UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
SEPTEMBER 2008--FORM A

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

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

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 22		
REACTOR THEORY	23 - 36		
THERMODYNAMICS	37 - 50		
TOTALS	50		

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

_____

Applicant's Signature

RULES AND GUIDELINES FOR THE NRC
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 your individual docket number.

3. Fill in the name of your facility.

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 and Mollier Diagram provided by your proctor.

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

7. Scrap paper will be provided for calculations.

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

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

11. Turn in your examination materials, answer sheet on top, followed by the examination copy and the examination aids - 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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

Thermal Efficiency = Net Work Out/Energy In

$$\frac{g(z_2 - z_1)}{g_c} + \frac{(\vec{v}_2^{\,2} - \vec{v}_1^{\,2})}{2g_c} + \upsilon(P_2 - P_1) + (u_2 - u_1) + (q - w) = 0$$

$g_c = 32.2$ 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

A completely full water storage tank is being hydrostatically tested to 200 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 8 gpm. The tank is protected by a relief valve and a safety valve; both valves discharge to the atmosphere. Each valve has an opening setpoint of 205 psig and a maximum rated discharge flow rate of 6 gpm. The PDP is inadvertently left running when tank pressure reaches 200 psig.

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

A. partially; 6 gpm

B. partially; 2 gpm

C. fully; 6 gpm

D. fully; 2 gpm

QUESTION: 2

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

Which one of the following could cause this condition?

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

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

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

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

QUESTION: 3

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

Thermocouple temperature indication is currently 150°F. Reference junction temperature is currently 90°F. Indicator range is from 0°F to 2,000°F.

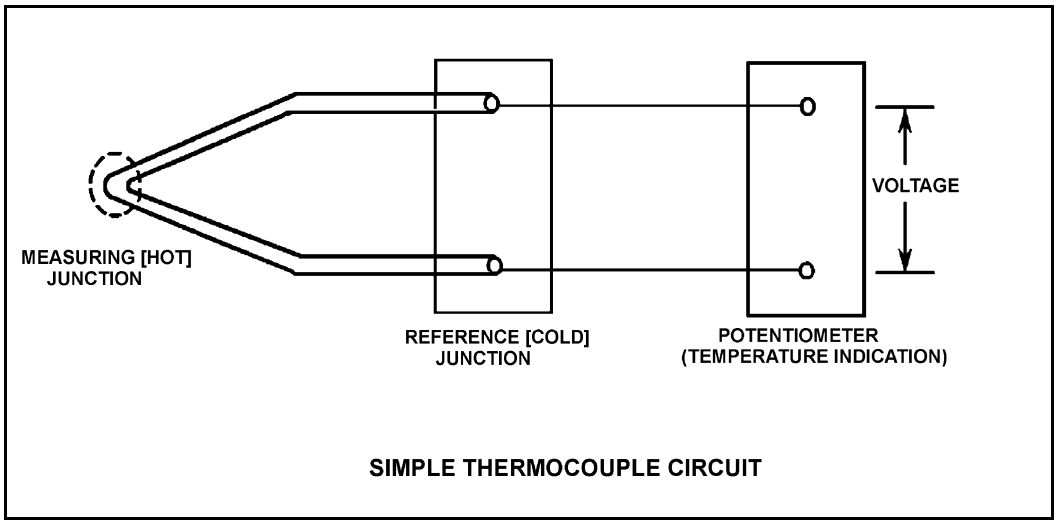
If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

A. Minimum instrument reading (0°F)

B. 60°F

C. 90°F

D. Maximum instrument reading (2,000°F)



SIMPLE THERMOCOUPLE CIRCUIT

QUESTION: 4

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

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

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

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

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

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

QUESTION: 5

Select the option that correctly fills in the blanks.

Quench gases are added to gas-filled radiation detectors that operate in the _____ region; the quench gases prevent a single ionization event from causing _____ in the detector gas volume.

A. ion chamber; multiple discharges

B. ion chamber; secondary ionizations

C. Geiger-Mueller; multiple discharges

D. Geiger-Mueller; secondary ionizations

QUESTION: 6

Which one of the following describes a characteristic of a self-reading pocket dosimeter?

A. Provides dose rate indication in mR/hr.

B. More sensitive to gamma radiation than beta radiation.

C. Contains crystals that luminesce when exposed to ionizing radiation.

D. Can be stored as an accurate record of lifetime radiation exposure.

QUESTION: 7

Refer to the drawing of a pneumatic control system (see figure below).

An increasing steam generator (S/G) water level will decrease the S/G level control signal and reduce the control air pressure applied to the actuator of the feed control valve.

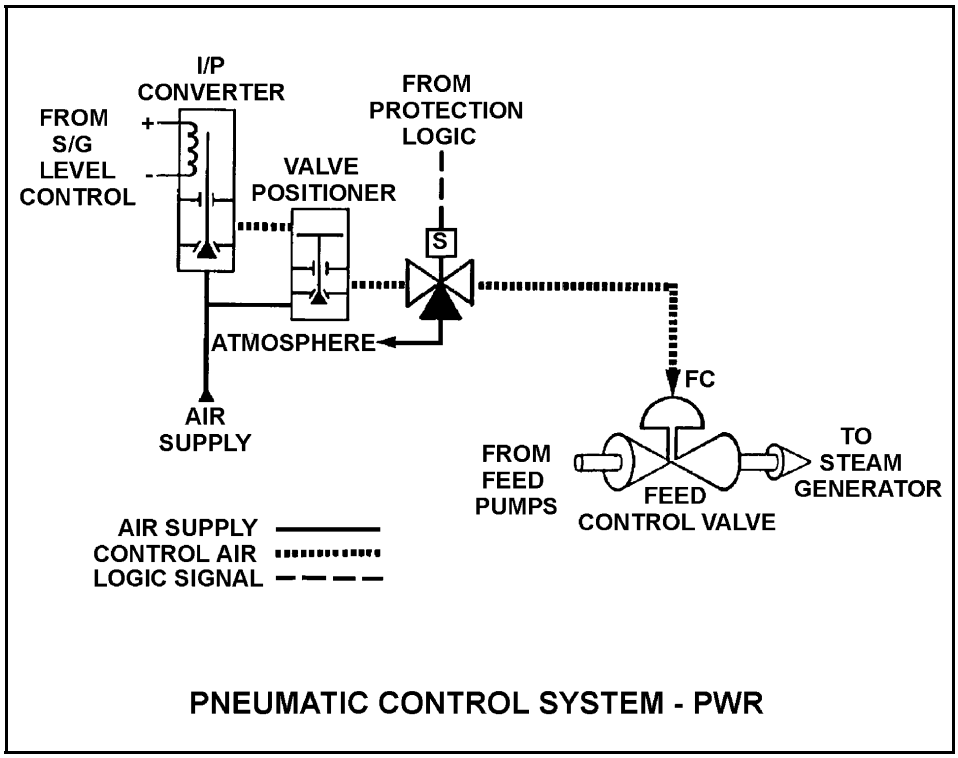
If the level control signal fails high, S/G water level will _____ because the control air pressure to the valve positioner will _____.

A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase



PNEUMATIC CONTROL SYSTEM - PWR

QUESTION: 8

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

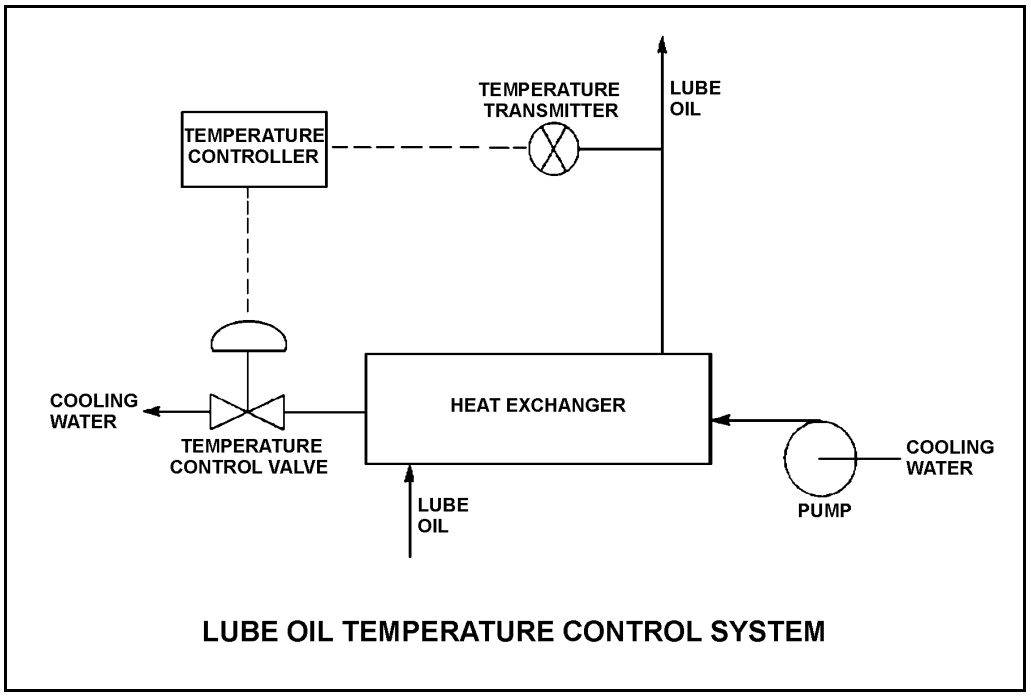
The temperature controller is a direct-acting proportional controller with a gain of 1.0. Which one of the following describes the effect of changing the gain to 2.0?

A. Increases the range of lube oil temperatures that produces a proportional controller response.

B. Increases the change in valve position resulting from a given change in lube oil temperature.

C. Increases the difference between the controller setpoint and the lube oil temperature at steady state conditions.

D. Increases the lube oil temperature deviation from setpoint required to produce a given controller output.



LUBE OIL TEMPERATURE CONTROL SYSTEM

QUESTION: 9

Which one of the following describes the response of a direct-acting proportional-integral controller, operating in automatic mode, to an increase in the controlled parameter above the controller set point?

A. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller set point, at which time the output signal stops increasing.

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

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

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

QUESTION: 10

Which one of the following is a symptom associated with cavitation of a centrifugal pump?

A. Decreased motor current and pump speed

B. Decreased pump and motor temperature

C. Steadily increasing discharge pressure

D. Increased noise and vibration

QUESTION: 11

An ac motor-driven centrifugal pump was just started. During the start, motor current remained peaked for 6 seconds before decreasing to standard running current. Normally, the starting current peak lasts about 4 seconds.

Which one of the following could have caused the extended starting current peak?

A. The pump shaft was seized and did not turn.

B. The pump was initially rotating slowly in the reverse direction.

C. The pump discharge check valve was stuck closed and did not open.

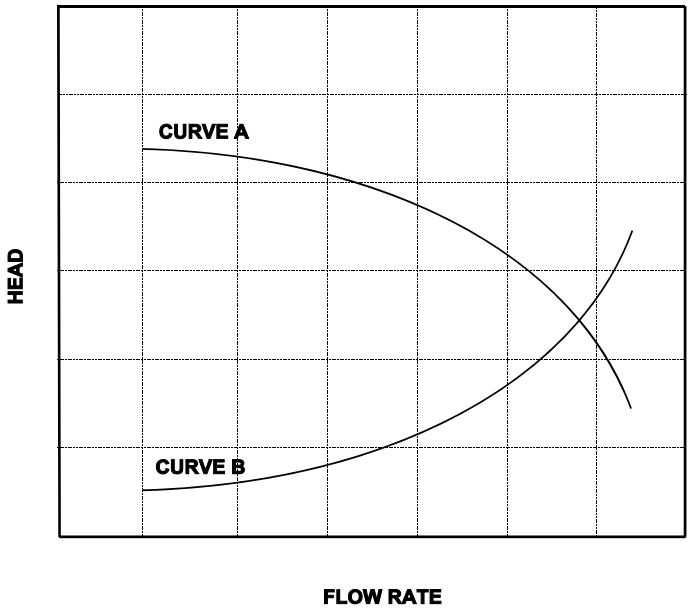
D. The pump was initially air bound, and then primed itself after 6 seconds of operation.

QUESTION: 12

Refer to the graph that represents the head-capacity characteristics for a single-speed centrifugal cooling water pump (see figure below).

Which one of the following lists a pair of parameters that could be represented by curves A and B? (Note: NPSH = net positive suction head.)

	Curve A	Curve B
A.	Pump Head	Available NPSH
B.	Available NPSH	Required NPSH
C.	Required NPSH	System Head Loss
D.	System Head Loss	Pump Head



QUESTION: 13

A section of reactor coolant piping is being hydrostatically tested to 2,900 psig using a positive displacement pump. The operating characteristics of the positive displacement pump are shown below, identifying ideal, expected, and actual pump performance.

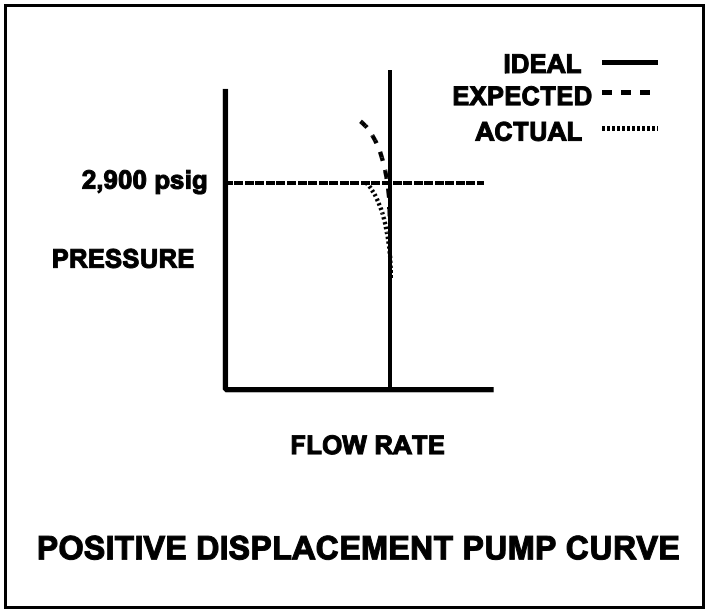
Which one of the following could cause the observed difference between the expected and the actual pump performance?

A. Pump internal leakage is greater than expected.

B. Reactor coolant piping boundary valve leakage is greater than expected.

C. Available NPSH has decreased more than expected, but remains slightly above required NPSH.

D. A relief valve on the pump discharge piping has opened prior to its setpoint of 2,900 psig.



POSITIVE DISPLACEMENT PUMP CURVE

QUESTION: 14

Which one of the following breaker trip signals will trip the associated motor breaker if a motor bearing seizes while the motor is running?

A. Undervoltage

B. Underfrequency

C. Time-delayed overcurrent

D. Instantaneous overcurrent

QUESTION: 15

Two identical 4,160 VAC three-phase induction motors are connected to identical radial-flow centrifugal pumps in identical but separate cooling water systems. Each motor is rated at 200 hp. The discharge valve for motor/pump A is fully open and the discharge valve for motor/pump B is fully closed.

When the motors are started under these conditions, the shorter time period required to reach a stable running current will be experienced by motor _____, and the higher stable running current will be experienced by motor _____.

A. A; A

B. A; B

C. B; A

D. B; B

QUESTION: 16

Refer to the drawing of an operating parallel-flow lube oil heat exchanger (see figure below). Assume that lube oil (LO) inlet temperature is greater than cooling water (CW) inlet temperature.

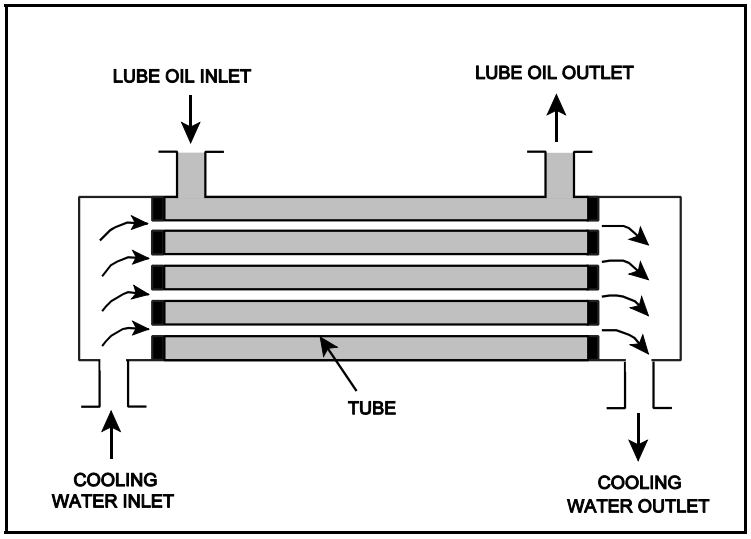
Unlike a counter-flow heat exchanger, in a parallel-flow heat exchanger the _____ temperature can <u>never</u> be greater than the _____ temperature.

A. LO outlet; CW inlet

B. LO outlet; CW outlet

C. CW outlet; LO inlet

D. CW outlet; LO outlet



QUESTION: 17

Borated water is flowing through the tubes of a heat exchanger being cooled by fresh water. The shell side pressure is less than tube side pressure. What will occur as a result of a tube failure?

A. Shell side pressure will increase and the borated water system will be diluted.

B. Shell side pressure will decrease and the borated water inventory will be depleted.

C. Shell side pressure will increase and the borated water inventory will be depleted.

D. Shell side pressure will decrease and the borated water system will be diluted.

QUESTION: 18

An indication that a demineralizer resin bed is clogged is a...

A. large pressure drop across the bed.

B. high flow rate through the bed.

C. temperature rise in the effluent.

D. large conductivity increase across the bed.

QUESTION: 19

A mixed-bed ion exchanger is being used to process reactor coolant letdown. The ion exchanger is boron-saturated for the existing reactor coolant conditions.

If reactor coolant letdown temperature decreases by 20°F, the total number of boron atoms occupying the ion exchange sites will _____, and the boron concentration (ppm) in the ion exchanger effluent will _____.

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

QUESTION: 20

Two identical 1,000 MW electrical generators are operating in parallel, supplying the same isolated electrical bus. The generator output breakers also provide identical protection for the generators. Generator A and B output indications are as follows:

Generator A	Generator B
22.5 KV	22.5 KV
60.2 Hertz	60.2 Hertz
750 MW	750 MW
25 MVAR (out)	50 MVAR (out)

A malfunction causes the voltage regulator for generator B to slowly and continuously increase the terminal voltage for generator B. If no operator action is taken, which one of the following describes the electrical current indications for generator A?

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

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

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

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

QUESTION: 21

Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully closed and has a 10-second stroke time.

Note: Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts are shown open/closed according to the standard convention for control circuit drawings.

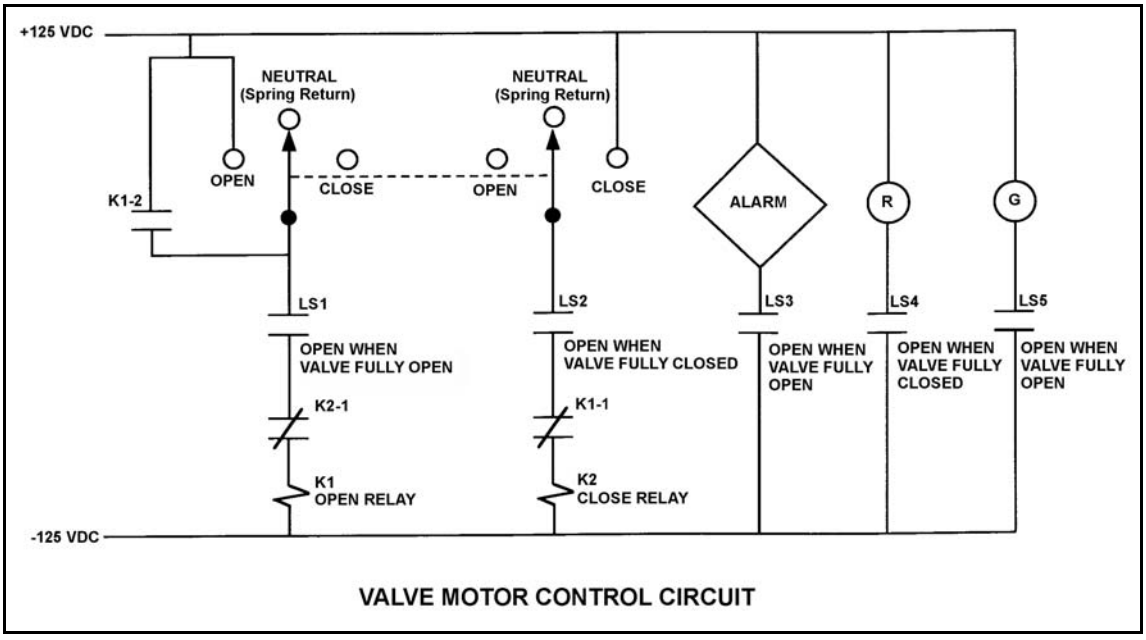
The operator takes the control switch to "Open". Two seconds later, after verifying the valve is opening, the operator releases the control switch. Which one of the following describes the valve motor control circuit alarm response after the switch is released?

A. The alarm will continue to actuate for approximately 8 seconds.

B. The alarm will continue to actuate until additional operator action is taken.

C. The alarm will actuate after approximately 8 seconds.

D. The alarm will <u>not</u> actuate until additional operator action is taken.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 22

When a typical 4,160 volt breaker is racked to the "test" position, control power is _____ the breaker and the breaker is _____ the load.

A. available to; connected to

B. available to; isolated from

C. removed from; connected to

D. removed from; isolated from

QUESTION: 23

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the prompt neutron is more likely to...

A. require a greater number of collisions to become a thermal neutron.

B. be captured by U-238 at a resonance energy peak between 1 eV and 1000 eV.

C. be expelled with a lower kinetic energy.

D. cause thermal fission of a U-235 nucleus.

QUESTION: 24

A thermal neutron is about to interact with a U-238 nucleus in an operating nuclear reactor core. Which one of the following describes the most likely interaction and the effect on core K_{eff}?

A. The neutron will be scattered, thereby leaving K_{eff} unchanged.

B. The neutron will be absorbed and U-238 will undergo fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and U-238 will undergo fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and U-238 will undergo radioactive decay to Pu-239, thereby increasing K_{eff}.

QUESTION: 25

For an operating nuclear reactor, the "effective" delayed neutron fraction may differ from the delayed neutron fraction because, compared to prompt neutrons, delayed neutrons...

A. are less likely to leak out of the reactor core, and they are less likely to cause fast fission.

B. are less likely to cause fast fission, and they require more time to complete a neutron generation.

C. require more time to complete a neutron generation, and they spend less time in the resonance absorption energy region.

D. spend less time in the resonance absorption energy region, and they are less likely to leak out of the reactor core.

QUESTION: 26

As the reactor coolant boron concentration increases, the moderator temperature coefficient becomes less negative. This is because, at higher boron concentrations, a 1°F increase in reactor coolant temperature at higher boron concentrations results in a larger increase in the...

A. fast fission factor.

B. thermal utilization factor.

C. total nonleakage probability.

D. resonance escape probability.

QUESTION: 27

Given the following initial parameters:

Total power coefficient	= -0.016% ΔK/K/%
Boron worth	= -0.010% ΔK/K/ppm
Rod worth	= -0.030% ΔK/K/inch inserted
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

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

A. 390 ppm

B. 420 ppm

C. 450 ppm

D. 470 ppm

QUESTION: 28

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

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

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

A. 0.5

B. 1.4

C. 2.0

D. 4.0

QUESTION: 29

Differential rod worth will become most negative if reactor coolant system (RCS) temperature is _____ and RCS boron concentration is _____.

A. increased; decreased

B. decreased; decreased

C. increased; increased

D. decreased; increased

QUESTION: 30

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

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

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

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

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

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

D. It is impossible to determine without additional information.

QUESTION: 31

After a reactor shutdown from equilibrium core xenon conditions, the maximum xenon -135 negative reactivity (height of the xenon peak) is _____ the pre-shutdown equilibrium power level.

A. independent of

B. directly proportional to

C. inversely proportional to

D. dependent on but not directly proportional to

QUESTION: 32

Which one of the following describes whether reactor power can be increased from 50% to 100% in a controlled manner faster near the beginning of core life (BOL) or near the end of core life (EOL)? (Assume all control rods are fully withdrawn just prior to beginning the power increase.)

A. Faster near EOL due to faster changes in boron concentration

B. Faster near EOL due to greater control rod worth

C. Faster near BOL due to faster changes in boron concentration

D. Faster near BOL due to greater control rod worth

QUESTION: 33

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 8.0. What is the current core K_{eff}?

A. 0.125

B. 0.5

C. 0.75

D. 0.875

QUESTION: 34

During a nuclear reactor startup from a xenon-free condition, and after recording critical data, the operator establishes a positive startup rate to continue increasing power. Within a few minutes, and prior to reaching the point of adding heat, reactor power stops increasing and begins to slowly decrease.

Which one of the following changes could have caused this behavior?

A. Inadvertent boration of the RCS

B. Xenon buildup in the core

C. Gradual cooling of the RCS

D. Fission-induced heating of the fuel

QUESTION: 35

One week after a refueling outage, a nuclear power plant is operating at 80% of rated power with control rods fully withdrawn. During the outage, the entire core was replaced by new fuel assemblies and new burnable poison assemblies were installed at various locations in the core.

Assume reactor power and control rod position do not change. If no operator action is taken, how and why will reactor coolant average temperature change during the next week?

A. Decrease slowly due to fuel burnup only.

B. Decrease slowly due to fuel burnup and fission product poison buildup.

C. Increase slowly due to burnable poison burnout only.

D. Increase slowly due to burnable poison burnout and fission product poison decay.

QUESTION: 36

A nuclear reactor has been shutdown for several weeks when a loss of all ac power results in a loss of forced decay heat removal flow.

Given the following information, what will be the average reactor coolant heatup rate during the 20 minutes immediately after decay heat removal flow is lost? Assume that only ambient losses are removing heat from the reactor coolant system (RCS).

Reactor rated thermal power:	2,800 MWt
Decay heat rate:	0.2% rated thermal power
RCS ambient heat loss rate:	2.4 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	325,000 lbm

A. Less than 25°F/hour

B. 26 to 50°F/hour

C. 51 to 75°F/hour

D. More than 76°F/hour

QUESTION: 37

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

The tanks are identical and are presently at 2 psig overpressure, the same constant water level, and a temperature of 60°F. They are surrounded by atmospheric pressure. All level detectors have been calibrated and are producing the same level indication. A leak in the top of each tank causes a complete loss of overpressure in both tanks.

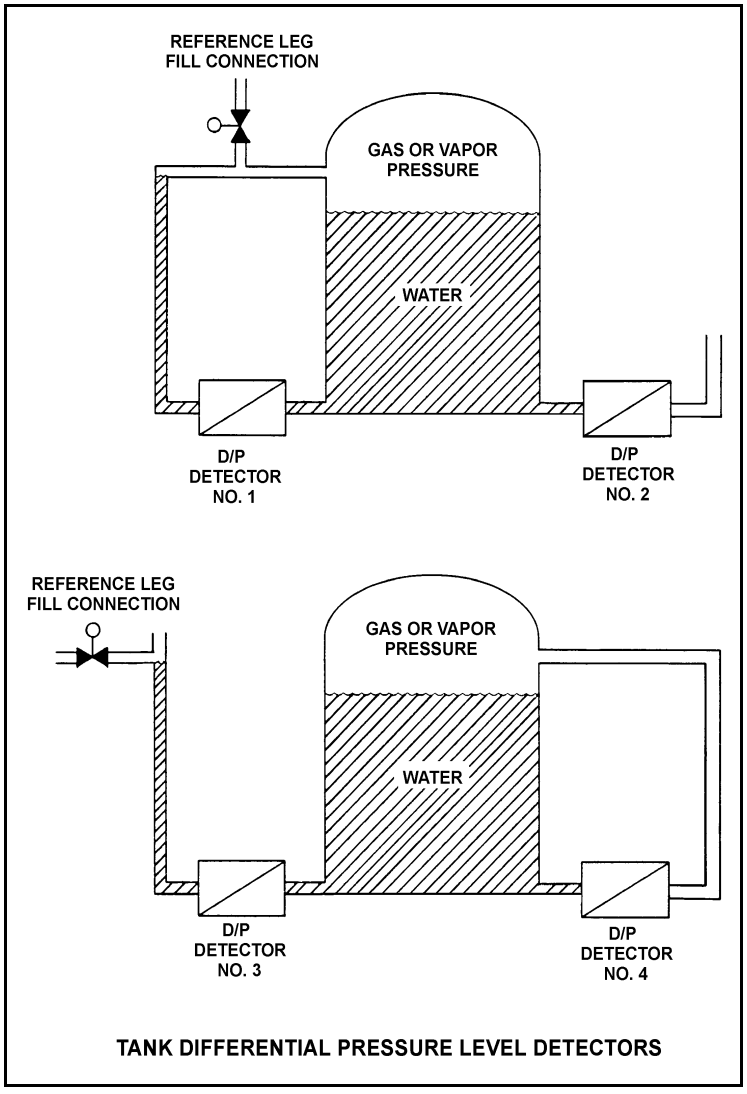
Which level detector(s) will produce the highest level indication?

A. No. 1 only

B. No. 2 only

C. No. 1 and 4

D. No. 2 and 3



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 38

Consider a saturated water/steam mixture at 500°F with a quality of 90%. If the pressure of the mixture is decreased with no heat gain or loss, the temperature of the mixture will _____ and the quality of the mixture will _____. (Assume the mixture remains saturated.)

A. decrease; decrease

B. decrease; increase

C. remain the same; decrease

D. remain the same; increase

QUESTION: 39

A steam turbine exhausts to a steam condenser at 1.0 psia. The steam turbine is supplied with saturated steam at 900 psia at a flow rate of 200,000 lbm/hr. What is the approximate rate of condensate addition to the condenser hotwell in gallons per minute (gpm)?

A. 400 gpm

B. 2,400 gpm

C. 4,000 gpm

D. 24,000 gpm

QUESTION: 40

What is the approximate temperature and phase of the fluid downstream of the pressurizer relief valve if it sticks partially open with 2,200 psia in the pressurizer and a 50 psia backpressure?

A. 281°F, saturated

B. 281°F, superheated

C. 332°F, saturated

D. 332°F, superheated

QUESTION: 41

A nuclear power plant is operating at 85% of rated thermal power when the extraction steam to a high-pressure feedwater heater is isolated. After the transient, the operator returns reactor power to 85% and stabilizes the plant. Compared to conditions just prior to the transient, current main turbine generator output (MWe) is...

A. higher because increased steam flow causes the turbine generator to pick up load.

B. lower because decreased steam flow causes the turbine generator to reject load.

C. higher because plant efficiency has increased.

D. lower because plant efficiency has decreased.

QUESTION: 42

Cavitation is the formation of vapor bubbles in the _____ of a pump and the subsequent collapse of these bubbles in the pump _____.

A. impeller; casing

B. impeller; discharge piping

C. volute; casing

D. volute; discharge piping

QUESTION: 43

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

A main steamline break downstream of the venturi causes the main steam mass flow rate through the venturi to increase. Soon, the steam reaches sonic velocity in the throat of the venturi.

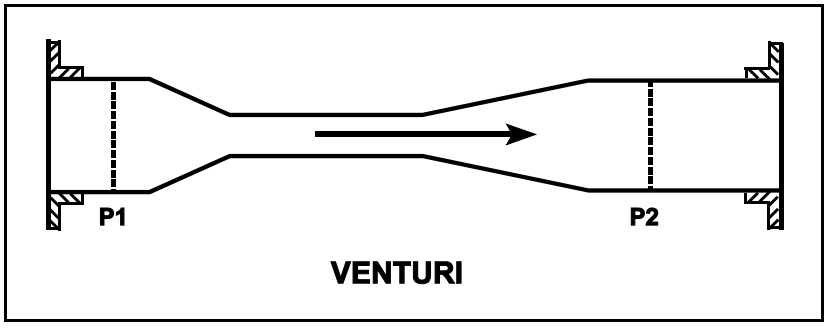
How will the main steam mass flow rate through the venturi be affected as the steam pressure downstream of the venturi continues to decrease?

A. It will continue to increase at a rate that is dependent on the steam velocity in the throat of the venturi.

B. It will continue to increase at a rate that is dependent on the differential pressure (P1 - P2) across the venturi.

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

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



QUESTION: 44

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

A. Oil to water in a lube oil cooler

B. Steam to water in a feedwater heater

C. Water to air in a ventilation heating unit

D. Water to water in a cooling water heat exchanger

QUESTION: 45

Initially, subcooled water is flowing into a fuel assembly, with subcooled water exiting the fuel assembly several degrees hotter than when it entered, and no boiling is occurring in the fuel assembly. Assume that fuel assembly thermal power and water flow rate remain the same.

System pressure is decreased, causing some of the water in contact with the fuel rods to boil during transit through the fuel assembly. If the water exiting the fuel assembly remains subcooled, the average fuel temperature in the fuel assembly will be _____, and the temperature of the water exiting the fuel assembly will be _____.

A. higher; the same

B. higher; higher

C. lower; the same

D. lower; higher

QUESTION: 46

A nuclear power plant is operating with the following initial conditions:

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

Assuming reactor power level does not change, which one of the following will increase the steady-state departure from nucleate boiling ratio?

A. One reactor coolant pump trips with automatic rod control.

B. A spray valve malfunction decreases reactor coolant system pressure by 20 psig with no rod motion.

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

D. Core Xe-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

QUESTION: 47

Following a nuclear reactor accident, transition boiling is occurring near the top of one fuel assembly coolant channel. At the coolant channel elevation where the onset of transition boiling is occurring, coolant flow is changing from _____ flow to _____ flow.

A. annular; slug

B. annular; vapor

C. bubbly; slug

D. bubbly; vapor

QUESTION: 48

During the reflux boiling method of core cooling, the steam that is generated in the core is condensed in the _____ side of a steam generator and flows back into the core via the _____. (Assume the steam generators contain U-tubes.)

A. hot leg; hot leg

B. cold leg; hot leg

C. hot leg; cold leg

D. cold leg; cold leg

QUESTION: 49

A PWR core consists of 50,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal power. If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 3.0, what is the maximum local linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

QUESTION: 50

Operating with which of the following conditions is least effective in preventing brittle fracture in the reactor coolant system (RCS)?

A. Operating within prescribed heatup and cooldown rate limitations.

B. Operating with RCS temperature greater than nil-ductility transition temperature.

C. Operating with RCS pressure low when RCS temperature is low.

D. Operating with a ramped RCS temperature as power level varies.

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

SEPTEMBER 2008 NRC GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

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