UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2019 BWR – 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. boiling water reactor (BWR) 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

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

Setpoint pressure (MSSV starts to open) = 1,200 psia
Maximum pressure (MSSV will be fully open) = 1,230 psia
Reseat pressure (MSSV will be fully closed) = 1,140 psia

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

A. 2.5 percent

B. 5.0 percent

C. 7.5 percent

D. 33.3 percent

QUESTION: 2

Subcooled water is flowing through a throttled valve in an open system. The initial steady-state conditions for the throttled valve are as follows:

Inlet pressure = 60 psia
Outlet pressure = 44 psia
Flow rate = 800 gpm

After four hours, the current steady-state conditions for the throttled valve are as follows:

Inlet pressure = 62 psia
Outlet pressure = 40 psia
Flow rate = 600 gpm

Which one of the following could be responsible for the difference between the initial and current steady-state conditions for the throttled valve?

A. The throttled valve was opened more.

B. The throttled valve was closed more.

C. Another valve, located upstream of the throttled valve, was partially closed.

D. Another valve, located downstream of the throttled valve, was partially closed.

QUESTION: 3

Which one of the following is a disadvantage associated with using a gate valve, versus a globe valve, to throttle flow in a cooling water system?

A. The tortuous flow path through a throttled gate valve body makes flow control difficult.

B. A gate valve will experience stem leakage unless it is fully opened and backseated.

C. The turbulent flow created by a throttled gate valve will cause erosion damage to the valve seat.

D. A fully-open gate valve will produce a greater system head loss than a fully-open globe valve.

QUESTION: 4

Refer to the drawing of a differential pressure (D/P) level detection system (see figure below) for a reactor vessel at normal operating temperature and pressure. The level detector has just been calibrated.

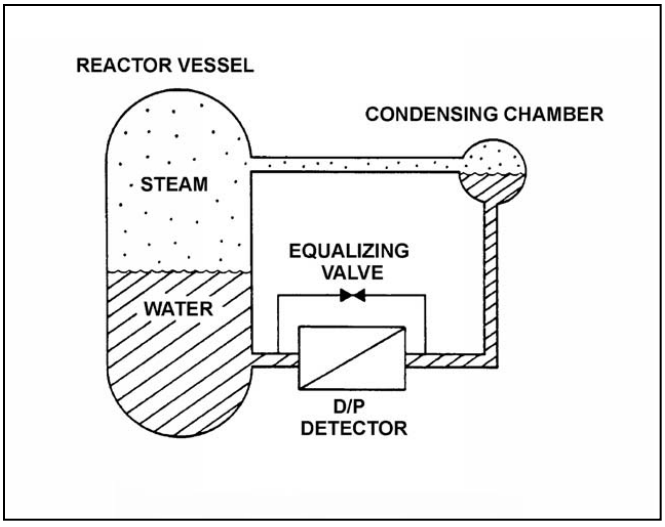
The high pressure side of the detector is connected to the _____; and if the equalizing valve is opened, the indicated reactor vessel level will be _____ than the actual level.

A. reactor vessel; lower

B. reactor vessel; higher

C. condensing chamber; lower

D. condensing chamber; higher



QUESTION: 5

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

A. coil, due to an increased pressure-induced force on the outside of the tube.

B. straighten, due to an increased pressure-induced force on the outside of the tube.

C. coil, due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

D. straighten, due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

QUESTION: 6

Refer to the drawing of a simple thermocouple circuit (see figure below) that is calibrated for a reference junction temperature of 90°F.

Thermocouple temperature indication is currently 150°F. Indicator range is from 0°F to 2000°F.

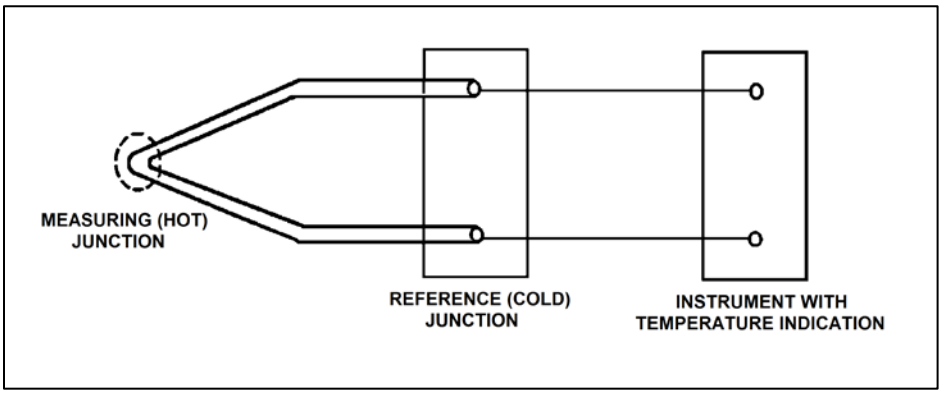
Which one of the following temperature indications will result if one of the thermocouple extension wires becomes dislodged from its terminal in the reference junction panel?

A. 0°F

B. 60°F

C. 90°F

D. 2000°F



QUESTION: 7

A typical gamma ray (1 to 2 MeV) normally produces a free electron in a gas-filled radiation detector by…

A. transferring energy to a nucleus, which recoils and leaves behind a free electron.

B. transferring energy to a bound electron, which recoils and becomes a free electron.

C. entering the electrostatic field of a nucleus, where it transforms into a proton and a free electron.

D. entering the electrostatic field of a bound electron, where it transforms into a positron and a free electron.

QUESTION: 8

Refer to the drawing of a 30-foot water storage tank and its level control system (see figure below).

The level control system has just been returned to service following replacement of the drain valve actuator. Unfortunately, the original direct-acting actuator was mistakenly replaced with a reverse-acting actuator.

Given:

- The drain valve will now fail open if air pressure is lost to its actuator.
- The level control system uses a direct-acting level sensor and a direct-acting proportional-integral level controller with a setpoint of 15 feet.
- The tank water level is stable at 16 feet with the drain valve 50 percent open.
- The level controller is in Manual control.

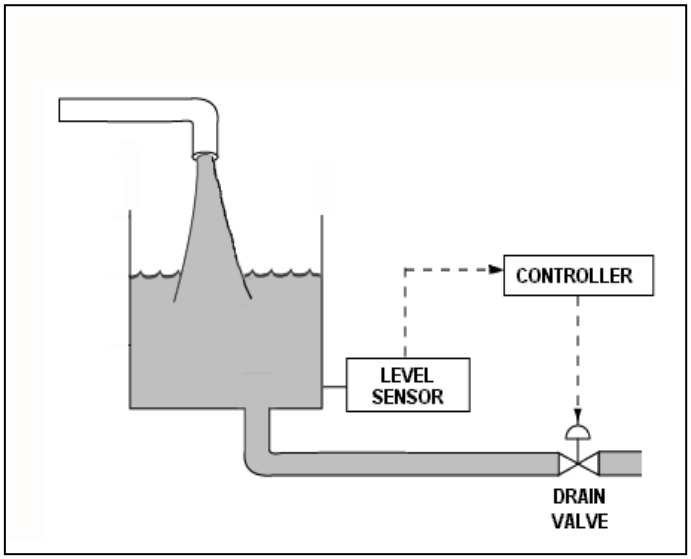
If the level controller is shifted to Automatic control, the tank water level will…

A. increase until the tank overflows.

B. decrease until the tank almost completely empties.

C. initially increase, and then decrease and stabilize at 15 feet.

D. initially decrease, and then increase and stabilize at 15 feet.



QUESTION: 9

If the turbine shaft speed signal received by a typical turbine governor control system fails low during turbine startup, the turbine governor will cause turbine speed to...

A. decrease to a minimum speed setpoint.

B. decrease until the mismatch with demanded turbine speed is nulled.

C. increase until the mismatch with demanded turbine speed is nulled.

D. increase until an upper limit is reached or the turbine trips on overspeed.

QUESTION: 10

A centrifugal pump is operating with the following parameters:

Head = 60 psid
Flow rate = 300 gpm
Power input = 4 KW

If the pump's speed is increased until the pump's flow rate equals 400 gpm, the pump's power input will be approximately...

A. 5.3 KW

B. 7.1 KW

C. 9.5 KW

D. 12.7 KW

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 drawing of a cooling water system with an operating centrifugal pump (see figure below).

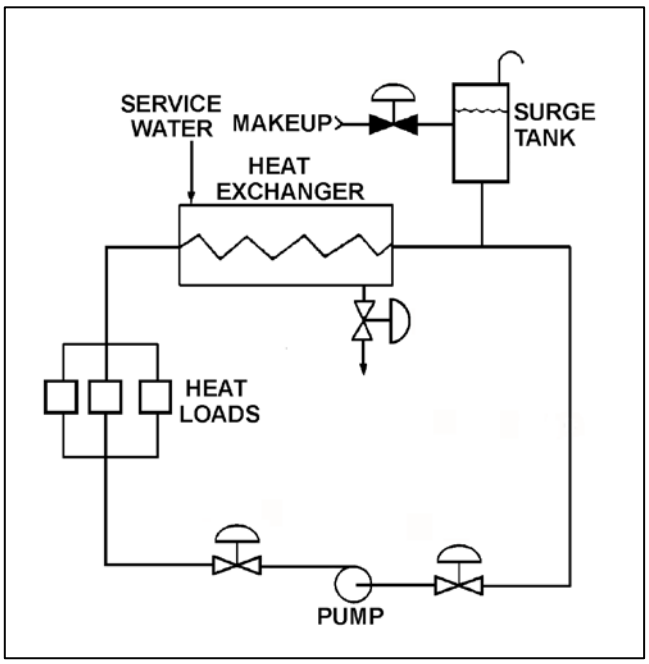
If the surge tank water level increases from 8 feet to 9 feet, the pump mass flow rate will…

A. increase, because the pump suction head will increase while the pump discharge head decreases.

B. increase, because the pump suction head will increase while the pump discharge head remains the same.

C. remain the same, because the pump suction and discharge heads will increase by the same amount.

D. remain the same, because the pump suction and discharge heads will be unaffected by the change in surge tank water level.



QUESTION: 13

A positive displacement pump should be started with its suction valve _____ and its discharge valve _____.

A. closed; closed

B. closed; open

C. open; closed

D. open; open

QUESTION: 14

A shutdown nuclear power plant is operating normally when an electrical fault causes a sustained 20 percent voltage reduction on all phases of the onsite three-phase AC electrical distribution system. Assume that all previously-operating three-phase AC induction motors continue operating, and the mechanical load on each motor remains the same.

As a result of the voltage reduction, the operating three-phase AC induction motors will draw _____ current; and will experience _____ stator temperatures.

A. more; higher

B. more; lower

C. less; higher

D. less; lower

QUESTION: 15

The frequency of starts for large AC motors should be limited to prevent excessive...

A. heat buildup within the motor.

B. wear of pump thrust bearings.

C. torsional stresses on the motor shaft.

D. arcing and degradation of motor breaker contacts.

QUESTION: 16

Decreasing the temperature of the lube oil leaving a lube oil heat exchanger is normally accomplished by...

A. increasing the cooling water flow rate.

B. increasing the lube oil flow rate.

C. decreasing the cooling water flow rate.

D. decreasing the lube oil flow rate.

QUESTION: 17

A nuclear power plant is operating at steady-state 100 percent power. Assume the main condenser cooling water inlet temperature and flow rate do not change.

If the main condenser vacuum slowly decreases, the temperature of the condensate falling into the hotwell will...

A. decrease, because the condensate saturation pressure has decreased.

B. decrease, because the amount of condensate subcooling has increased.

C. increase, because the condensate saturation pressure has increased.

D. increase, because the amount of condensate subcooling has decreased.

QUESTION: 18

Refer to the drawing of two system curves for a main condenser cooling water system (see figure below).

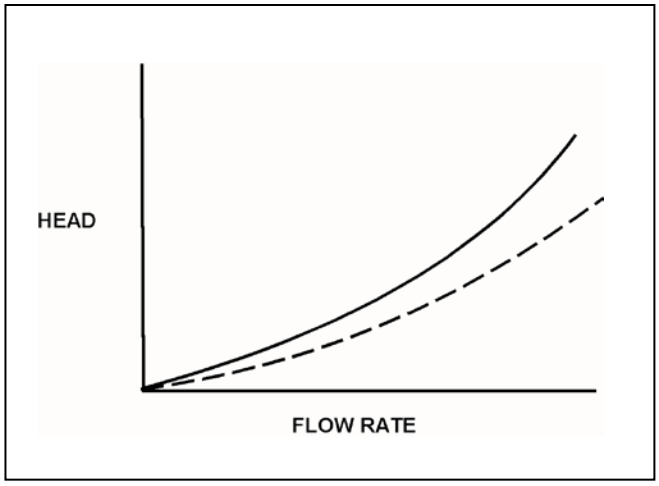
Which one of the following will cause the system curve to shift from the solid curve toward the dashed curve?

A. The main condenser tubes are cleaned.

B. The main condenser tubes become increasingly fouled.

C. Cooling water flow rate is increased by 25 percent by starting an additional cooling water pump.

D. Cooling water flow rate is decreased by 25 percent by stopping one of the operating cooling water pumps.



QUESTION: 19

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

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

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

C. demineralizer inlet and outlet conductivity.

D. demineralizer inlet and outlet pH.

QUESTION: 20

Condensate mixed-bed demineralizer 1A was removed from service after it became saturated with chloride (Cl^-) ions while processing condensate with 10 times the normal chloride concentration. Alternate condensate mixed-bed demineralizer 1B was placed in service and the condensate chloride concentration was restored to normal.

Demineralizer 1A was drained and refilled with condensate having the normal chloride concentration in preparation for being returned to service to replace demineralizer 1B.

When demineralizer 1A is returned to service, its effluent chloride concentration initially will be _____ than its influent chloride concentration because _____.

A. lower; demineralizer 1A will continue to remove chloride ions from the condensate as it flows through the demineralizer.

B. higher; some of the previously-captured chloride ions will be released as the condensate flows through demineralizer 1A.

C. the same; for each chloride ion removed from the condensate by demineralizer 1A, one chloride ion will be released.

D. the same; demineralizer 1A is chloride-saturated and <u>cannot</u> remove additional chloride ions from the condensate.

QUESTION: 21

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

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

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

A. open; in

B. closed; in

C. open; out

D. closed; out

QUESTION: 22

The main generator output breaker was just closed to connect the main generator to the main transformer. Just before the breaker was closed, the following parameter values existed:

Main Generator	Main Transformer
20,000 volts	20,050 volts
60.1 Hz	59.9 Hz

With no additional operator action, the main generator stabilized with the following parameter values:

25 MW
15 MVAR (in)

Now consider this following alternate set of parameters values:

Main Generator	Main Transformer
20,020 volts	20,050 volts
60.0 Hz	59.9 Hz

If the alternate set of parameter values had existed just before the breaker was closed, the resulting main generator MW value would have been _____; and the resulting main generator MVAR (in) value would have been _____.

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

QUESTION: 23

Neutron moderation refers to a decrease in neutron_____; primarily due to _____.

A. population; neutron absorption by the control rods

B. population; neutron leakage at the core boundary

C. energy; scattering reactions in the fuel pellets

D. energy; scattering reactions in the reactor coolant

QUESTION: 24

Approximately 12 hours ago, a reactor scrammed from steady-state 100 percent power due to an instrument malfunction. All systems operated normally.

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

Xenon = ( ) 2.0 %ΔK/K
Fuel temperature = ( ) 2.5 %ΔK/K
Control rods = ( ) 14.0 %ΔK/K
Voids = ( ) 4.5 %ΔK/K

A. -5.0 %ΔK/K

B. -9.0 %ΔK/K

C. -14.0 %ΔK/K

D. -23.0 %ΔK/K

QUESTION: 25

A reactor is critical at a constant power level of 1.0×10^{-8} percent. Consider the following two cases:

Case 1: A step addition of positive 0.001 ΔK/K.
Case 2: A step addition of negative 0.001 ΔK/K.

Which case will produce the faster rate of power change one minute after the reactivity addition, and why?

A. Case 1, because the effective delayed neutron fraction is smaller during a power increase.

B. Case 1, because the effective delayed neutron precursor decay constant is larger during a power increase.

C. Case 2, because the effective delayed neutron fraction is smaller during a power decrease.

D. Case 2, because the effective delayed neutron precursor decay constant is larger during a power decrease.

QUESTION: 26

Which one of the following describes the change in the moderator temperature coefficient (MTC) of reactivity over core life while operating at a constant 100 percent power level?

A. MTC becomes less negative because as U-238 depletes, a 1°F increase in moderator temperature results in fewer neutrons escaping resonance capture.

B. MTC becomes less negative because as control rods are withdrawn from the core, the increase in the number of neutrons leaking from the core for a 1°F increase in moderator temperature decreases.

C. MTC becomes more negative because as U-235 depletes, a 1°F increase in moderator temperature permits more neutrons to leak out of the core.

D. MTC becomes more negative because as fission product poisons build up, the increase in the number of neutrons being absorbed by fission product poisons for a 1°F increase in moderator temperature increases.

QUESTION: 27

During a reactor power increase from steady-state 20 percent to steady-state 100 percent, the smallest addition of negative reactivity will be caused by the change in…

A. void content.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

QUESTION: 28

Initially, the following plant conditions exist during a reactor startup:

- Reactor power is stable at the point of adding heat.
- The main steam isolation valves are open.
- Reactor vessel pressure is stable at 600 psig.
- The steam bypass system pressure setpoint is 920 psig.

Then, two control rods are manually withdrawn a few notches. When the plant conditions stabilize, reactor power will be _____; and reactor vessel pressure will be _____. (Assume the reactor does <u>not</u> scram.)

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher

QUESTION: 29

If a control rod is being moved from position 16 to 22, it is being...

A. inserted 18 inches.

B. withdrawn 18 inches.

C. inserted 36 inches.

D. withdrawn 36 inches.

QUESTION: 30

A reactor scram occurred one hour ago following several months of operation at 100 percent power. Reactor vessel pressure is being maintained at 800 psia and the source range count rate is currently 400 cps. If no operator action is taken, how will the source range count rate respond during the next 24 hours? (Assume a constant source neutron flux.)

A. The count rate will remain about the same.

B. The count rate will decrease for the entire period.

C. Initially, the count rate will decrease, and then increase.

D. Initially, the count rate will increase, and then decrease.

QUESTION: 31

A reactor had been operating at 70 percent power for two weeks when power was increased to 100 percent over a two-hour period. To offset xenon-135 reactivity changes during the next 12 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, and then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, and then withdraw rods slowly.

QUESTION: 32

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

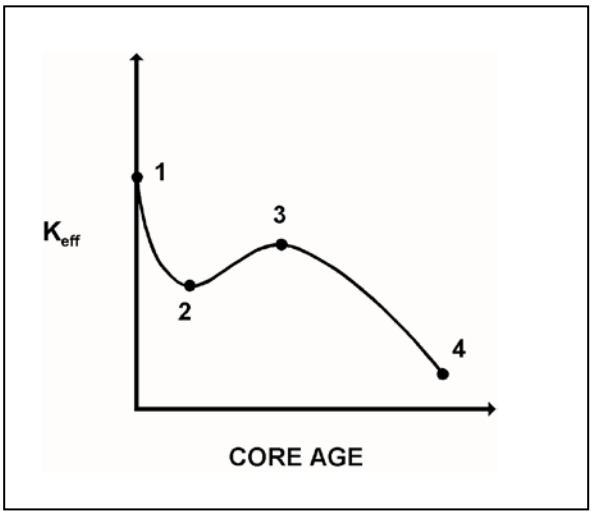
The major cause for the change in K_{eff} from point 1 to point 2 is the…

A. depletion of fuel.

B. burnout of burnable poisons.

C. initial heatup of the reactor.

D. buildup of fission product poisons.



QUESTION: 33

A refueling outage has just been completed, and a reactor startup is being commenced. Which one of the following lists the method(s) typically used to add positive reactivity during the approach to criticality?

A. Control rods only

B. Recirculation flow only

C. Control rods and recirculation flow

D. Recirculation flow and steaming rate

QUESTION; 34

A reactor has a stable positive 100-second period, with reactor power entering the intermediate range. Assuming no operator action, which one of the following describes the future response of reactor period? (Ignore any changes in fission product poison reactivity.)

A. Prior to reaching the point of adding heat, the fuel temperature increase will add negative reactivity and reactor period will approach infinity.

B. When heat production in the reactor exceeds ambient heat losses, the temperature of the fuel and moderator will increase, adding negative reactivity, and reactor period will approach infinity.

C. The heat produced by the reactor when operating in the intermediate range is insufficient to raise the fuel or moderator temperatures, and reactor period will remain nearly constant throughout the entire intermediate range.

D. When heat production in the reactor exceeds ambient losses, positive reactivity from a fuel temperature increase will offset the negative reactivity from a moderator temperature increase, and reactor period will remain nearly constant throughout the entire intermediate range.

QUESTION: 35

Initially, a nuclear power plant is operating at steady-state 85 percent power when a failure of the turbine control system partially closes the turbine control valves, which reduces the main steam mass flow rate to the main turbine by 10 percent.

Given:

- No operator actions are taken.
- No protective system actuations occur.
- The turbine control valves remain in their failed positions.
- The turbine bypass valves remain closed.

In response to the turbine control system failure, reactor power will initially…

A. decrease, and then stabilize at a critical power level above the point of adding heat.

B. decrease, and then stabilize at a critical power level below the point of adding heat.

C. increase, and then decrease and stabilize at a critical power level above the point of adding heat.

D. increase, and then decrease and stabilize at a critical power level below the point of adding heat.

QUESTION: 36

A nuclear power plant is operating at steady-state 100 percent power. If a recirculation pump trips, which one of the following reactivity coefficients will cause the initial change in reactor power?

A. Void coefficient

B. Pressure coefficient

C. Moderator temperature coefficient

D. Fuel temperature (Doppler) coefficient

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.

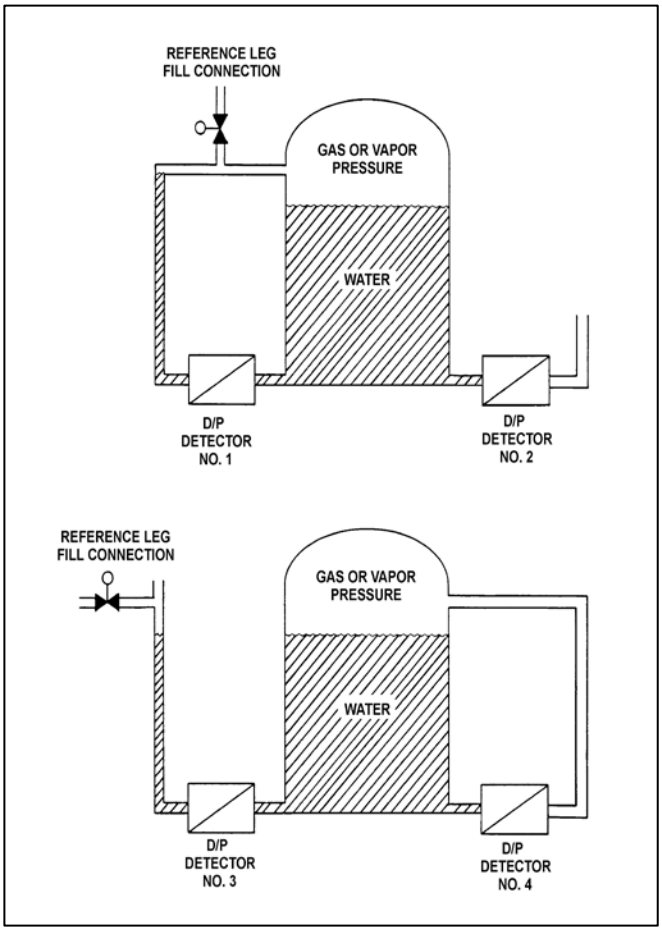
If each detector experiences a ruptured diaphragm, which detector(s) will produce a reduced level indication? (Assume that actual tank and reference leg water levels do <u>not</u> change.)

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 fluid outlet enthalpy greater than the fluid inlet enthalpy? (Assume horizontal fluid flow in each process.)

(A) Cooling water flowing through a fixed convergent nozzle.
(B) Cooling water flowing through an operating lube oil heat exchanger.

A. (A) only

B. (B) only

C. Both (A) and (B)

D. Neither (A) nor (B)

QUESTION: 39

Three days ago, a nuclear power plant experienced a sustained loss of all AC electrical power, which disabled the normal means of heat removal from the spent fuel pool. Currently, there is turbulent boiling occurring throughout the spent fuel pool. A fire truck is being used to supply pure makeup water at 70°F to maintain the spent fuel pool water level.

For simplification of calculations, assume the following:

- The spent fuel pool contains pure water.
- All steam leaving the surface of the spent fuel pool is dry saturated steam at 15.0 psia.

Approximately how much heat is each pound-mass of makeup water removing from the spent fuel pool?

A. 143 Btu

B. 970 Btu

C. 1,113 Btu

D. 1,151 Btu

QUESTION: 40

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation with steam reaching supersonic velocities.

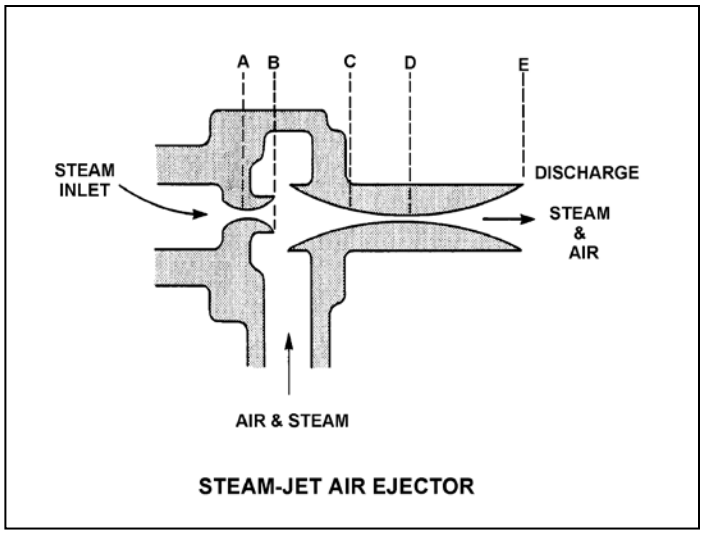
Steam flowing from D to E undergoes a pressure _____ and a velocity _____.

A. decrease; decrease

B. decrease; increase

C. increase; increase

D. increase; decrease



STEAM-JET AIR EJECTOR

QUESTION: 41

Initially, a main turbine is being supplied with inlet steam containing 0.25 percent moisture content. If the inlet steam moisture content increases to 0.5 percent at the same pressure and mass flow rate, the main turbine work output will…

A. increase, due to the increased enthalpy of the inlet steam.

B. increase, due to the increased momentum transfer from water droplets impacting the turbine blading.

C. decrease, due to the decreased temperature of the inlet steam.

D. decrease, due to the increased braking action from water droplets impacting the turbine blading.

QUESTION: 42

Initially, two identical centrifugal pumps were operating in parallel in a closed system when one pump tripped.

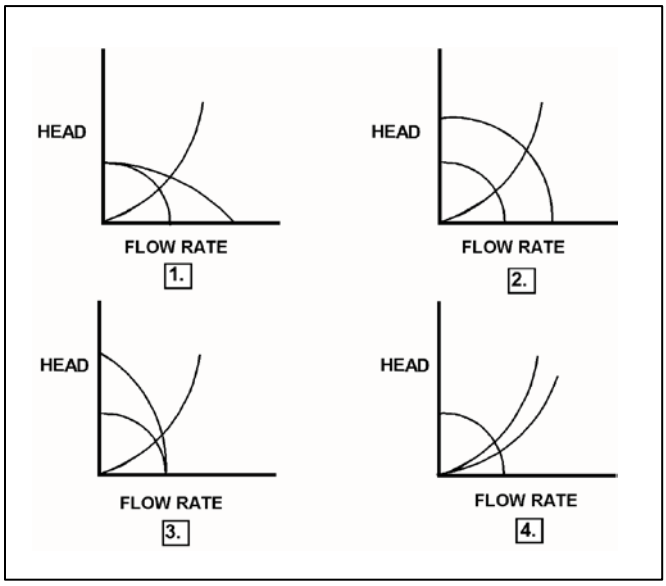
Which set of operating curves shown below depicts the steady-state "before and after" conditions described above?

A. 1.

B. 2.

C. 3.

D. 4.



QUESTION: 43

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

High pressure coolant injection (HPCI) pumps = 1,200 psia
Low pressure coolant injection (LPCI) pumps = 200 psia

If the injection pumps continue operating under these conditions, which pumps are more likely to fail, and why?

A. LPCI pumps, due to pump overheating.

B. LPCI pumps, due to motor overheating.

C. HPCI pumps, due to pump overheating.

D. HPCI pumps, due to motor overheating.

QUESTION: 44

The power range nuclear instruments have been adjusted to 100 percent based on a calculated heat balance. Which one of the following will result in indicated reactor power being <u>lower</u> 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 value used in the heat balance was 10 percent lower than actual reactor recirculation pump heat input.

C. The feedwater flow rate used in the heat balance calculation was 10 percent higher than actual feedwater flow rate.

D. The operator miscalculated the enthalpy of the steam exiting the reactor vessel to be 10 Btu/lbm higher than actual.

QUESTION: 45

Void fraction is the ratio of the _____ of steam to the _____ of steam-water mixture at a given elevation in a fuel channel.

A. volume; mass

B. mass; mass

C. volume; volume

D. mass; volume

QUESTION: 46

Reactors A and B are operating at steady-state 100 percent power. The reactors are identical except that reactor A uses the standard core orifice design while reactor B uses equal-sized flow openings for all fuel bundles. Both reactors have the same power distribution and core mass flow rate.

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: 47

The ratio of the highest fuel pin heat flux in a node to the average fuel pin heat flux in the same node is called the _____ peaking factor.

A. local

B. radial

C. axial

D. total

QUESTION: 48

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

Given the following initial stable parameters:

LHGR = 6 kW/ft
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 1,250°F

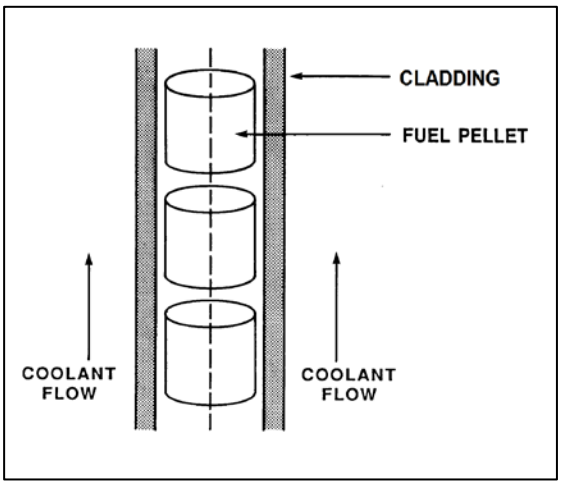
What will the stable fuel centerline temperature ($T_{fuel\ centerline}$) be if the fuel rod's linear heat generation rate (LHGR) increases to 9 kW/ft? (Assume the total heat transfer coefficient and $T_{coolant}$ do not change.)

A. 1,600°F

B. 1,875°F

C. 2,425°F

D. 2,700°F



QUESTION: 49

Initially, a reactor was operating at steady-state 100 percent power with a top-peaked axial power distribution. Reactor power was reduced, and a control rod pattern exchange was completed to establish a bottom-peaked axial power distribution. Reactor power was returned to 100 percent and is currently at steady-state.

Compared to the initial (top-peaked) critical power for a typical fuel bundle, the current (bottom-peaked) critical power is…

A. higher, because the highest linear heat generation rate is occurring in the region of the fuel bundle with the highest mass flow rate of coolant.

B. higher, because the greatest coolant enthalpy rise is occurring in the region of the fuel bundle that contains subcooled or low-quality coolant.

C. lower, because the highest linear heat generation rate is occurring in the region of the fuel bundle with the highest mass flow rate of coolant.

D. lower, because the greatest coolant enthalpy rise is occurring in the region of the fuel bundle that contains subcooled or low-quality coolant.

QUESTION: 50

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. A high fast neutron flux in the reactor rather than a high gamma flux.

B. A high material ductility of the reactor vessel rather than a high material strength.

C. A rapid 100°F reactor heatup at a high temperature rather than at a low temperature.

D. A rapid 100°F reactor cooldown at a high temperature rather than at a low temperature.

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

MARCH 2019 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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