UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
SEPTEMBER 2017 PWR – FORM A

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO EXAMINEE

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 percent is required to pass this portion of the NRC operator licensing written examination. All examination materials will be collected 3 hours after the examination begins. This examination applies to a typical U.S. 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.

_____

Examinee's Signature

RULES AND INSTRUCTIONS FOR THE
NRC GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

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

NOTE: Numerical answers are rounded to the nearest whole number unless otherwise indicated.

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 times.

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 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, e.g., steam tables, handouts, and scrap paper.

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 SHEET

EQUATIONS

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

$\ell^* = 1.0 \times 10^{-4}$ sec

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

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

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

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

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

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

$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

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

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

$P = I^2R$

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

$P_R = \sqrt{3}IE\sin\theta$

Thermal Efficiency = Net Work Out/Energy In

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

$g = 32.2\ \text{ft/sec}^2$

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

CONVERSIONS

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1 MW $= 3.41 \times 10^6$ Btu/hr

1 hp $= 2.54 \times 10^3$ Btu/hr

1 Btu $= 778$ ft-lbf

°C $= (5/9)(°F - 32)$

°F $= (9/5)(°C) + 32$

1 kg $= 2.21$ lbm

1 ft^3_{water} $= 7.48$ gal

1 gal_{water} $= 8.35$ lbm

1 Curie $= 3.7 \times 10^{10}$ dps

QUESTION: 1

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 percent of the design flow rate of the safety and relief valves). After vessel pressure reaches the setpoint for each valve, vessel A pressure will _____; and vessel B pressure will _____.

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

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

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

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

QUESTION: 2

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: 3

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

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

A. 98 psig

B. 94 psig

C. 87 psig

D. 74 psig

QUESTION: 4

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

The thermocouple, thermocouple connection head, and reference junction panel are located inside a reactor building (RB), while the temperature instrument is located outside the RB. Initially, the temperature instrument indicates 440°F.

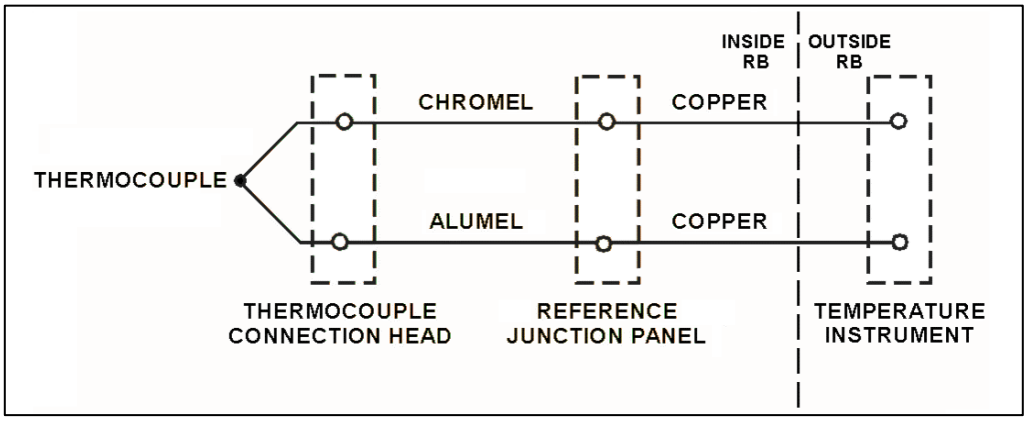
A steam leak outside the RB increases the temperature of the temperature instrument from 80°F to 120°F, while the temperatures at the thermocouple, thermocouple connection head, and reference junction panel remain unchanged. Assuming the temperature instrument remains operable, what is the resulting temperature indication?

A. 400°F

B. 440°F

C. 480°F

D. 560°F



QUESTION: 5

Reed switches are being used in an electrical measuring circuit to monitor the position of a control rod in a 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: 6

Which one of the following describes the ion collection that occurs in a proportional counter, such as a BF_3 detector?

A. A fraction of the ions created by primary ionizations are collected. No secondary ionizations take place.

B. Virtually all of the ions created by primary ionizations are collected. No secondary ionizations take place.

C. Virtually all of the ions created by primary ionizations along with a fraction of the ions created by secondary ionizations are collected.

D. Virtually all of the ions created by primary and secondary ionizations are collected.

QUESTION: 7

Refer to the drawing of a pressure 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 deadband, or neutral zone.

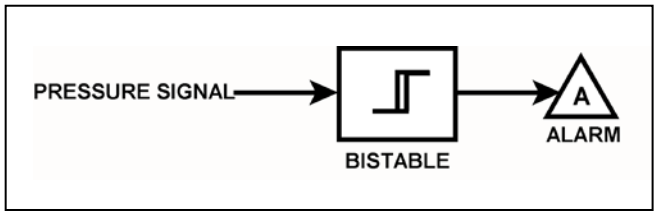
If system pressure is currently 90 psig, which one of the following describes the alarm circuit response as system pressure slowly increases to 110 psig?

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

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

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

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

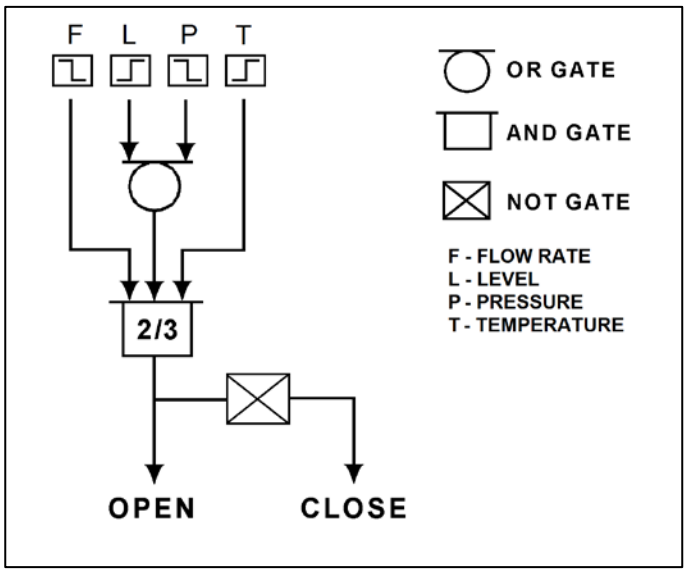


QUESTION: 8

Refer to the logic diagram for a valve controller (see figure below).

Which one of the following combinations of flow rate (F), level (L), pressure (P), and temperature (T) input conditions will result in the valve receiving a CLOSE signal? (The options below indicate whether the input values are higher or lower than the associated bistable setpoints.)

	INPUT CONDITIONS			
	F	L	P	T
A.	Higher	Higher	Lower	Higher
B.	Lower	Lower	Higher	Lower
C.	Higher	Lower	Lower	Higher
D.	Lower	Higher	Higher	Lower



QUESTION: 9

Refer to the drawing of a flow control valve (see figure below) located in the makeup water supply line to a water storage tank.

The flow control valve is positioned by a tank level controller that can maintain a stable water level anywhere between 10 percent above and 10 percent below the controller setpoint. The tank level controller receives input from a direct-acting tank level detector.

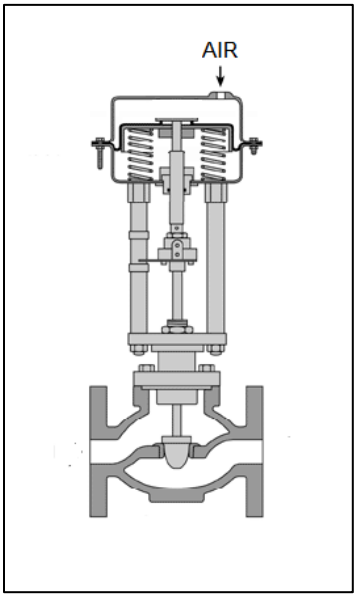
Which one of the following describes the characteristics of the tank level controller?

A. Direct-acting with proportional only control.

B. Direct-acting with proportional-integral control.

C. Reverse-acting with proportional only control.

D. Reverse-acting with proportional-integral control.



QUESTION: 10

An AC motor-driven centrifugal water pump was just started. During the start, motor current remained peaked for 2 seconds, and then decreased and stabilized at about one-fifth the standard running current. Normally, the starting current peak lasts about 4 seconds.

Which one of the following could have caused the abnormal start indications above?

A. The pump shaft was initially seized and the motor breaker opened.

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

C. The pump was initially air bound, and then primed itself after 2 seconds of operation.

D. The coupling between the motor and pump shafts was left disconnected after maintenance.

QUESTION: 11

A centrifugal firewater pump is operating to pressurize a fire main. The pump takes suction from a water reservoir. A fire hose connected to the fire main is being used to suppress an elevated fire.

Given:

- The eye of the pump impeller is located 5 feet above the reservoir water level.
- The pump has a design shutoff head of 120 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60°F.

At which one of the following elevations above the eye of the pump impeller will the fire hose spray nozzle first be <u>unable</u> to provide flow? (Disregard all sources of head loss.)

A. 111 feet

B. 116 feet

C. 121 feet

D. 126 feet

QUESTION: 12

Consider the required net positive suction head ($NPSH_R$) and the available net positive suction head ($NPSH_A$) for a typical centrifugal pump operating normally in a closed cooling water system. If the pump flow rate increases, _____ will be affected; and if the pump inlet pressure increases, _____ will be affected.

A. only $NPSH_A$; only $NPSH_A$

B. only $NPSH_A$; both $NPSH_R$ and $NPSH_A$

C. both $NPSH_R$ and $NPSH_A$; only $NPSH_A$

D. both $NPSH_R$ and $NPSH_A$; both $NPSH_R$ and $NPSH_A$

QUESTION: 13

Which one of the following specifies the proper pump discharge valve position and the basis for that position when starting a large motor-driven radial-flow centrifugal pump?

A. Discharge valve fully open to reduce motor starting power requirements.

B. Discharge valve fully open to ensure adequate pump net positive suction head.

C. Discharge valve throttled to reduce motor starting power requirements.

D. Discharge valve throttled to ensure adequate pump net positive suction head.

QUESTION: 14

A large AC motor has a maximum ambient temperature rating of 40°C. Which one of the following will occur if the motor is continuously operated at rated load with an ambient temperature of 50°C?

A. Accelerated embrittlement of the motor windings, leading to an open circuit within the motor windings.

B. Accelerated embrittlement of the motor windings, leading to a short circuit within the motor windings.

C. Accelerated breakdown of the motor winding insulation, leading to an open circuit within the motor windings.

D. Accelerated breakdown of the motor winding insulation, leading to a short circuit within the motor windings.

QUESTION: 15

An axial flow ventilation fan is being driven by an AC motor. The fan is operating at its maximum rated flow rate. How will the fan motor current initially change if the flow rate through the fan is decreased by partially closing a discharge damper?

A. The motor current will increase in accordance with the centrifugal pump laws.

B. The motor current will increase, but not in accordance with the centrifugal pump laws.

C. The motor current will decrease in accordance with the centrifugal pump laws.

D. The motor current will decrease, but not in accordance with the centrifugal pump laws.

QUESTION: 16

DELETED

QUESTION: 17

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

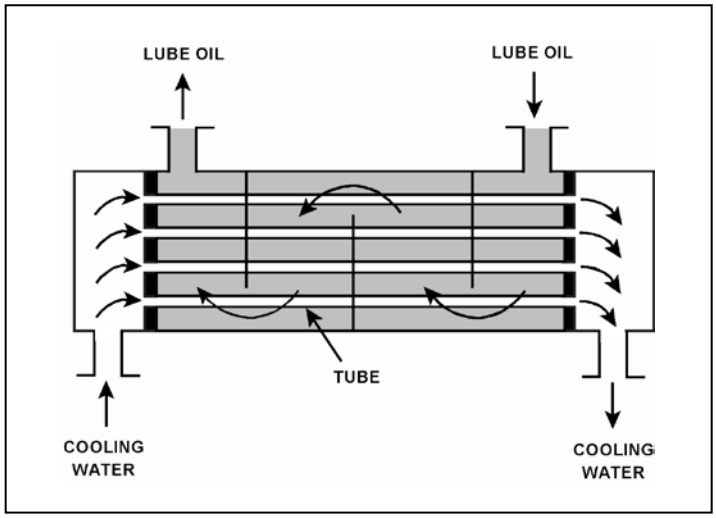
Assume that the inlet lube oil and inlet cooling water temperatures are constant and cooling water flow rate remains the same. Decreasing the oil flow rate through the heat exchanger will cause the lube oil outlet temperature to _____ and the cooling water outlet temperature to _____.

A. decrease, decrease

B. decrease, increase

C. increase, decrease

D. increase, increase



QUESTION: 18

Which one of the following is an indication of resin exhaustion in a demineralizer?

A. An increase in suspended solids in the effluent.

B. A decrease in the flow rate through the demineralizer.

C. An increase in the conductivity of the effluent.

D. An increase in the differential pressure across the demineralizer.

QUESTION: 19

After 12 months of operation at 100 percent power, a reactor was shut down and a plant cooldown is in progress. An operator reports that the general area radiation level near the in-service reactor coolant ion exchanger has increased significantly since the cooldown began several hours ago.

Which one of the following is a typical cause of these indications, resulting from the cooldown?

A. Increased radioactive tritium in the reactor coolant.

B. Increased radioactive oxygen-16 dissolved in the reactor coolant.

C. Increased radioactive nitrogen-16 dissolved in the reactor coolant.

D. Increased radioactive corrosion products suspended in the reactor coolant.

QUESTION: 20

Refer to the drawing of a motor and its control circuit (see figure below).

Note: Relay contacts are shown open/closed according to the standard convention for control circuit drawings.

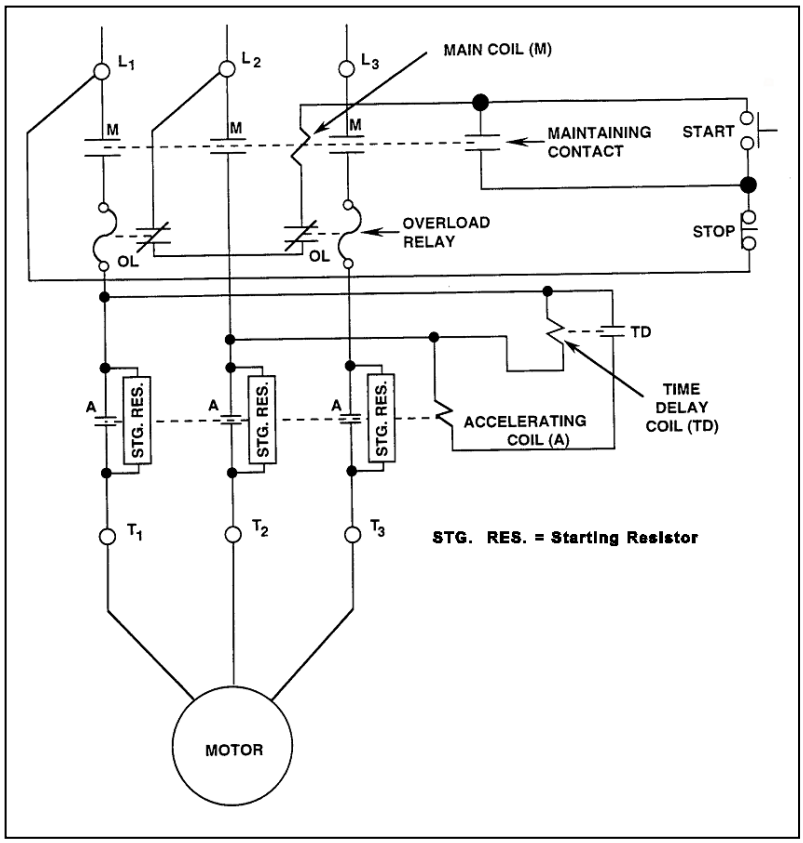
The motor has been idle for several days when it is decided to start the motor. What is the status of the starting resistors before and after the motor START pushbutton is depressed?

A. Initially bypassed; bypass is removed immediately after the START pushbutton is depressed.

B. Initially bypassed; bypass is removed following a preset time delay after the START pushbutton is depressed.

C. Initially inserted in the motor circuit; bypassed immediately after the START pushbutton is depressed.

D. Initially inserted in the motor circuit; bypassed following a preset time delay after the START pushbutton is depressed.



QUESTION: 21

If a main generator output breaker is closed when the generator output voltage is 5 degrees out of phase with the power grid voltage, the main generator will experience a _____ stress; if the breaker remains closed and no additional operator action is taken, the main generator voltage will _____ with the grid voltage.

A. minor; remain out of phase

B. minor; become locked into phase

C. potentially damaging; remain out of phase

D. potentially damaging; become locked into phase

QUESTION: 22

Which one of the following functions or capabilities would remain following a loss of control power to a typical 480 VAC bus feeder breaker?

A. Remote breaker control capability.

B. Breaker closing spring automatic recharging capability.

C. Remote bus voltage indication.

D. Remote breaker position indication.

QUESTION: 23

Which one of the following nuclei will cause the greater loss of kinetic energy from a 2.1 MeV fission neutron during a head-on collision? (Assume that each nucleus is stationary just prior to the collision and the neutron is elastically scattered in all cases.)

A. A helium-4 nucleus in the fuel rod fill gas.

B. An oxygen-16 nucleus in the reactor coolant.

C. A zirconium-90 nucleus in the fuel cladding.

D. A uranium-235 nucleus in a fuel pellet.

QUESTION: 24

Which one of the following is a reason for installing excess reactivity (K_{excess}) in a reactor?

A. To compensate for the conversion of U-238 to Pu-239 during a fuel cycle.

B. To compensate for burnout of Xe-135 and Sm-149 during a power increase.

C. To ensure the fuel temperature coefficient remains negative during a fuel cycle.

D. To compensate for the negative reactivity added by the power coefficient during a power increase.

QUESTION: 25

A reactor is critical at 1.0×10^{-8} percent power during a reactor startup. $\bar{\beta}_{eff}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to attain a stable startup rate of 1.0 dpm?

A. 0.2 %ΔK/K

B. 0.5 %ΔK/K

C. 1.0 %ΔK/K

D. 2.0 %ΔK/K

QUESTION: 26

Which one of the following describes why the moderator temperature coefficient is more negative near the end of a fuel cycle (EOC) compared to the beginning of a fuel cycle (BOC)?

A. Increased nucleate boiling near the EOC amplifies the negative reactivity added by a 1°F moderator temperature increase.

B. Increased control rod insertion near the EOC amplifies the negative reactivity added by a 1°F moderator temperature increase.

C. Decreased fuel temperature near the EOC results in reduced resonance neutron capture for a 1°F increase in moderator temperature.

D. Decreased coolant boron concentration near the EOC results in fewer boron atoms leaving the core for a 1°F moderator temperature increase.

QUESTION: 27

Ignoring the effects of changes in fission product poisons, which one of the following power changes requires the smallest amount of positive reactivity addition?

A. 3 percent to 10 percent

B. 10 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 40 percent

QUESTION: 28

A reactor is operating at steady-state 50 percent power near the end of a fuel cycle when the operator inserts a group of control rods for 5 seconds. Assume that turbine load remains constant and the reactor does not trip.

In response to the control rod insertion, reactor power will stabilize _____ the initial power level and reactor coolant temperature will stabilize _____ the initial temperature.

A. at; at

B. at; below

C. below; at

D. below; below

QUESTION: 29

A reactor is operating at steady-state 75 percent power in the middle of a fuel cycle. Which one of the following actions will cause the greatest shift in reactor power distribution toward the top of the core? (Assume control rods remain fully withdrawn.)

A. Decrease reactor power by 25 percent.

B. Decrease reactor coolant boron concentration by 10 ppm.

C. Decrease average reactor coolant temperature by 5°F.

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

QUESTION: 30

Reactors A and B are operating at steady-state 100 percent power with equilibrium xenon-135. The reactors are identical except that reactor A is operating near the end of a fuel cycle (EOC) and reactor B is operating near the beginning of a fuel cycle (BOC).

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

A. Reactor A (EOC), due to a greater equilibrium concentration of xenon-135.

B. Reactor A (EOC), due to lower competition from the fuel for thermal neutrons.

C. Reactor B (BOC), due to a greater thermal neutron flux in the core.

D. Reactor B (BOC), due to a smaller accumulation of fission product poisons.

QUESTION: 31

A reactor was operating at 100 percent power for 2 months when a reactor trip occurred. Four hours later, the reactor is critical and stable at 10 percent power.

Which one of the following operator actions is required to maintain reactor coolant temperature stable over the next 18 hours?

A. Add positive reactivity during the entire period.

B. Add negative reactivity during the entire period.

C. Add positive reactivity at first, and then negative reactivity.

D. Add negative reactivity at first, and then positive reactivity.

QUESTION: 32

Refer to the graph of critical boron concentration versus core burnup for a reactor during its first fuel cycle (see figure below).

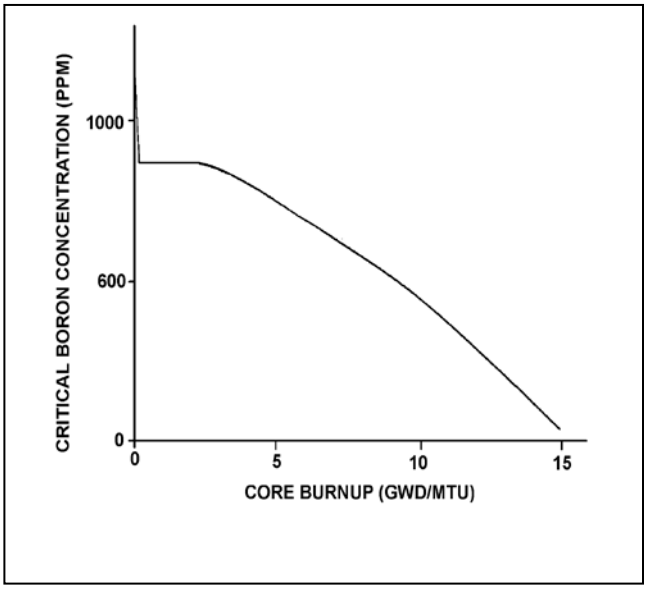
Which one of the following explains why reactor coolant critical boron concentration becomes relatively constant for a period early in the fuel cycle?

A. Fission product poison buildup is being offset by burnable poison burnout and fuel depletion.

B. Fuel depletion is being offset by the buildup of fissionable plutonium and fission product poisons.

C. Fission product poison buildup and fuel depletion are being offset by burnable poison burnout.

D. Fuel depletion and burnable poison burnout and are being offset by the buildup of fission product poisons.



QUESTION: 33

Initially, a reactor is subcritical with a K_{eff} of 0.97 and a stable source range count rate of 500 cps.

Which one of the following will be the approximate final steady-state count rate following a rod withdrawal that adds 1.05 %ΔK/K?

A. 750 cps

B. 1,000 cps

C. 2,000 cps

D. 2,250 cps

QUESTION: 34

Initially, a reactor is critical at 10,000 cps in the source range when a steam generator atmospheric relief valve fails open. Assume end of fuel cycle conditions, no reactor trip, and no operator actions are taken.

When the reactor stabilizes, the average reactor coolant temperature (T_{ave}) will be _____ than the initial T_{ave} and reactor power will be _____ the point of adding heat.

A. less; at

B. less; greater than

C. greater; at

D. greater; greater than

QUESTION: 35

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power level stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.2 %ΔK/K reactivity.

Given:

- All control rod motion has been stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.04 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.006.

What is the reactor power level increase required to offset the reactivity added by the inadvertent control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

A. 3.3 percent

B. 5.0 percent

C. 6.7 percent

D. 7.5 percent

QUESTION: 36

Initially, a reactor was critical just below the point of adding heat during a normal reactor startup when a reactivity event caused a rapid insertion of negative reactivity. No subsequent changes to reactivity occurred.

Ten seconds after the completion of the negative reactivity insertion, the startup rate was observed to be stable at – 0.24 DPM. Was the reactivity event a reactor trip or a dropped fully-withdrawn control rod, and why?

A. Reactor trip, because a dropped fully-withdrawn control rod will <u>not</u> produce a stable negative startup rate 10 seconds after the completion of the negative reactivity insertion.

B. Reactor trip, because a dropped fully-withdrawn control rod will produce a <u>less</u> negative stable startup rate 10 seconds after the completion of the negative reactivity insertion.

C. A dropped fully-withdrawn control rod, because a reactor trip will <u>not</u> produce a stable negative startup rate 10 seconds after the completion of the negative reactivity insertion.

D. A dropped fully-withdrawn control rod, because a reactor trip will produce a <u>more</u> negative stable startup rate 10 seconds after the completion of the negative reactivity insertion.

QUESTION: 37

Refer to the drawing of two water storage tanks with four differential pressure (D/P) level detectors (see figure below).

The tanks are identical with equal water levels and 20 psia gas pressure above the water. The tanks are surrounded by standard atmospheric pressure. The temperature of the water in the tanks and reference legs is 70°F.

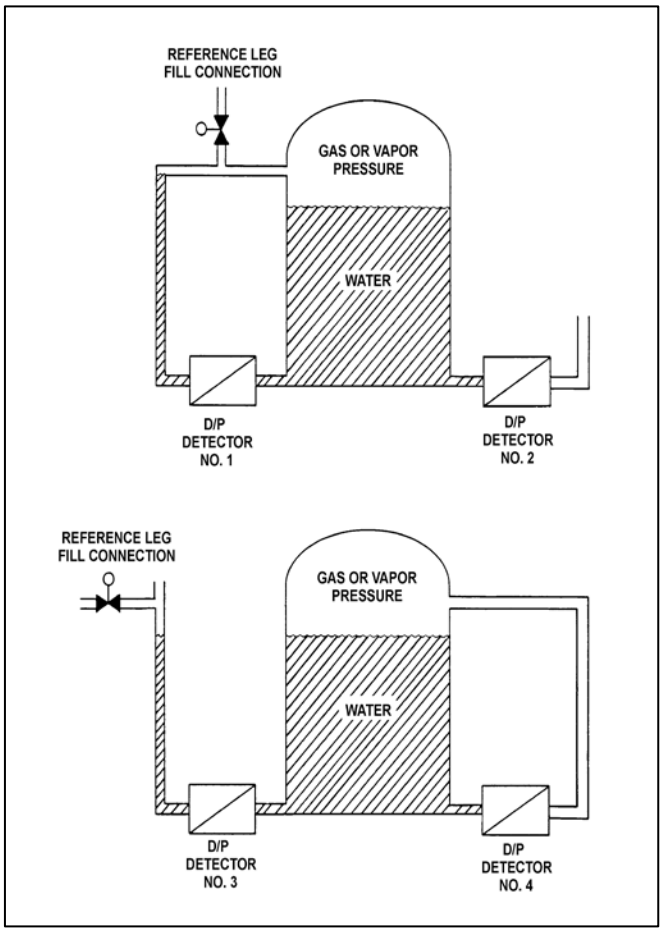
If each detector experiences a ruptured diaphragm, which detector(s) will produce a lower level indication? (Assume that actual tank and reference leg water levels do <u>not</u> change.)

A. No. 1 only

B. No. 2 only

C. No. 1, 2, and 3

D. No. 2, 3, and 4



QUESTION: 38

For which of the following ideal processes, if any, is the steam inlet enthalpy equal to the steam outlet enthalpy? (Assume horizontal fluid flow in each process.)

(A) Dry saturated steam flowing through a pressure reducing valve.
(B) Dry saturated steam flowing through a fixed convergent nozzle.

A. (A) only

B. (B) only

C. Both (A) and (B)

D. Neither (A) nor (B)

QUESTION: 39

Consider a pressurizer containing a saturated steam-water mixture at 636°F with a quality of 15 percent. If an outsurge removes 10 percent of the liquid volume from the pressurizer, the temperature of the remaining mixture will _____, and the quality of the remaining mixture will _____. (Assume the mixture remains saturated.)

A. decrease; decrease

B. decrease; increase

C. remain the same; decrease

D. remain the same; increase

QUESTION: 40

An ideal main turbine generator (MTG) is producing 1,000 MW of electrical power while being supplied with 100 percent quality steam at 920 psig. Steam supply pressure is then gradually increased to 980 psig at the same quality. Assume turbine control valve position and condenser vacuum remain the same.

Which one of the following describes why the MTG output increases as steam pressure increases?

A. Each lbm of steam entering the turbine has a higher specific heat.

B. Each lbm of steam entering the turbine has a higher specific enthalpy.

C. Each lbm of steam passing through the turbine expands to fill a greater volume.

D. Each lbm of steam passing through the turbine performs increased work in the turbine.

QUESTION: 41

A nuclear power plant is operating at 80 percent power with 5°F of condensate depression in the main condenser. If the condensate depression increases to 10°F, the steam cycle thermal efficiency will _____; and the condensate pumps will operate _____ cavitation.

A. decrease; closer to

B. decrease; farther from

C. increase; closer to

D. increase; farther from

QUESTION: 42

Consider the steam cycle thermal efficiency of a nuclear power plant operating at rated power.

If the pressure at which saturated steam is produced in the steam generators is increased, thermal efficiency will _____; and if the temperature of the feedwater entering the steam generators is increased, thermal efficiency will _____.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

QUESTION: 43

Which one of the following describes the relationship between the main steam mass flow rate leaving a steam generator and the main feedwater mass flow rate entering the same steam generator at steady-state power operation? (Assume no other addition/removal of steam generator inventory.)

A. The mass flow rates will be the same only if downcomer level is constant.

B. The mass flow rates will be the same only if the reactor is operating near rated power.

C. The main steam mass flow rate is smaller than the main feedwater mass flow rate by the amount of moisture removed by the steam generator moisture separators.

D. The main steam mass flow rate is greater than the main feedwater mass flow rate by the amount of moisture removed by the steam generator moisture separators.

QUESTION: 44

Two centrifugal pumps and two positive displacement pumps are able to be cross-connected to provide makeup water flow to a system. Each pump will produce 100 gpm at a system pressure of 1,000 psig backpressure.

If system pressure is 800 psig, which one of the following combinations will produce the greatest flow rate to the system?

A. Two centrifugal pumps in parallel.

B. Two centrifugal pumps in series.

C. Two positive displacement pumps in parallel.

D. Two positive displacement pumps in series.

QUESTION: 45

Two of the parameters listed below are used for calculating core thermal power using the standard heat balance method. Which one of the following identifies the two parameters?

	Feedwater Pressure	Feedwater Mass Flow Rate	Steam Generator Pressure	Steam Generator Mass Flow Rate
A.	Yes	Yes	No	No
B.	No	No	Yes	Yes
C.	Yes	No	No	Yes
D.	No	Yes	Yes	No

QUESTION: 46

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

- Reactor power is 45 percent 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 control rod motion.

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

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

QUESTION: 47

Refer to the drawing of a section of pipe that contains flowing subcooled water. (See figure below).

Given:

- Pressure at P_1 is 30 psig.
- Pressure at P_2 is 32 psig.
- Pressure change due to change in velocity is 2 psig.
- Pressure change due to change in elevation is 2 psig.

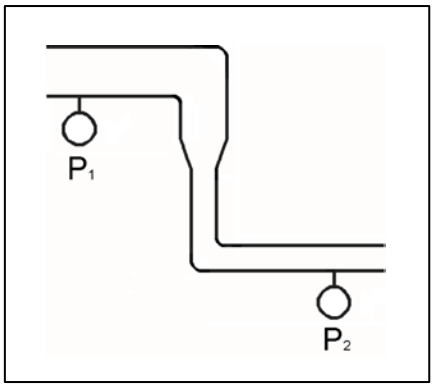
The pressure decrease due to friction head loss between P_1 and P_2 is _____; and the direction of flow is from _____.

A. 2 psig; left to right

B. 2 psig; right to left

C. 6 psig; left to right

D. 6 psig; right to left



QUESTION: 48

A nuclear power plant was operating at steady-state 100 percent power when a loss of offsite power occurred, resulting in a reactor trip and a loss of forced reactor coolant circulation. Thirty minutes later, reactor coolant system (RCS) hot leg temperature is greater than cold leg temperature and steam generator (SG) levels are stable.

Which one of the following combinations of parameter trends, observed 30 minutes after the trip, indicates that natural circulation is occurring? (CET = core exit thermocouple)

	RCS Hot Leg Temperature	RCS Cold Leg Temperature	SG Pressures	RCS CET Subcooling
A.	Decreasing	Stable	Stable	Increasing
B.	Increasing	Decreasing	Increasing	Decreasing
C.	Decreasing	Decreasing	Decreasing	Decreasing
D.	Increasing	Increasing	Decreasing	Increasing

QUESTION: 49

Refer to the drawing of a fuel rod and coolant flow channel (see figure below).

Given the following initial core parameters:

Reactor power = 100 percent
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,500°F

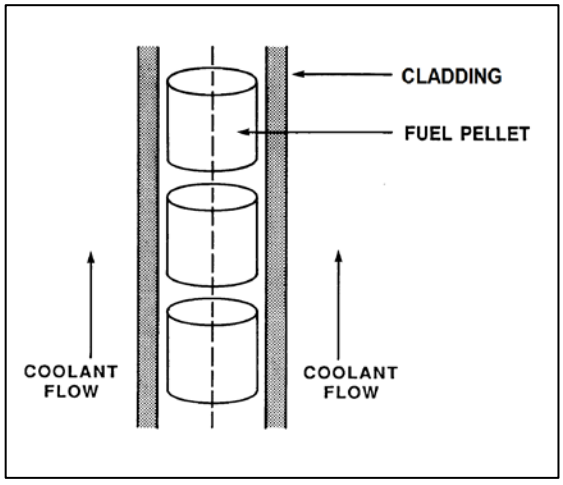
What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

A. 1,250°F

B. 1,300°F

C. 1,400°F

D. 1,500°F



QUESTION: 50

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

The conservative value used for the reactor vessel NDTT is _____ than the actual NDTT; the actual NDTT is verified periodically by _____.

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

B. higher; in-service inspection and analysis of the reactor vessel wall

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

D. lower; in-service inspection and analysis of the reactor vessel wall

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

SEPTEMBER 2017 GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

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