UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
DECEMBER 2016 – 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)

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

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

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

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

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

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

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

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

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

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

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

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

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

Inlet pressure = 58 psia
Outlet pressure = 46 psia
Flow rate = 1,000 gpm

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

A. The throttle valve was closed more.

B. The throttle valve was opened more.

C. Another valve, located upstream of the throttle valve, was opened more.

D. Another valve, located downstream of the throttle valve, was opened more.

QUESTION: 2

A completely full water tank is being hydrostatically tested to 180 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 6 gpm. The tank is protected by two relief valves that discharge to the atmosphere. The relief valves have the following characteristics:

- Relief valve A opening setpoint is 180 psig with an accumulation of 5 percent.
- Relief valve B opening setpoint is 200 psig with an accumulation of 5 percent.
- Each relief valve has linear flow rate characteristics and a maximum flow rate of 4 gpm.

The PDP is inadvertently left running when tank pressure reaches 180 psig.

With the PDP still running, at what pressure will the tank stabilize?

A. 190 psig

B. 195 psig

C. 205 psig

D. 210 psig

QUESTION: 3

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

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

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

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

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

QUESTION: 4

A bourdon-tube pressure detector was indicating 50 percent of scale when it was suddenly exposed to a high pressure transient that caused permanent strain to the bourdon tube. The detector remained intact and actual pressure was restored to its original value.

During the pressure transient, the affected pressure indication initially went off-scale high. After the original pressure was restored, the indication was...

A. unpredictable.

B. less than 50 percent of scale.

C. 50 percent of scale.

D. greater than 50 percent of scale.

QUESTION: 5

When comparing a resistance temperature detector (RTD) to a thermocouple, the RTD is unique because only the RTD…

A. has a measuring junction made from two metals or alloys.

B. has a characteristic that varies almost linearly with temperature.

C. requires a power supply to produce a voltage that represents the measured temperature.

D. requires a known reference temperature to ensure accuracy of the temperature indication.

QUESTION: 6

Refer to the simplified drawing of a control rod position detector circuit (see figure below).

A magnet on the control rod extension (or drive) shaft sequentially closes individual reed switches mounted vertically adjacent to the control rod drive housing. A constant +5 DC volts is supplied to the input of the resistor network at resistor R_1.

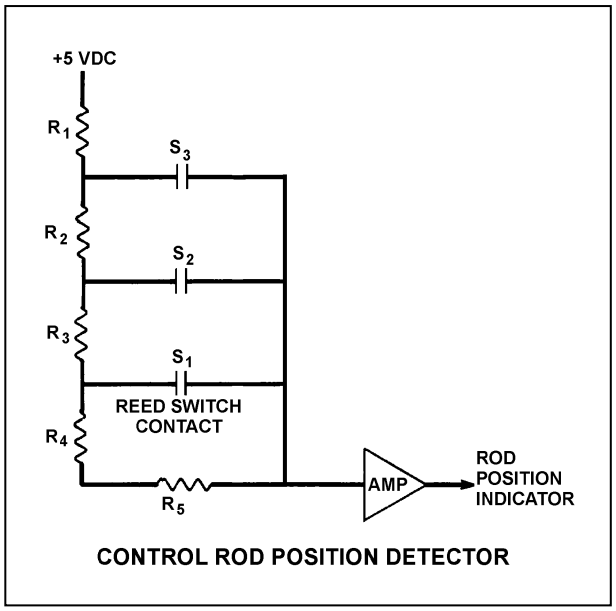
A control rod is initially fully inserted such that all reed switch contacts are open; then the rod is withdrawn until reed switch contact S_1 is closed. Compared to the initial circuit currents, the current through resistor R_5 after the rod withdrawal will be _____; and the output current of the resistor network to the amplifier will be _____.

A. lower; higher

B. lower; lower

C. higher; higher

D. higher; lower



CONTROL ROD POSITION DETECTOR

QUESTION: 7

A Geiger-Mueller detector with a "pancake" probe is being used to monitor workers leaving a radiologically controlled area for contamination. The probe is sensitive to alpha, beta, and gamma radiation. The background count rate is 20 cpm. As one worker's shoe is scanned, the count rate increases to 1,000 cpm.

Given the following separate actions:

- When a sheet of paper is placed between the probe and the shoe, the count rate decreases to 600 cpm.
- When a sheet of aluminum foil is placed between the probe and the shoe, the count rate decreases to 600 cpm.

Which one of the following describes the type(s) of radiation being emitted by the contamination?

A. Beta only

B. Alpha only

C. Beta and gamma

D. Alpha and gamma

QUESTION: 8

Refer to the drawing of a water storage tank and level control system (see figure below) that have 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 operating air pressure is lost.
- The level control system uses a direct-acting proportional-integral level controller with a setpoint of 15 feet.
- The level controller is currently in manual control, with an operator maintaining the tank water level at 14 feet.
- Tank inlet and outlet flow rates are currently equal with the drain valve 50 percent open.

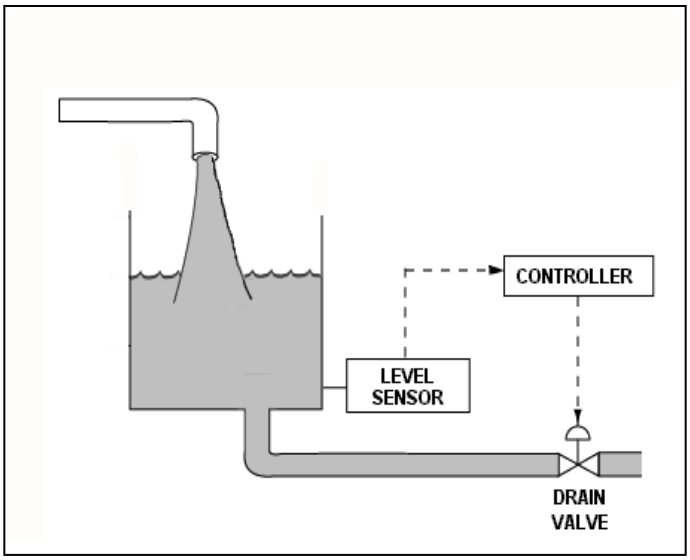
If the level controller is shifted to automatic control, the tank water level will…

A. increase and stabilize at 15 feet.

B. increase and stabilize slightly higher than 15 feet.

C. decrease until the tank nearly empties.

D. increase until the tank overflows.



QUESTION: 9

An outside water storage tank is equipped with submerged heaters. The heaters energize at minimum power when water temperature decreases to 48°F. If water temperature continues to decrease, heater power will increase directly with the temperature deviation from 48°F until maximum power is reached at 40°F. If water temperature decreases faster than 1°F/min, the heaters will reach maximum power at a higher water temperature.

Which one of the following types of control is used in the heater control circuit to produce these characteristics?

A. Proportional only

B. Proportional plus integral

C. Proportional plus derivative

D. Proportional plus integral plus derivative

QUESTION: 10

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: 11

A flow-limiting venturi in the discharge piping of a centrifugal pump decreases the potential for the pump to experience...

A. runout.

B. reverse flow.

C. shutoff head.

D. water hammer.

QUESTION: 12

A centrifugal firewater pump is operating to pressurize a fire main. The pump takes suction from a vented water storage tank. 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 30 feet below the tank 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 tank 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. 106 feet

B. 121 feet

C. 136 feet

D. 151 feet

QUESTION: 13

Refer to the drawing of operating curves for a positive displacement pump in a closed water system (see figure below).

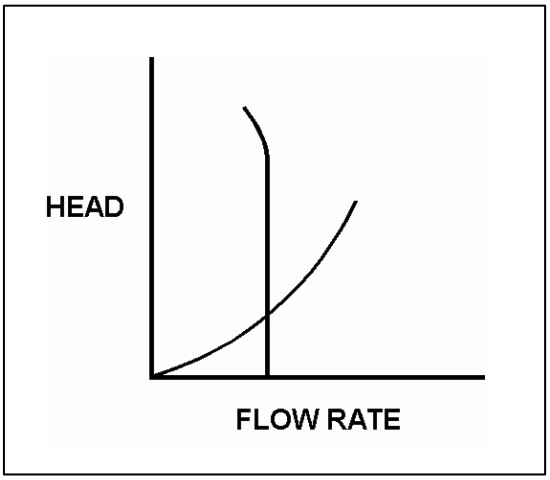
Which one of the following describes the value of the pump head where the two curves cross?

A. The amount of pump head produced at zero flow rate.

B. The amount of pump head required to avoid cavitation.

C. The amount of pump head needed to maintain the system flow rate.

D. The amount of pump head converted to kinetic energy in the pump.



QUESTION: 14

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: 15

What is the significance of a 0.8 power factor when describing the output of a generator?

A. 80 percent of the generator output is being converted to useful power.

B. 80 percent of the generator output is being used by reactive loads.

C. The generator is operating at 80 percent of its maximum rated output.

D. The generator is 80 percent efficient at converting mechanical power to electrical power.

QUESTION: 16

A main turbine-generator was operating at 80 percent load with the following initial steady-state lube oil and cooling water temperatures for the main turbine lube oil heat exchanger:

$T_{oil\ in}$ = 174°F
$T_{oil\ out}$ = 114°F
$T_{water\ in}$ = 85°F
$T_{water\ out}$ = 115°F

Six months later, the following current steady-state heat exchanger temperatures are observed:

$T_{oil\ in}$ = 177°F
$T_{oil\ out}$ = 111°F
$T_{water\ in}$ = 85°F
$T_{water\ out}$ = 115°F

Assume the lube oil system is a closed system. Also, assume the following did not change:

- Cooling water mass flow rate
- Cooling water and lube oil specific heats
- Heat exchanger heat transfer coefficient

Which one of the following could be responsible for the differences between the initial and current steady-state heat exchanger temperatures?

A. The current main turbine-generator load is lower than the initial load.

B. The current main turbine-generator load is higher than the initial load.

C. The current main turbine lube oil mass flow rate is less than the initial flow rate.

D. The current main turbine lube oil mass flow rate is greater than the initial flow rate.

QUESTION: 17

What is the reason for ensuring that a piping system is completely filled and vented prior to initiating system flow?

A. To minimize the system head losses.

B. To minimize the potential for water hammer.

C. To preclude a reduction in the overall system heat transfer coefficient.

D. To ensure all noncondensible gases are removed from the piping system to reduce system corrosion.

QUESTION: 18

A nuclear power plant was initially operating at steady-state 50 percent power with 50 gpm of main condenser cooling water inleakage through a cooling water tube rupture. Power was then increased, and is currently stable at 60 percent.

Assume the size of the cooling water tube rupture does not change, and the main condenser cooling water inlet pressure and inlet temperature do not change.

When compared to the flow rate of main condenser cooling water inleakage at 50 percent power, the flow rate of cooling water inleakage at 60 percent power is _____ because the main condenser pressure at 60 percent power is _____.

A. lower; higher

B. lower; lower

C. higher; higher

D. higher; lower

QUESTION: 19

How does demineralizer differential pressure indicate the condition of a demineralizer resin bed?

A. High differential pressure indicates flow blockage in the demineralizer.

B. High differential pressure indicates that the demineralizer resin bed is exhausted.

C. Low differential pressure indicates flow blockage in the demineralizer.

D. Low differential pressure indicates that the demineralizer resin bed is exhausted.

QUESTION: 20

Mixed-bed demineralizer 1A was removed from service after it became saturated with sodium (Na^+) ions while processing condensate with 10 times the normal sodium concentration. Alternate mixed-bed demineralizer 1B has restored the condensate sodium concentration to normal. Demineralizer 1A has <u>not</u> been processed in any way since being removed from service.

If demineralizer 1A is returned to service to replace demineralizer 1B, the downstream condensate system sodium concentration will...

A. remain the same, because demineralizer 1A can <u>no</u> longer remove <u>any</u> anions from the condensate.

B. remain the same, because demineralizer 1A can <u>no</u> longer remove <u>any</u> cations from the condensate.

C. increase, <u>only</u> due to the water volume contained in demineralizer 1A mixing with the condensate influent.

D. increase, due to <u>both</u> the water volume contained in demineralizer 1A mixing with the condensate influent <u>and</u> the release of sodium ions from the resin.

QUESTION: 21

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

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

Based on these indications, the operator can accurately report that the breaker is open and racked to _____ position.

A. the OUT

B. the IN

C. the TEST

D. an unknown

QUESTION: 22

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

Generator frequency = 59.9 Hz
Grid frequency = 60.1 Hz
Generator voltage = 114.8 KV
Grid voltage = 115.1 KV

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

A. acquire real load and reactive load.

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

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

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

QUESTION: 23

Which one of the following accounts for the majority of energy transfer from a fission neutron while slowing down in a moderator?

A. Collisions with the nuclei in the moderator.

B. Collisions with the electrons in the moderator.

C. Interactions with the electric fields of the nuclei in the moderator.

D. Interactions with the electric fields of the electrons in the moderator.

QUESTION: 24

A nuclear power plant has just completed a refueling outage. Based on the expected core loading, reactor engineers have predicted a control rod configuration at which the reactor will become critical during the initial reactor startup following the refueling outage. However, the burnable poisons scheduled to be loaded were inadvertently omitted.

Which one of the following describes the effect of the burnable poison omission on achieving reactor criticality during the initial reactor startup following the refueling outage?

A. The reactor will become critical before the predicted critical control rod configuration is achieved.

B. The reactor will become critical after the predicted critical control rod configuration is achieved.

C. The reactor will be unable to achieve criticality because the fuel assemblies contain insufficient positive reactivity to make the reactor critical.

D. The reactor will be unable to achieve criticality because the control rods contain insufficient positive reactivity to make the reactor critical.

QUESTION: 25

Two identical reactors, A and B, with identical fuel compositions, are initially critical at 1.0×10^{-8} percent power. Then, suddenly and simultaneously, positive 0.001 ΔK/K is added to reactor A while negative 0.001 ΔK/K is added to reactor B.

One minute later, which reactor will have the shorter period, and why? (Note: λ_{eff} is the effective delayed neutron precursor decay constant.)

A. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is positive.

B. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is positive.

C. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is negative.

D. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is negative.

QUESTION: 26

A reactor is shut down near the end of a fuel cycle with the shutdown cooling system in service. The initial reactor vessel water temperature is 100°F. In this condition, the reactor is overmoderated.

Then, a heatup and pressurization is performed to bring the reactor to normal operating temperature and pressure. The reactor remains subcritical.

During the heatup, K_{eff} will…

A. decrease continuously.

B. increase continuously.

C. initially decrease, and then increase.

D. initially increase, and then decrease.

QUESTION: 27

A reactor has an initial effective fuel temperature of 800EF. If the effective fuel temperature increases to 1,000EF, the fuel temperature coefficient will become _____ negative; because at higher effective fuel temperatures, a 1EF increase in effective fuel temperature produces a _____ change in Doppler broadening.

A. less; greater

B. less; smaller

C. more; greater

D. more; smaller

QUESTION: 28

A reactor has been shut down for three weeks with all control rods fully inserted. If a center control rod is fully withdrawn from the core, neutron flux level will… (Assume the reactor remains subcritical.)

A. remain the same.

B. increase and stabilize at a new higher level.

C. increase temporarily then return to the original level.

D. increase exponentially until the operator reinserts the center control rod.

QUESTION: 29

If the void fraction surrounding several centrally located fuel bundles increases, the worth of the associated control rods will...

A. decrease, because the average neutron energy in the fuel bundles will decrease, resulting in fewer neutrons traveling from within the fuel bundles to the affected control rods.

B. decrease, because more neutrons will be resonantly absorbed in the fuel while they are slowing down, resulting in fewer thermal neutrons available to be absorbed by the affected control rods.

C. increase, because the diffusion length of the thermal neutrons will increase, resulting in more thermal neutrons traveling from within the fuel bundles to the affected control rods.

D. increase, because neutrons will experience a longer slowing down length, resulting in a smaller fraction of thermal neutrons being absorbed by the fuel and more thermal neutrons available to be absorbed by the affected control rods.

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. The count rate will initially decrease and then increase.

D. The count rate will initially 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).

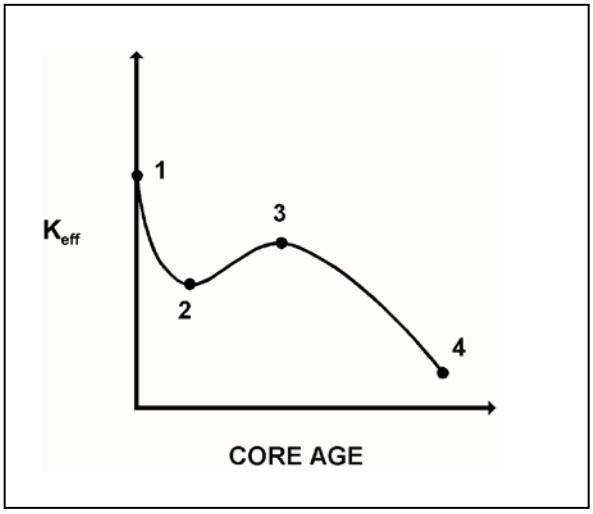
The major cause for the change in K_{eff} from point 2 to point 3 is the...

A. depletion of fuel.

B. depletion of control rods.

C. burnout of burnable poisons.

D. burnout of fission product poisons.



QUESTION: 33

The following data was obtained under stable conditions during a reactor startup:

Control Rod Position (units withdrawn)	Source Range Count Rate (cps)
10	360
15	400
20	450
25	514
30	600
35	720
40	900

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

A. 50 units withdrawn

B. 60 units withdrawn

C. 70 units withdrawn

D. 80 units withdrawn

QUESTION: 34

A reactor is critical near the end of a fuel cycle with power level stable at 1.0×10^{-10} percent. Which one of the following is the smallest listed amount of positive reactivity that is capable of increasing reactor power level to the point of adding heat?

A. 0.001 %ΔK/K

B. 0.003 %ΔK/K

C. 0.005 %ΔK/K

D. 0.007 %ΔK/K

QUESTION: 35

A reactor is initially critical just below the point of adding heat when a small amount of negative reactivity is added to the reactor. If the same amount of positive reactivity is added to the reactor approximately 5 minutes later, reactor power will...

A. stabilize at the initial power level.

B. stabilize at the point of adding heat.

C. stabilize at a critical power level below the initial power level.

D. decrease on a negative 80-second period until it stabilizes at a power level determined by the source neutron flux.

QUESTION: 36

A reactor is operating at steady-state 60 percent power in the middle of a fuel cycle when, suddenly, one main turbine bypass valve fails open and remains open. The operator immediately verifies that no control rod motion is occurring and takes no further action.

In addition,

- The reactor vessel water level remains stable.
- The automatic pressure control system returns reactor pressure to its initial value.
- The reactor does not scram and no other protective actions occur.

In response to the main turbine bypass valve failure, reactor power will…

A. decrease, and then stabilize at a lower power level.

B. increase, and then stabilize at a higher power level.

C. decrease, and then increase and stabilize near the initial power level.

D. increase, and then decrease and stabilize near the initial power level.

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 and are being maintained at 2 psig overpressure, 60°F, and the same constant water level. The tanks are located within a sealed containment structure that is being maintained at standard atmospheric pressure. All level detectors have been calibrated and are producing the same level indication.

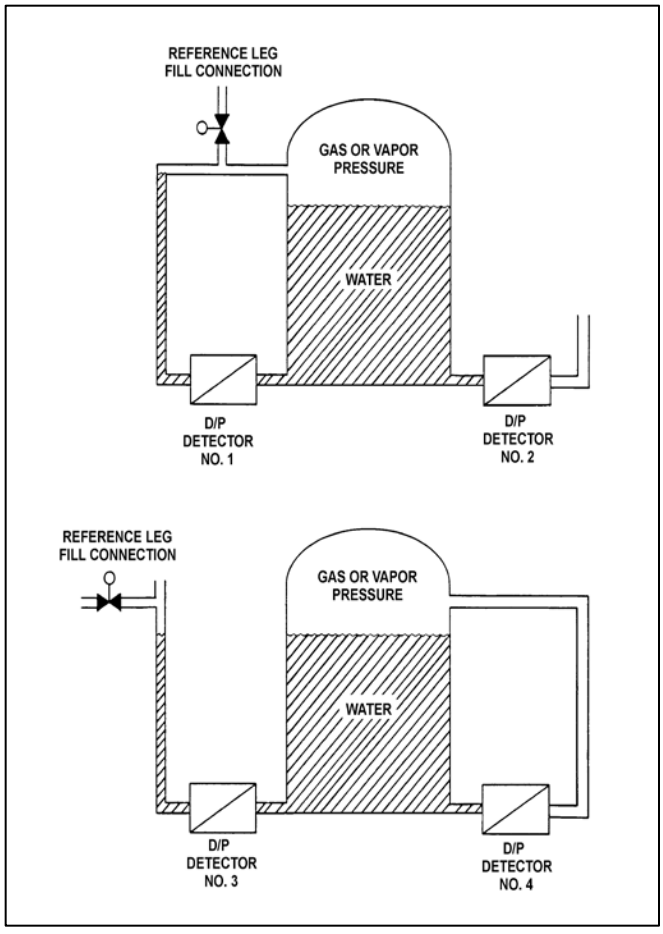
If a ventilation malfunction causes the containment structure pressure to decrease to 13 psia, which detectors will produce the highest level indications?

A. 1 and 2

B. 3 and 4

C. 1 and 4

D. 2 and 3



QUESTION: 38

The temperature of a saturated steam-water mixture is 467°F.

Which one of the following parameter values, when paired with the temperature, provides insufficient information to determine the quality of the mixture?

A. Pressure is 499.96 psia.

B. Enthalpy is 977.33 Btu/lbm.

C. Entropy is 1.17 Btu/lbm -°R.

D. Specific volume is 0.817 ft^3/lbm.

QUESTION: 39

Steam entering an air ejector reaches sonic velocity in the throat of a convergent-divergent nozzle. Upon entering the divergent section of the nozzle, steam velocity will _____ and steam pressure will _____.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

QUESTION: 40

A nuclear power plant is operating at 80 percent power with 10°F of condensate subcooling. Which one of the following will initially increase the steam cycle thermal efficiency? (Assume main condenser vacuum does not change unless stated otherwise.)

A. Isolating extraction steam to a feedwater heater.

B. Decreasing main condenser cooling water flow rate.

C. Decreasing main condenser cooling water inlet temperature.

D. Decreasing main condenser vacuum (increasing pressure).

QUESTION: 41

Which one of the following will result in a higher probability and/or severity of water hammer in a flowing water system?

A. Gradual pipe bends rather than sharp pipe bends.

B. Shorter pipe lengths rather than longer pipe lengths.

C. Lower initial flow rates rather than higher initial flow rates.

D. Shorter valve stroke times rather than longer valve stroke times.

QUESTION: 42

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

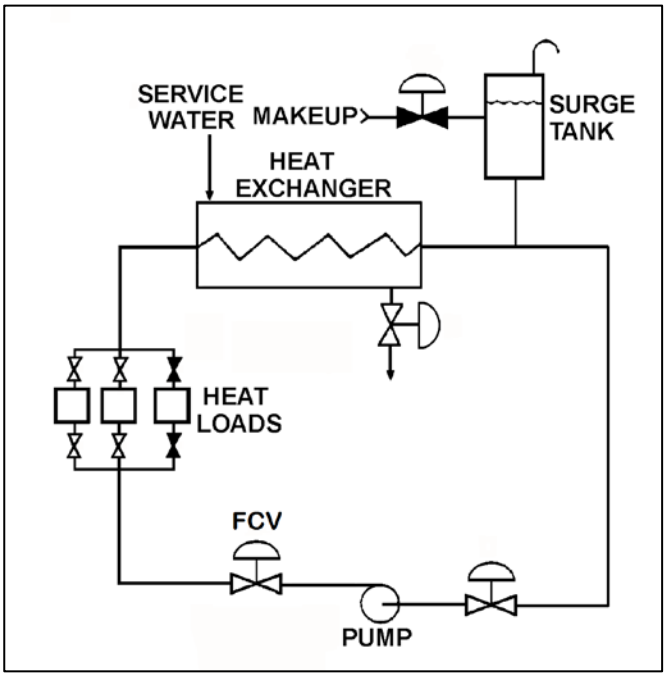
The pump is initially operating with the flow control valve (FCV) fully open. If the FCV is partially closed to decrease system flow rate, the pump differential pressure will _____; and the heat exchanger cooling water differential pressure will _____.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease



QUESTION: 43

A reactor is operating with the following parameters:

Feedwater inlet temperature = 400°F
Feedwater mass flow rate = 6.0×10^6 lbm/hr
Reactor outlet steam pressure = 960 psia
Reactor outlet steam quality = 100 percent

What is the approximate thermal power output of the reactor in megawatts (MW)?

A. 660 MW

B. 1,157 MW

C. 1,441 MW

D. 2,101 MW

QUESTION: 44

A nuclear power plant is currently shut down after several months of operation at 100 percent power. The shutdown cooling system is in operation, maintaining an average reactor coolant temperature of 280°F. A pressure control malfunction causes reactor coolant pressure to slowly and continuously decrease from 100 psia while reactor coolant temperature remains constant.

Which one of the following describes the location where nucleate boiling will <u>first</u> occur?

A. At a scratch on the surface of a fuel rod near the top of a fuel assembly.

B. At a scratch on the surface of a fuel rod near the bottom of a fuel assembly.

C. In the bulk fluid of a coolant channel near the top of a fuel assembly.

D. In the bulk fluid of a coolant channel near the bottom of a fuel assembly.

QUESTION: 45

Which one of the following describes the relationship between the feedwater mass flow rate entering the reactor vessel and the core mass flow rate at steady-state 100 percent reactor power?

A. The mass flow rates are about the same as long as the reactor vessel downcomer level is constant.

B. The mass flow rates are about the same as long as the reactor recirculation mass flow rate is constant.

C. The feedwater mass flow rate is much larger than the core mass flow rate because the feedwater pump differential pressure is much larger than the core differential pressure.

D. The feedwater mass flow rate is much smaller than the core mass flow rate because most of the core mass flow is returned to the reactor vessel downcomer by the steam separators.

QUESTION: 46

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

Given:

- Pressure at P_1 is 34 psig.
- Pressure at P_2 is 20 psig.
- Pressure change due to change in velocity is 2 psig.
- Pressure change due to change in elevation is 8 psig.

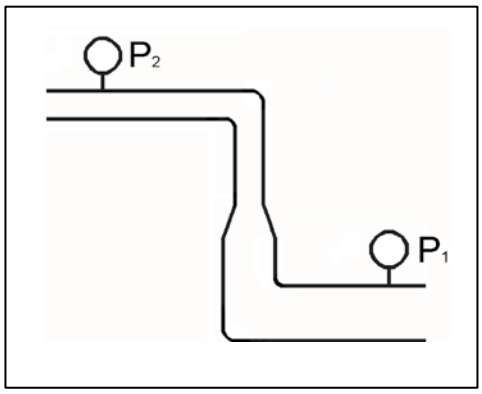
The pressure decrease due to friction head loss between P_1 and P_2 is _____; and the direction of flow is from _____.

A. 2 psig; left to right

B. 2 psig; right to left

C. 4 psig; left to right

D. 4 psig; right to left



QUESTION: 47

A reactor is initially operating at steady-state 80 percent power with the radial power distribution peaked in the center of the core. Reactor power is then decreased to 60 percent over the next two hours by (1) reducing reactor recirculation flow rate by 10 percent, and (2) partially inserting a group of centrally-located deep control rods.

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

A. smaller; recirculation flow rate

B. smaller; control rod position

C. larger; recirculation flow rate

D. larger; control rod position

QUESTION: 48

If a reactor is operating above its maximum average planar linear heat generation rate (MAPLHGR) prior to a loss of coolant accident, fuel pellet centerline temperature may reach 4,200°F and fuel cladding temperature may reach 2,300°F during the accident.

Which one of the following describes the likely cladding failure mechanism if the above temperatures are reached?

A. Excessive fuel pellet expansion.

B. Excessive plastic strain in the cladding.

C. Excessive embrittlement of the cladding.

D. Excessive cadmium and iodine attack on the cladding.

QUESTION: 49

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel rod at the beginning of a fuel cycle (BOC) compared to the end of a fuel cycle (EOC)?

A. Smaller at BOC, due to a larger gap between the fuel pellets and cladding.

B. Smaller at BOC, due to a smaller corrosion film on the surface of the fuel rods.

C. Greater at BOC, due to a higher fuel pellet density.

D. Greater at BOC, due to lower contamination of fuel rod fill gas with fission product gases.

QUESTION: 50

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

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

A. Reactor A, due to the lower average capacity factor.

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

C. Reactor B, due to the higher average capacity factor.

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

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

DECEMBER 2016 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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