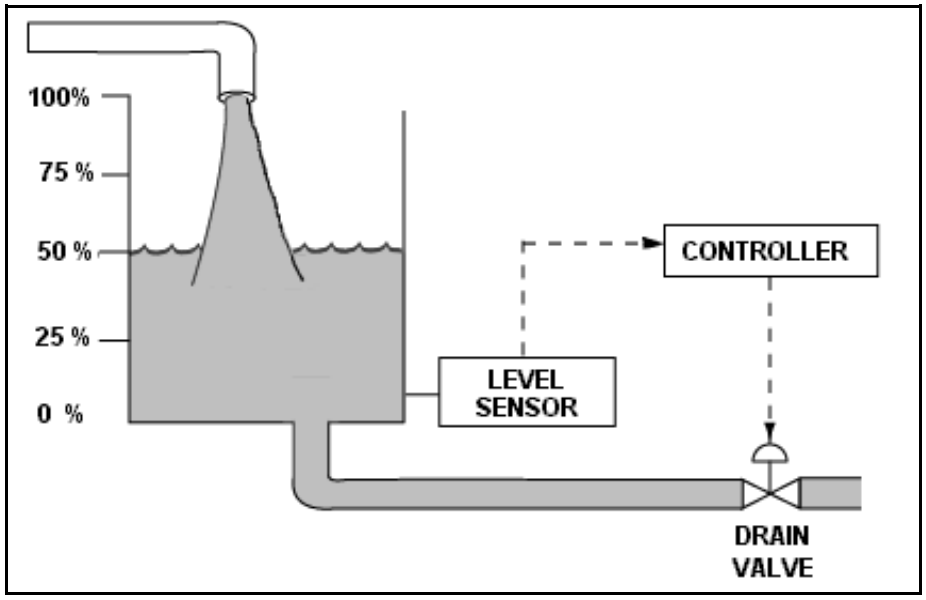
The tank suddenly develops a constant 200 gpm leak, while the input flow rate remains constant at 500 gpm. When tank water level stabilizes, level will be _____, and the drain valve position will be _____.

A. 50%; more open

B. 50%; more closed

C. lower than 50%; more open

D. lower than 50%; more closed



QUESTION: 16

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

The orientation of the bistable symbol indicates the characteristics of the bistable as is normal for a control circuit diagram. The bistable turns on to actuate an alarm at a system pressure of 100 psig. The bistable has a 5 psig dead band, or neutral zone.

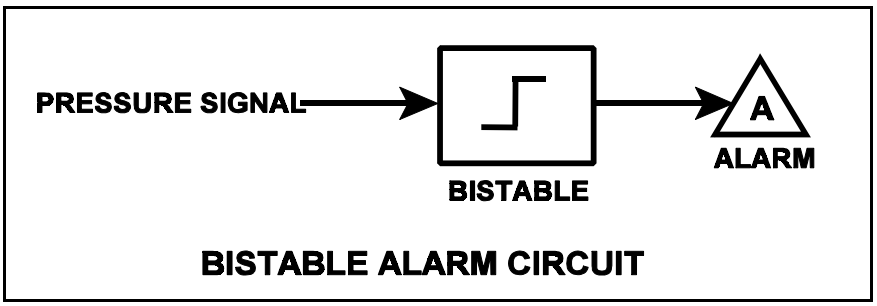
If current system pressure is 90 psig, which one of the following describes the alarm response as system pressure is slowly increased to 110 psig?

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

B. The alarm will actuate at 100 psig and will not turn off.

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

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



QUESTION: 17

Which one of the following describes a characteristic of pneumatic valve positioners?

A. They can provide auto and manual demand signals to valve controllers and valve actuators.

B. They can increase air pressure to valve actuators above existing main air header pressure.

C. They can either receive or supply air to/from valve controllers, depending on the direction of valve travel.

D. They can automatically increase or decrease air pressure to valve actuators to overcome sluggish valve response.

QUESTION: 18

Which one of the following describes gas binding of a centrifugal pump?

A. Pump capacity is reduced due to the presence of steam or air in the pump impeller.

B. Pump capacity is reduced due to windage losses between the pump impeller and pump casing.

C. Pump motor current increases due to the compression of gases in the pump volute.

D. Pump motor current increases due to the high head requirements for pumping a fluid saturated with dissolved gases.

QUESTION: 19

A variable-speed centrifugal pump is driven by an ac motor with the following initial conditions:

Pump speed = 400 rpm
Motor current = 40 amps
Pump head = 60 psid

If pump speed is increased to 1,600 rpm what will be the new pump head?

A. 240 psid

B. 480 psid

C. 960 psid

D 1,440 psid

QUESTION: 20

A centrifugal pump is circulating water at 180°F with a motor current of 100 amps. After several hours, system temperature has changed such that the water density has increased by 4%.

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

A. 84 amps

B. 96 amps

C. 104 amps

D. 116 amps

QUESTION: 21

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.”

QUESTION: 22

Which one of the following describes a reason for designing centrifugal pumps with suction nozzles that are larger than their discharge nozzles?

A. Increases pump capacity by decreasing turbulence at the suction of the pump.

B. Increases the differential pressure across the pump by decreasing pump head loss.

C. Increases total pump head by increasing the velocity head at the suction of the pump.

D. Increases pump available net positive suction head by decreasing head loss at the pump suction.

QUESTION: 23

Refer to the drawing of a centrifugal pump operating curve (see figure below).

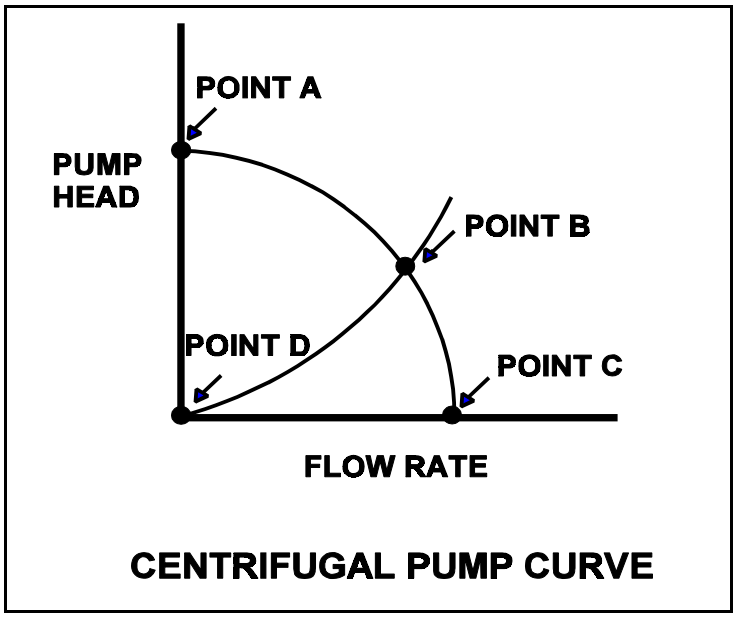
A centrifugal pump operating in a cooling water system exhibits the operating curve shown below. Which one of the following points on the curve will be closest to the pump operating conditions after the pump suction valve is inadvertently closed?

A. Point A

B. Point B

C. Point C

D. Point D



QUESTION: 24

Failing to provide adequate minimum flow for a centrifugal pump can directly result in:

A. pump overheating.

B. excessive pump leakoff.

C. suction piping overpressurization.

D. discharge piping overpressurization.

QUESTION: 25

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

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

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

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

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

QUESTION: 26

A cooling water pump is being driven by an ac induction motor. Which one of the following describes how and why pump motor current will change if the pump shaft shears?

A. Decreases due to decreased pump work

B. Decreases due to decreased counter electromotive force

C. Increases due to increased pump work

D. Increases due to decreased counter electromotive force

QUESTION: 27

If the voltage supplied by an ac generator to an isolated electrical system with a power factor of 1.0 is held constant while real load (kW) is increased, the current supplied by the generator will increase in direct proportion to the _____ of the change in real load. (Assume power factor remains constant at 1.0.)

A. square root

B. amount

C. square

D. cube

QUESTION: 28

The number of starts for an ac induction 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

QUESTION: 29

The force that causes electrons to flow in an electrical circuit is called:

A. power.

B. current.

C. voltage.

D. resistance.

QUESTION: 30

A diesel generator (D/G) is supplying an electrical bus in parallel with an infinite power 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. higher; higher

B. higher; the same

C. the same; higher

D. the same; the same

QUESTION: 31

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

The heat exchanger is operating with the following parameters:

$C_{p\text{-}oil}$ = 1.1 Btu/lbm-°F
$C_{p\text{-}water}$ = 1.0 Btu/lbm-°F
$T_{oil\ in}$ = 174°F
$T_{oil\ out}$ = 114°F
$T_{water\ in}$ = 85°F
$T_{water\ out}$ = 121°F
$\dot{m}_{oil}$ = 4.0 x 10^4 lbm/hr
$\dot{m}_{water}$ = ?

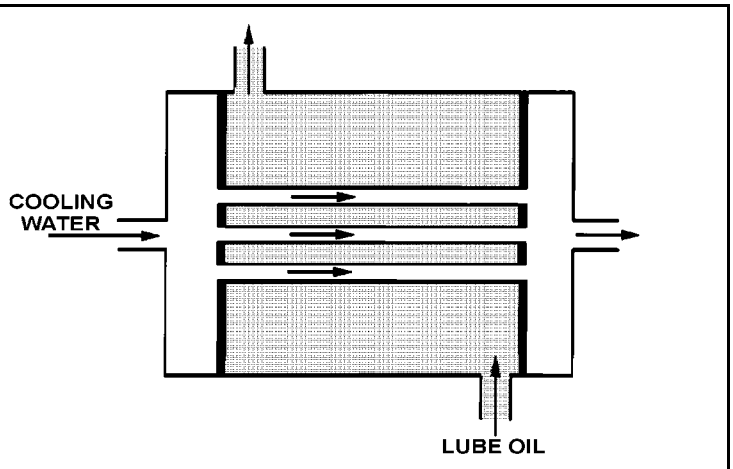
What is the mass flow rate of the cooling water?

A. 8.0 x 10^4 lbm/hr

B. 7.3 x 10^4 lbm/hr

C. 2.6 x 10^4 lbm/hr

D. 2.2 x 10^4 lbm/hr



LUBE OIL HEAT EXCHANGER

QUESTION: 32

A reactor plant is shut down at 400°F with all control rods fully inserted. What is the major adverse consequence resulting from rapidly reducing the reactor coolant/moderator temperature to 250°F?

A. Excessive stress in the ceramic fuel pellets of the reactor core

B. Excessive stress on the reactor vessel wall

C. Uncontrolled reactor criticality

D. Loss of core inlet subcooling

QUESTION: 33

During normal reactor operation, a main condenser develops an air leak which decreases vacuum at a rate of 1 inch Hg/min. Which one of the following would increase because of this condition?

A. Steam cycle efficiency

B. Extraction steam flow rate

C. Condenser hotwell temperature

D. Low pressure turbine exhaust steam moisture content

QUESTION: 34

A pressure gauge on a condenser reads 27 inches of mercury (Hg) vacuum. What is the absolute pressure corresponding to this vacuum? (Assume an atmospheric pressure of 15 psia.)

A. 1.0 psia

B. 1.5 psia

C. 13.5 psia

D. 14.0 psia

QUESTION: 35

The primary reason for slowly opening the discharge valves of large motor-driven centrifugal cooling water pumps after starting the pumps is to minimize the:

A. potential for pump cavitation.

B. potential for a water hammer.

C. motor running current requirements.

D. net positive suction head requirements.

QUESTION: 36

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

A. Increased condenser vacuum

B. Decreased condensate pump flow rate

C. Increased conductivity of the condensate

D. Decreased condensate pump net positive suction head

QUESTION: 37

The decontamination factor (also called the demineralization factor) of a condensate demineralizer has just been determined to be 50, based on conductivity measurements.

If condensate having a conductivity of 20 µmho/cm is flowing into this demineralizer, which one of the following is the conductivity of the condensate at the outlet of the demineralizer?

A. 0.4 µmho/cm

B. 1.0 µmho/cm

C. 4.0 µmho/cm

D. 10.0 µmho/cm

QUESTION: 38

A condensate demineralizer differential pressure (D/P) gauge indicates 4 psid at 50% flow rate. Which one of the following combinations of condensate flow and demineralizer D/P observed at various power levels indicates an increase in the accumulation of insoluble corrosion products in the demineralizer?

	CONDENSATE FLOW	DEMINERALIZER D/P (PSID)
A.	25%	1.0
B.	60%	6.5
C.	75%	9.0
D.	100%	15.5

QUESTION: 39

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

A. Divert 50% of the process water to bypass the demineralizer.

B. Reverse the flow of process water through the demineralizer.

C. Increase the temperature of the process water from 100°F to 110°F.

D. Decrease the flow rate of the process water from 105 gpm to 90 gpm.

QUESTION: 40

Given the following indications for an open 4160 Vac breaker:

- The local OPEN/CLOSED mechanical flag indicates open
- A breaker overcurrent trip flag is actuated on one phase
- The line-side voltmeter indicates 4160 Vac
- The load-side voltmeter indicates 0 volts

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

A. A ground fault caused an automatic breaker trip.

B. An operator tripped the breaker normally at the breaker.

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

D. An operator tripped the breaker normally from a remote location.

QUESTION: 41

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

Pushbutton PB2 was depressed to open the valve, and the current contact status is as shown with the following exceptions:

LS1 is closed.
LS3 is closed.
#1 contact is closed.
#2 contact is closed.

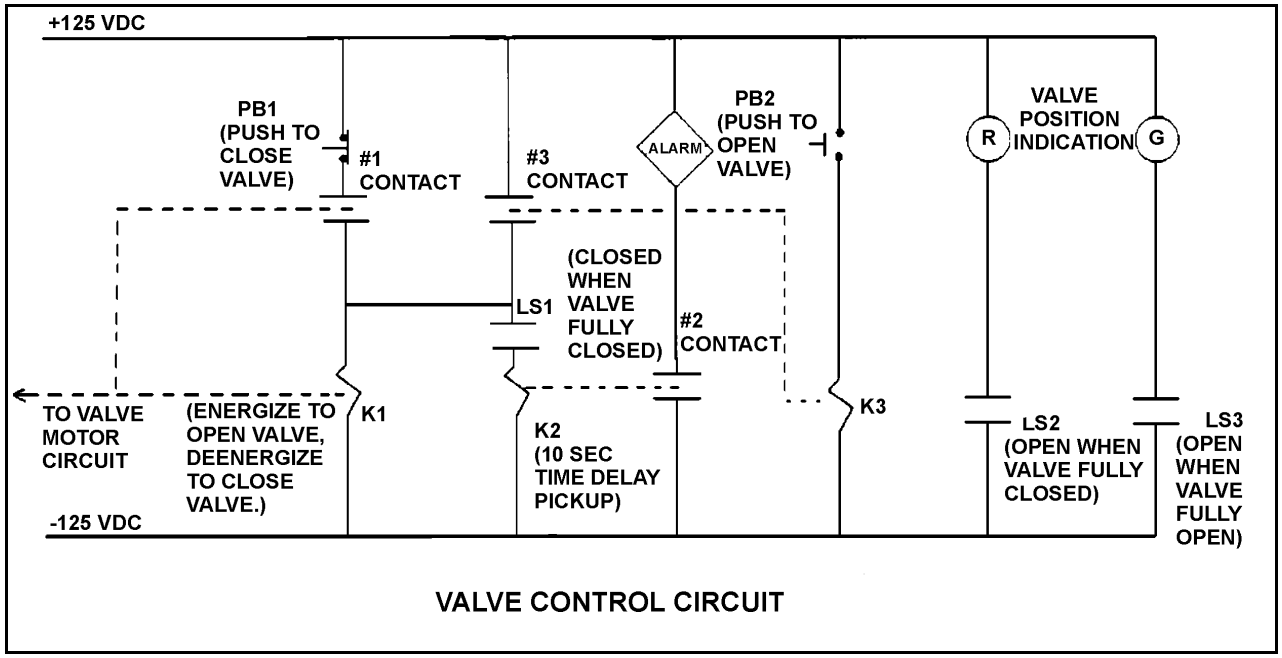
Which one of the following describes the condition of the valve and its control circuit?

A. The valve is closed and the valve motor circuit has just been energized to open the valve.

B. The valve is closed and an open demand signal has existed for at least 10 seconds.

C. The valve is partially open and the valve motor circuit is deenergized as PB2 was prematurely released.

D. The valve is partially open and an open demand signal has existed for at least 10 seconds.



VALVE CONTROL CIRCUIT

QUESTION: 42

A typical main generator is being paralleled to the grid. Generator voltage is slightly higher than grid voltage and the synchroscope is rotating slowly in the clockwise direction. The generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position.

Which one of the following will occur after the breaker is closed?

A. The breaker will open due to overcurrent.

B. The breaker will open due to reverse power.

C. The breaker will remain closed and the generator will supply only MW to the grid.

D. The breaker will remain closed and the generator will supply both MW and MVAR to the grid.

QUESTION: 43

If a breaker is racked to the test position, the:

A. remote position indication for the breaker is still operational.

B. breaker can only be operated remotely from its associated remote control panel.

C. electrical jumpers must be connected to the operating coils to operate the breaker.

D. normal breaker opening and closing operations cannot be tested because the test position is for overload testing only.

QUESTION: 44

A 480 Vac motor control center supplies a load through a breaker and a manual disconnect. If both isolation devices are operated to isolate the load, which one of the following sequences will provide the greatest level of personnel safety when deenergizing the load for maintenance and when reenergizing the load after the maintenance?

	DEENERGIZING	REENERGIZING
A.	Open breaker first	Shut breaker first
B.	Open breaker first	Shut disconnect first
C.	Open disconnect first	Shut breaker first
D.	Open disconnect first	Shut disconnect first

QUESTION: 45

Which one of the following will decrease the ability of the coolant to moderate neutrons in a reactor operating at saturated conditions?

A. Decreasing moderator temperature

B. Decreasing feedwater inlet temperature

C. Decreasing reactor pressure vessel pressure

D. Increasing reactor recirculation system flow

QUESTION: 46

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

A. large; small

B. large; large

C. small; small

D. small; large

QUESTION: 47

The following are combinations of critical conditions that existed for the same reactor operating at 50% power at different times in core life. Which one of the following combinations indicates the smallest amount of excess reactivity present in the reactor fuel?

	CONTROL ROD POSITION	REACTOR RECIR-CULATION FLOW
A.	25% rod density	75%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	75%

QUESTION: 48

Shutdown margin for an operating reactor is the amount of reactivity by which a xenon-free reactor at 68°F would be subcritical if all control rods were:

A. withdrawn, assuming an average worth rod remains fully inserted.

B. inserted, assuming an average worth rod remains fully withdrawn.

C. withdrawn, assuming the highest worth rod remains fully inserted.

D. inserted, assuming the highest worth rod remains fully withdrawn.

QUESTION: 49

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%

QUESTION: 50

Two reactors are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 ΔK/K) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be _____ than reactor A (BOL); and the stable reactor period observed for reactor B (EOL) will be _____ than reactor A (BOL).

A. smaller; longer

B. smaller; shorter

C. larger; longer

D. larger; shorter

QUESTION: 51

A reactor core is exactly critical well below the point of adding heat during a plant startup. A small amount of positive reactivity is then added to the core, and a stable positive reactor period is established.

With the stable positive reactor period, the following is observed:

Time	Power Level
0 sec	3.16×10^{-7}%
90 sec	1.0×10^{-5}%

Which one of the following will be the reactor power at time = 120 seconds?

A. 3.16×10^{-5}%

B. 5.0×10^{-5}%

C. 6.32×10^{-5}%

D. 1.0×10^{-4}%

QUESTION: 52

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

A. Xenon-135

B. Samarium-149

C. Uranium-235

D. Uranium-238

QUESTION: 53

Which one of the following is the primary reason the void coefficient becomes less negative with core burnup toward the end of core life?

A. The control rod density decreases.

B. The thermal neutron flux increases.

C. The thermal diffusion length decreases.

D. The fuel centerline temperature increases.

QUESTION: 54

The reverse power effect (or reverse reactivity effect) occasionally observed when a shallow control rod is withdrawn one or two notches is due to a relatively:

A. small local power decrease due to increased local Doppler effects.

B. small local power decrease due to the shadowing effect of nearby control rods.

C. large local power increase being offset by a void-related power decrease.

D. large local power increase being offset by a moderator temperature-related power decrease.

QUESTION: 55

A reactor is operating steady state at the point of adding heat (POAH) during a reactor startup near the beginning of core life. Reactor pressure is stable at 600 psig and main steam isolation valves are closed (no steam flow from reactor).

If a control rod is manually inserted for 5 seconds, and the reactor does not scram, when conditions stabilize, reactor power will be _____ and reactor vessel pressure will be _____.

A. at the POAH; 600 psig

B. at the POAH; less than 600 psig

C. less than the POAH; 600 psig

D. less than the POAH; less than 600 psig

QUESTION: 56

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1 x 10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 5 x 10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1 x 10^{13} n/cm^2-sec, then the differential control rod worth will increase by a factor of _____. (Assume the average flux is constant.)

A. 2

B. 4

C. 10

D. 100

QUESTION: 57

A control rod located at notch position _____ in the core would be considered a _____ control rod.

A. 12; deep

B. 36; deep

C. 12; intermediate

D. 36; intermediate

QUESTION: 58

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

Which reactor has the smaller concentration of core Xe-135?

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

B. Reactor A (EOL) due to the larger 100% power thermal neutron flux

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

D. Reactor B (BOL) due to the larger 100% power thermal neutron flux

QUESTION: 59

Which one of the following describes the change in core xenon-135 concentration immediately following a power increase from 50% power equilibrium conditions?

A. Initially increases due to the increased xenon-135 production from fission.

B. Initially increases due to the increased iodine-135 production from fission.

C. Initially decreases due to the increased rate of xenon-135 radioactive decay.

D. Initially decreases due to the increased absorption of thermal neutrons by xenon-135.

QUESTION: 60

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to compensate for peak core xenon-135 negative reactivity will be smallest after a reactor scram from equilibrium _____ reactor power at the _____ of core life.

A. 20%; beginning

B. 20%; end

C. 100%; beginning

D. 100%; end

QUESTION: 61

A reactor is being started up and taken to rated power using a constant ramp rate following an extended outage. To compensate for the effect of core xenon-135 while increasing reactor power, it will be necessary to _____ rods and _____ recirculation flow.

A. insert; decrease

B. insert; increase

C. withdraw; increase

D. withdraw; decrease

QUESTION: 62

A reactor is initially operating at equilibrium 100% power. An operator inserts control rods intermittently over a period of 30 minutes. At the end of this time period, reactor power is 70%.

Assuming no additional operator actions are taken, what will reactor power be after an additional 60 minutes?

A. 70% and stable

B. Less than 70% and slowly increasing

C. Less than 70% and slowly decreasing

D. Less than 70% and stable

QUESTION: 63

Sixteen hours after a reactor scram from 100% power, equilibrium xenon condition, the amount of core xenon will be:

A. lower than 100% equilibrium xenon, and will have added a net positive reactivity since the scram.

B. higher than 100% equilibrium xenon, and will have added a net positive reactivity since the scram.

C. lower than 100% equilibrium xenon, and will have added a net negative reactivity since the scram.

D. higher than 100% equilibrium xenon, and will have added a net negative reactivity since the scram.

QUESTION: 64

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

A. Provide neutron flux shaping.

B. Provide more uniform power density.

C. Counteract the effects of control rod burnout.

D. Allow higher fuel enrichment of initial core load.

QUESTION: 65

A nuclear plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor scram occurred. Four hours after the scram, reactor pressure is being maintained at 600 psig in anticipation of commencing a reactor startup.

At this time, which one of the following will cause the fission rate in the reactor core to decrease?

A. Core void fraction is decreased by 2%.

B. Reactor coolant temperature is allowed to decrease by 3°F.

C. The operator fully withdraws the first group of control rods.

D. An additional two hours is allowed to pass with no other changes in plant parameters.

QUESTION: 66

The following data was obtained at steady-state conditions during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
10	360
15	400
20	450
25	514
30	600
35	720
40	900

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

A. 50 units withdrawn

B. 60 units withdrawn

C. 70 units withdrawn

D. 80 units withdrawn

QUESTION: 67

When a reactor is exactly critical, reactivity is:

A. infinity.

B. undefined.

C. 0.0 ΔK/K.

D. 1.0 ΔK/K.

QUESTION: 68

A reactor is undergoing a startup with initial parameters stable at 731.4 psia and 508°F. Main steam isolation valves are closed and reactor criticality has been achieved. The reactor currently has a stable positive 100-second reactor period with reactor power well below the point of adding heat (POAH).

Which one of the following will occur first when reactor power reaches the POAH?

A. Reactor period will shorten.

B. Reactor pressure will increase.

C. Reactor coolant temperature will decrease.

D. Intermediate range power level will decrease.

QUESTION: 69

A reactor is critical at 5 x 10^{-2}% power during a cold reactor startup at the beginning of core life. Reactor period is stable at positive 87 seconds. Assuming no operator action, no reactor scram, and no steam release, what will be reactor power 10 minutes later?

A. Below the point of adding heat (POAH)

B. At the POAH

C. Above the POAH but less than 49%

D. Approximately 50%

QUESTION: 70

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

A. HUR will initially decrease and then increase.

B. HUR will slowly decrease during the entire period.

C. HUR will slowly increase during the entire period.

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

QUESTION: 71

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.

QUESTION: 72

A reactor is critical just below the point of adding heat when an inadvertent reactor scram occurs. All control rods fully insert except for one rod, which remains fully withdrawn. Five minutes after the reactor scram, with reactor period stable at approximately negative (-) 80 seconds, the remaining withdrawn control rod suddenly and rapidly fully inserts.

Which one of the following describes the reactor response to the insertion of the last control rod?

A. The negative period will remain stable at approximately -80 seconds.

B. The negative period will immediately become shorter, and then lengthen and stabilize at approximately -80 seconds.

C. The negative period will immediately become shorter, and then lengthen and stabilize at a value more negative than -80 seconds.

D. The negative period will immediately become shorter, and then lengthen and stabilize at a value less negative than -80 seconds.

QUESTION: 73

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.

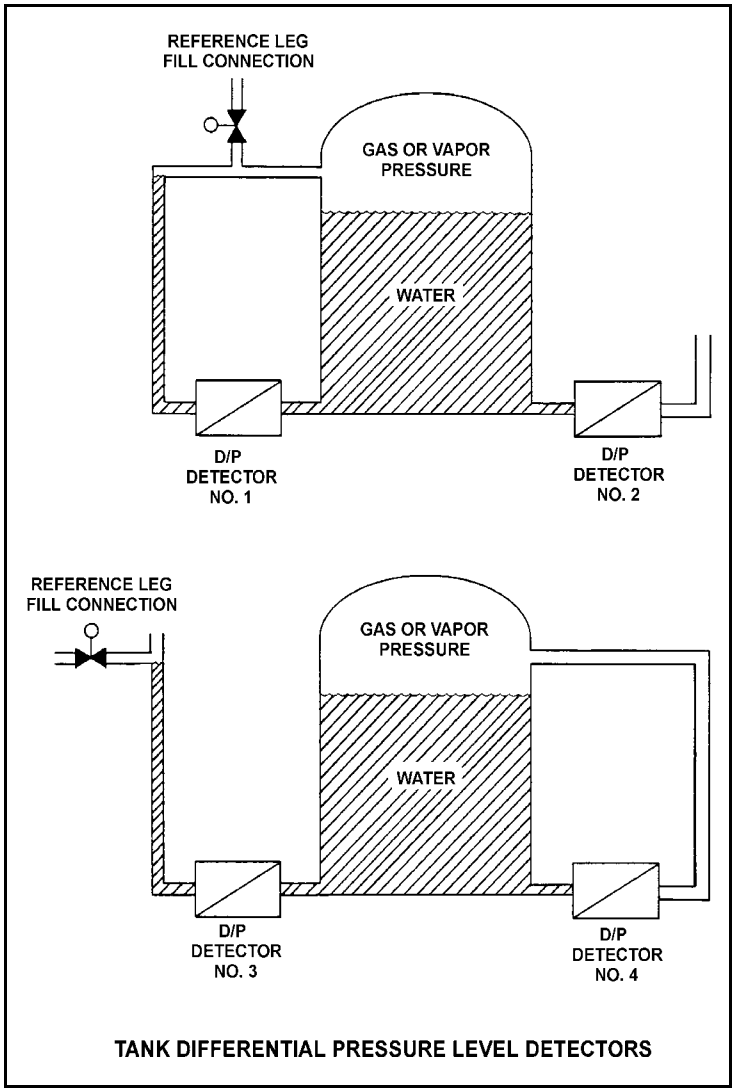
If each detector experiences a ruptured diaphragm, which detector(s) will cause indicated tank level to increase? (Assume actual tank water level remains constant.)

A. No. 1 only

B. No. 2 only

C. No. 1 and 3

D. No. 2 and 4



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 74

The temperature of a quantity of water is 212°F.

Which one of the following additional water parameters, when paired with the temperature, provides insufficient data to determine whether the water is a saturated liquid rather than a saturated liquid-vapor mixture?

A. Enthalpy

B. Entropy

C. Pressure

D. Specific volume

QUESTION: 75

Which one of the following is the approximate amount of heat required to convert 2 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A. 559.6 Btu

B. 1119.2 Btu

C. 2238.4 Btu

D. 3357.6 Btu

QUESTION: 76

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

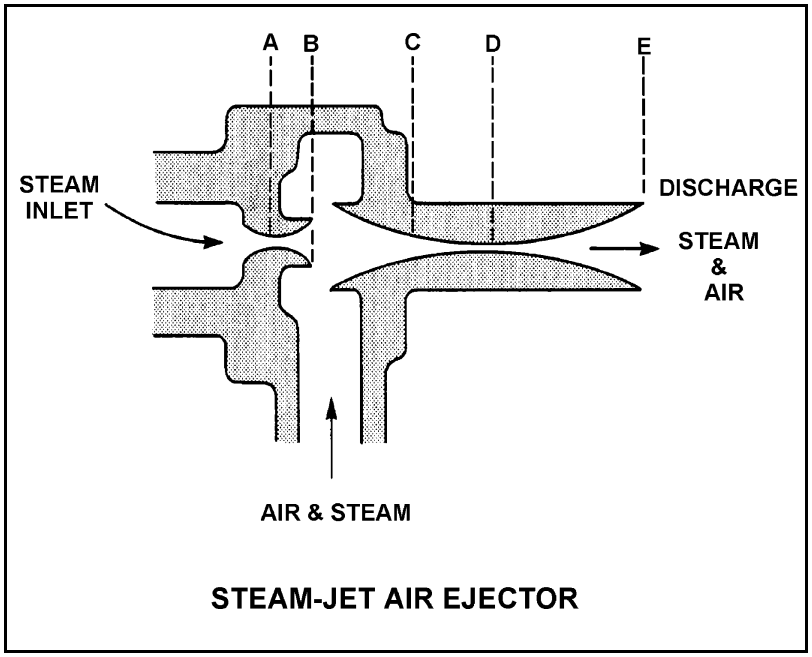
In the steam jet air ejector, steam flowing from C to D undergoes a pressure _____ and a velocity _____.

A. decrease; decrease

B. decrease; increase

C. increase; increase

D. increase; decrease



STEAM-JET AIR EJECTOR

QUESTION: 77

A reactor plant was initially operating normally at 90% power when heating steam (extracted from the main turbine) was automatically isolated to several feedwater heaters. Reactor power was returned to 90% and the plant was stabilized.

Compared to the initial main generator MW load, the current main generator MW load is:

A. lower, because the steam cycle is less efficient.

B. lower, because less steam is being extracted from the main turbine.

C. higher, because the steam cycle is less efficient.

D. higher, because less steam is being extracted from the main turbine.

QUESTION: 78

Complete the following statement.

Pump cavitation occurs when vapor bubbles are formed at the eye of a pump impeller...

A. because the localized flow velocity exceeds sonic velocity for the existing fluid temperature.

B. because the localized pressure exceeds the vapor pressure for the existing fluid temperature.

C. and enter a high pressure region of the pump where they collapse causing damaging pressure pulsations.

D. and are discharged from the pump where they expand into larger bubbles causing damaging pressure pulsations.

QUESTION: 79

Which one of the following explains why condensation of the steam entering a main condenser creates a vacuum?

A. The entropy of the steam increases.

B. The entropy of the steam decreases.

C. The specific volume of the steam increases.

D. The specific volume of the steam decreases.

QUESTION: 80

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

Pumps A and B are identical single-speed centrifugal pumps, but only pump A is operating. Assume real (non-ideal) system and pump operating characteristics.

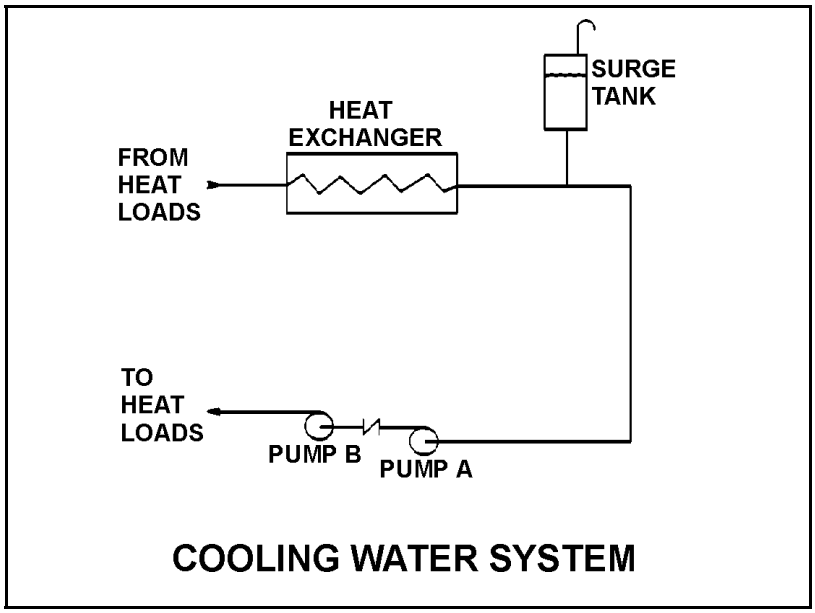
If pump B is started, system flow rate will _____ and the total pump head will _____.

A. increase; increase

B. increase; remain the same

C. remain the same; increase

D. remain the same; remain the same



QUESTION: 81

An 85 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 50 psig?

A. 33.3 gpm

B. 42.5 gpm

C. 51.7 gpm

D. 60.1 gpm

QUESTION: 82

A condenser is operating at 28.5 inches of Hg vacuum with a condensate outlet temperature of 88°F. Which one of the following is the approximate value of condensate depression?

A. 2°F

B. 9°F

C. 13°F

D. 17°F

QUESTION: 83

The measure of heat input per unit time from the reactor core to the reactor coolant in units of megawatts defines:

A. specific heat.

B. power density.

C. core thermal power.

D. percent reactor power.

QUESTION: 84

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

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

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

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

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

QUESTION: 85

During a loss of coolant accident, the reactor fuel may experience stable film boiling. Which one of the following types of heat transfer from the fuel cladding will increase significantly when stable film boiling begins?

A. Forced convection

B. Natural convection

C. Conduction

D. Radiation

QUESTION: 86

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. Reactor pressure decreases.

B. Recirculation flow decreases.

C. Feedwater temperature decreases.

D. Associated bundle power decreases.

QUESTION: 87

Consider the temperature profile from the centerline of a fuel pellet to the centerline of the flow channel under 100% power conditions and single-phase cooling. Which one of the following portions of the temperature profile will have the greatest temperature difference across it at the beginning of a fuel cycle?

A. Pellet-to-clad gap

B. Zircaloy cladding

C. Cladding corrosion film

D. Flow channel boundary layer

QUESTION: 88

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.

QUESTION: 89

Two reactors, A and B, are operating at rated 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. Both reactors have the same control rod pattern and density.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B will have the _____ exit steam quality and the _____ critical power.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

QUESTION: 90

Given:

- A reactor was shutdown 1 week ago from long term operation at 100% power.
- All reactor recirculation pumps are off.
- All reactor head vents are open.
- A shutdown core cooling system is currently in use, maintaining reactor coolant temperature stable at 170°F.
- Reactor coolant temperature is monitored by a detector at the inlet to the in-service shutdown core cooling heat exchanger.

The flow rate from the shutdown core cooling system to the core is inadvertently throttled, resulting in thermal stratification of the reactor coolant in the core. Which one of the following combinations will occur if this thermal stratification is permitted to exist for up to 24 hours?

A. Water in the core will begin to boil, and the in-service shutdown cooling pump will cavitate.

B. The in-service shutdown cooling pump will cavitate, and the jet pumps will cavitate.

C. The jet pumps will cavitate, and reactor coolant temperature will indicate lower than actual core water temperature.

D. Reactor coolant temperature will indicate lower than actual core water temperature, and water in the core will begin to boil.

QUESTION: 91

A reactor is operating at full power when a loss of offsite power results in a reactor scram and a loss of forced core coolant flow. Several minutes later, the development of natural circulation flow will be indicated by differential _____ across the core plate and flow through the _____ pumps.

A. pressure; jet

B. temperature; jet

C. pressure; recirculation

D. temperature; recirculation

QUESTION: 92

A reactor is operating at 80% of rated thermal power with the radial power distribution peaked in the center of the core. Reactor power is then decreased to 60% over the next two hours by:

- reducing reactor recirculation flow rate by 10%, and
- partially inserting a group of centrally-located deep control rods

Compared with the previous operation at 80%, when power is stabilized at 60%, the value of the core maximum radial peaking factor will be _____; and the primary contributor to the change in the value of the core maximum radial peaking factor will be the change in _____.

A. smaller; recirculation flow

B. smaller; control rod position

C. larger; recirculation flow

D. larger; control rod position

QUESTION: 93

A BWR core consists of 30,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal power. If the total peaking factor for a node is 2.0, what is the maximum local linear power density being produced in the node?

A. 4.0 kW/ft

B. 6.0 kW/ft

C. 8.0 kW/ft

D. 10.0 kW/ft

QUESTION: 94

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

A. Linear heat generation rate

B. Average planar linear heat generation rate

C. Minimum critical power ratio safety limit

D. Minimum critical power ratio operating limit

QUESTION: 95

If the average planar linear heat generation rate limit is exceeded, what is the most probable type of fuel clad failure during a design basis loss of cooling accident?

A. Cracking due to high stress

B. Embrittlement due to excessive oxidation

C. Cracking due to uneven heating and cooling of the clad

D. Gross failure due to exceeding 2200°F peak clad temperature

QUESTION: 96

Which one of the following describes the fuel-to-coolant thermal conductivity at the end of core life (EOL) as compared to the beginning of core life (BOL)?

A. Smaller at EOL due to fuel pellet densification

B. Smaller at EOL due to contamination of fill gas with fission product gases

C. Larger at EOL due to reduction in gap between fuel pellets and clad

D. Larger at EOL due to greater temperature difference between fuel pellets and coolant

QUESTION: 97

The pellet-to-clad gap in fuel rod construction is designed to:

A. increase heat transfer.

B. reduce internal clad strain.

C. reduce fission product gas pressure buildup.

D. decrease fuel pellet densification and elongation.

QUESTION: 98

With a reactor at 100% power, reactor pressure suddenly increases, causing a decrease in the latent heat of vaporization. Which one of the following is the limiting thermal limit for the increased reactor pressure transient?

A. Critical power ratio

B. Linear heat generation rate

C. Average planar linear heat generation rate

D Preconditioning interim operating management recommendations

QUESTION: 99

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel?

A. Maximum setpoint for main steam safety valves

B. Maximum chloride concentration in the reactor coolant

C. Maximum reactor pressure versus vessel temperature during heatup

D. Maximum differential temperature between the vessel steam dome and the bottom head

QUESTION: 100

Two identical reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles with an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles with an average power capacity of 60%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the lower average power capacity

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

C. Reactor B due to the higher average power capacity

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

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

JUNE 2002 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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