UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
SEPTEMBER 2013--FORM A

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____   Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item.   Each test item has equal point value.   A score of at least 80 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.

_____

Applicant'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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

$DRW \propto \varphi_{tip}^2 / \varphi_{avg}^2$

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

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

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

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

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

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

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

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

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

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

Thermal Efficiency $=$ Net Work Out/Energy In

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

$g = 32.2$ ft/sec^2

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

CONVERSIONS

- -

1 MW $= 3.41 \times 10^6$ Btu/hr	$^\circ C = (5/9)(^\circ F - 32)$	1 ft$^3_{water}$ $= 7.48$ gal
1 hp $= 2.54 \times 10^3$ Btu/hr	$^\circ F = (9/5)(^\circ C) + 32$	1 gal$_{water}$ $= 8.35$ lbm
1 Btu $= 778$ ft-lbf	1 kg $= 2.21$ lbm	1 Curie $= 3.7 \times 10^{10}$ dps

QUESTION: 1

A completely full water storage tank is being hydrostatically tested to 200 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 4 gpm. The tank is protected by a relief valve that discharges to the atmosphere. The relief valve has the following characteristics:

- The opening setpoint is 200 psig with an accumulation of 5 percent.
- The valve has linear flow characteristics and a maximum rated flow rate of 8 gpm.

The PDP is inadvertently left running when tank pressure reaches 200 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: 2

To verify a manual valve in an operating system is <u>closed</u>, the operator should observe valve position indication and operate the valve handwheel in the...

A. open direction at least one full rotation, then close the valve using normal force.

B. open direction until system flow is observed, then close the valve using normal force.

C. close direction using normal force and verify there is no substantial handwheel movement.

D. close direction using normal force, then operate the valve handwheel an additional one-quarter turn in the close direction.

QUESTION: 3

A typical motor-operated valve has been returned to service following a complete maintenance overhaul of the valve and actuator. The valve was remotely opened and closed to verify operability. The measured valve stroke time in each direction was 15 seconds, which is 25 percent longer than normal.

Which one of the following could have caused the increased stroke time?

A. The valve position limit switches were removed and were <u>not</u> reinstalled.

B. The valve torque limit switches were misadjusted to open at half their normal setpoints.

C. The valve was packed with improved packing material having a lower friction coefficient.

D. The valve stem packing gland was overtightened after the packing material was replaced.

QUESTION: 4

A reactor is currently shut down at 180°F. Reactor vessel (RV) level is being monitored using a differential pressure detector with a wet reference leg. The RV level instrument was calibrated at normal plant operating conditions.

The RV level instrument currently indicates _____ than actual RV level because, compared to the calibration conditions, there has been a significant change in the density of the fluid in the _____.

A. higher; reactor vessel

B. higher; reference leg

C. lower; reactor vessel

D. lower; reference leg

QUESTION: 5

Which one of the following parameters requires square root compensation when measured by a differential pressure detector?

A. Reactor vessel level

B. Condenser vacuum

C. Reactor vessel pressure

D. Recirculation pump flow rate

QUESTION: 6

For proper operation of a thermocouple circuit, the reference junction temperature…

A. must be less than the measuring junction temperature.

B. must be greater than the measuring junction temperature.

C. may be less than or greater than, but <u>not</u> equal to, the measuring junction temperature.

D. may be less than, greater than, or equal to the measuring junction temperature.

QUESTION: 7

A proportional detector with pulse height discrimination circuitry is being used in a constant field of neutron and gamma radiation to provide source range neutron count rate indication. Assume the pulse height discrimination value does <u>not</u> change.

If the detector voltage is decreased significantly, but maintained within the proportional region, the detector count rate indication will _____; and the detector will become _____ susceptible to the positive space charge effect.

A. decrease; less

B. decrease; more

C. remain the same; less

D. remain the same: more

QUESTION: 8

The level in a water collection tank is being controlled by an automatic level controller that positions a tank drain valve. Tank level is initially stable at the controller setpoint. Then, flow rate into the tank increases, slowly at first, and then faster until a stable flow rate is attained.

When tank level increases, the controller begins to open the tank drain valve farther. The level controller output signal increases both as the tank level increases and as the rate of tank level change quickens. After a few minutes, a new stable tank level above the original level is established, with the drain flow rate equal to the supply flow rate.

The controller in this system uses _____ control.

A. proportional only

B. proportional plus integral

C. proportional plus derivative

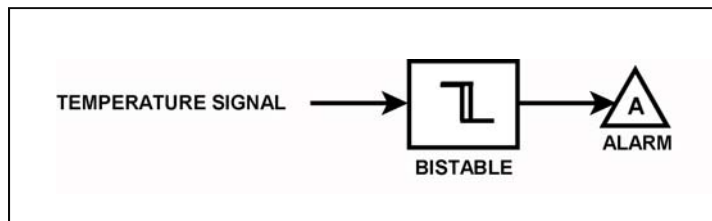D. proportional plus integral plus derivative

QUESTION: 9

Refer to the drawing of a temperature 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 temperature of 130°F. The bistable has a 5°F deadband, or neutral zone.

If the current temperature is 150°F, which one of the following describes the alarm circuit response as temperature slowly decreases to 110°F?

A. The alarm is currently actuated and will <u>not</u> turn off.

B. The alarm will actuate at 130°F and will <u>not</u> turn off.

C. The alarm is currently actuated and will turn off at 125°F.

D. The alarm will actuate at 130°F and will turn off at 125°F.

QUESTION: 10

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

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

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

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

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

QUESTION: 11

A centrifugal pump is used to provide makeup water to a vented storage tank that is 30 feet high. The pump is located at the base of the tank. The pump can be aligned to fill the tank via a top connection or a bottom connection using piping of equal lengths and diameters. The tank is currently half full.

With the pump in operation, the pump will have the lowest initial discharge pressure if the pump is aligned to fill the tank via the _____ connection; and the tank will require the longest amount of time to become completely full if the pump is aligned to fill the tank via the _____ connection.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

QUESTION: 12

A centrifugal pump in a cooling water system is operating with a motor current of 200 amps. After several hours, the system water density has increased by 3 percent, while the pump head and volumetric flow rate have remained the same.

Which one of the following is the new pump motor current?

A. 203 amps

B. 206 amps

C. 218 amps

D. 236 amps

QUESTION: 13

A centrifugal pump is needed to take suction on a water storage tank and deliver high pressure water to a water spray system. To minimize axial thrust on the pump shaft, the pump should have _____ stage(s); and to maximize the available NPSH at the impeller inlet, the pump should have a _____ suction impeller.

A. a single; single

B. a single; double

C. multiple opposed; single

D. multiple opposed; double

QUESTION: 14

A 4,000 KW diesel generator (DG) is supplying 2,000 KW to a 4.16 KV emergency bus.   The DG governor is in the isochronous mode (no speed droop).   The emergency bus is about to be synchronized with, and then connected to, an infinite offsite power grid by closing the emergency bus normal power feeder breaker.

The following stable emergency bus and normal power conditions currently exist:

	Emergency Bus (from DG)	Normal Power (from Offsite)
	4.16 KV	4.16 KV
	60.0 Hz	60.1 Hz

When the emergency bus normal power feeder breaker is closed, the DG will…   (Assume no additional operator action.)

A. transfer KW load to the offsite power grid but remain partially loaded.

B. transfer KW load to the offsite power grid until the DG is completely unloaded.

C. acquire KW load from the offsite power grid but remain within its KW load rating.

D. acquire KW load from the offsite power grid and ultimately exceed its KW load rating.

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

A nuclear power plant is shut down with core decay heat being removed by the residual heat removal (RHR) system.   Assume that only the RHR heat exchangers are removing heat from the reactor vessel (RV), and that the RHR system provides complete thermal mixing in the RV.

Given the following information:

    Reactor core rated thermal power   = 2,950 MW
    Core decay heat rate   = 0.6% rated thermal power
    RHR system heat removal rate   = 8.1 x 10^7 Btu/hr
    RHR and RV coolant c_p = 1.05 Btu/lbm-°F
    Combined RV and RHR inventory = 450,000 lbm

Which one of the following actions will establish a reactor cooldown rate between 20°F/hour and 30°F/hour?

A. Increase RHR heat exchanger flow rate to increase the cooldown rate by 10°F/hour.

B. Increase RHR heat exchanger flow rate to increase the cooldown rate by 20°F/hour.

C. Reduce RHR heat exchanger flow rate to decrease the cooldown rate by 10°F/hour.

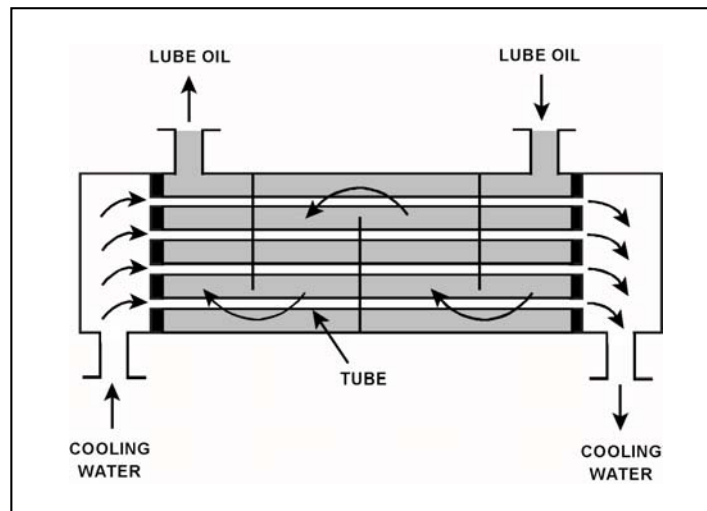D. Reduce RHR heat exchanger flow rate to decrease the cooldown rate by 20°F/hour.

QUESTION: 17

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

If deposits accumulate on the outside of the cooling water tubes, cooling water outlet temperature will _____; and lube oil outlet temperature will _____. (Assume the lube oil and cooling water inlet temperatures and flow rates do <u>not</u> change.)

A. decrease; increase

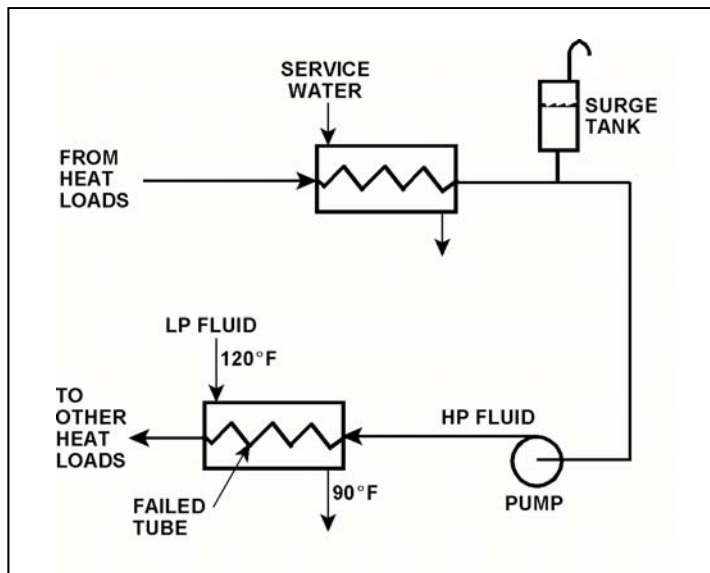B. decrease; decrease

C. increase; increase

D. increase; decrease

QUESTION: 18

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

Which one of the following effects would occur as a result of the failed tube in the heat exchanger?

A. Level in the surge tank increases.

B. Flow in the low pressure (LP) system reverses.

C. Pressure in the low pressure (LP) system decreases.

D. Low pressure (LP) fluid heat exchanger outlet temperature decreases.

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

Water containing dissolved sodium (Na^+) and chloride (Cl^-) ionic impurities is passing through an ion exchanger that contains only anion exchange resin.   How are the ionic impurities being affected as the water flows through the ion exchanger?

A. Sodium ions are being exchanged, but the chloride ions are unaffected.

B. Chloride ions are being exchanged, but the sodium ions are unaffected.

C. Sodium ions are being exchanged, and chloride ions are being removed by filtration.

D. Chloride ions are being exchanged, and sodium ions are being removed by filtration.

QUESTION: 21

Which one of the following describes the operation of a thermal overload device for a large motor?

A. A temperature sensor monitors the temperature of the operating equipment and completes a circuit to trip the breaker if the temperature setpoint is exceeded.

B. A balanced bridge circuit compares actual current to a fixed overcurrent setpoint and completes a circuit to trip the breaker if the current setpoint is exceeded.

C. A heater element in series with the motor heats up in proportion to the motor current and completes a circuit to trip the breaker if a high current condition persists.

D. An induction coil in series with the motor generates a secondary current proportional to the primary current and completes a circuit to trip the breaker if a high current condition persists.
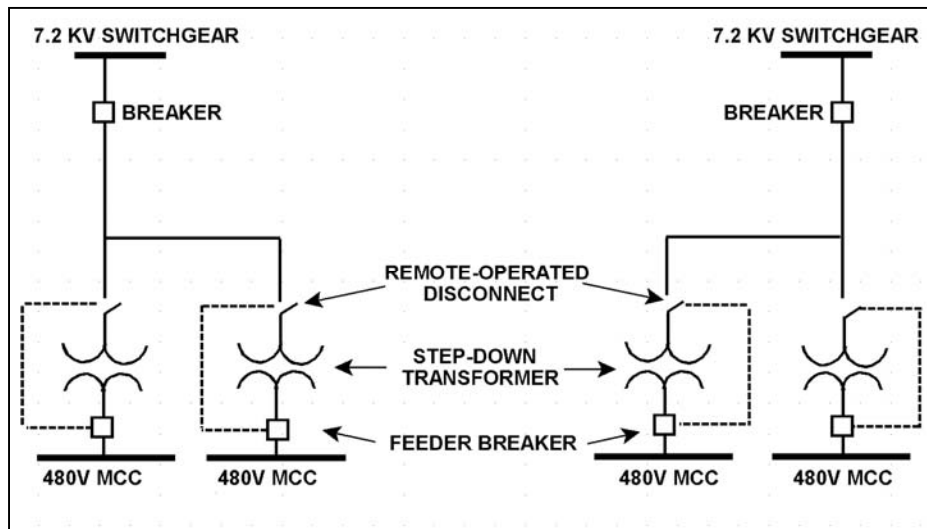
QUESTION: 22

Refer to the simplified drawing of an electrical distribution system showing 7.2 KV switchgear, step-down transformers, and 480 V motor control centers (MCCs) (see figure below).

The high voltage side of each step-down transformer has a remote-operated disconnect to allow transformer maintenance while keeping the other transformers in service. The control circuit for each disconnect is position-interlocked with the associated MCC feeder breaker.

Which one of the following describes the purpose served by the interlock?

A. Prevent damage to the disconnect.

B. Prevent damage to the transformer.

C. Prevent damage to the feeder breaker.

D. Prevent damage to the 480V MCC.

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 reactor scram from 100 percent steady-state power occurred 36 hours ago 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   = ( ) 1.0% $\Delta K/K$
Fuel temperature = ( ) 2.0% $\Delta K/K$
Control rods   = ( ) 14.0% $\Delta K/K$
Voids   = ( ) 3.0% $\Delta K/K$

A. -8.0% $\Delta K/K$

B. -10.0% $\Delta K/K$

C. -14.0% $\Delta K/K$

D. -20.0% $\Delta K/K$

QUESTION: 25

Given the following data for a reactor:

- The average delayed neutron fraction is 0.0052.
- The effective delayed neutron fraction is 0.0054.

The above data indicates that the reactor is operating near the _____ of a fuel cycle and that a typical delayed neutron is _____ likely than a typical prompt neutron to cause another fission in this reactor.

A. beginning; less

B. beginning; more

C. end; less

D. end; more

QUESTION: 26

Consider a one month period of 100 percent power operation near the beginning of a fuel cycle.

During this period of operation, the depletion of U-235 in the fuel tends to make the moderator temperature coefficient _____ negative; and the withdrawal of control rods tends to make the moderator temperature coefficient _____ negative.

A. less; less

B. less; more

C. more; less

D. more; more

QUESTION: 27

Which one of the following lists the moderator temperature coefficient (MTC), fuel temperature coefficient (FTC), and void coefficient (VC) in order of magnitude from most negative to least negative for a reactor at 50 percent power in the middle of a fuel cycle?

A. FTC, VC, MTC

B. FTC, MTC, VC

C. VC, FTC, MTC

D. VC, MTC, FTC

QUESTION: 28

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

Core average thermal neutron flux $= 1.0 \times 10^{12}$ n/cm^2-sec
Control rod tip thermal neutron flux $= 5.0 \times 10^{12}$ n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.0×10^{13} n/cm^2-sec, the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A. 2

B. 4

C. 10

D. 100

QUESTION: 29

Which one of the following conditions will cause the associated differential control rod worth(s) to become more negative?   (Consider only the direct effect of the indicated changes.)

A. During a small power change, fuel temperature increases.

B. During a small power change, the percentage of voids increases.

C. With the reactor shut down, reactor coolant temperature increases from 100°F to 200°F.

D. During a control pattern adjustment, the local thermal neutron flux surrounding a control rod decreases while the core average thermal neutron flux remains the same.

QUESTION: 30

Which one of the following explains why xenon-135 oscillations are a concern in a reactor?

A. They can adversely affect core power distribution, and they can require operation below full rated power.

B. They can adversely affect core power distribution, and they can prevent reactor criticality during a reactor startup.

C. They can cause excessively short reactor periods during power operation, and they can require operation below full rated power.

D. They can cause excessively short reactor periods during power operation, and they can prevent reactor criticality during a reactor startup.

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.

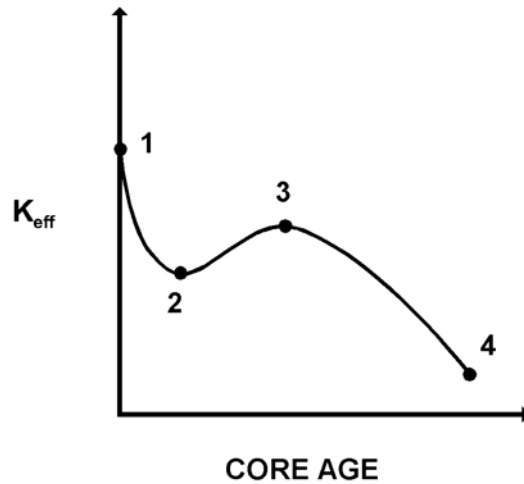D. Insert rods slowly at first, and then withdraw rods slowly.

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 3 to point 4 is the...

A. depletion of U-235.

B. depletion of U-238.

C. burnout of burnable poisons.

D. buildup of fission product poisons.

QUESTION: 33

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10 percent

B. 20 percent

C. 80 percent

D. 100 percent

QUESTION: 34

With K_{eff} at 0.985, how much reactivity must be added to make a reactor exactly critical?

A. 1.48% ΔK/K

B. 1.50% ΔK/K

C. 1.52% ΔK/K

D. 1.54% ΔK/K

QUESTION: 35

A reactor is being started up with a stable positive 100-second period, and power is 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 remains nearly constant throughout the entire intermediate range.

D. When heat production in the reactor exceeds ambient losses, positive reactivity added by the fuel temperature increase counteracts the negative reactivity added by the moderator temperature increase, and reactor period remains nearly constant throughout the entire intermediate range.
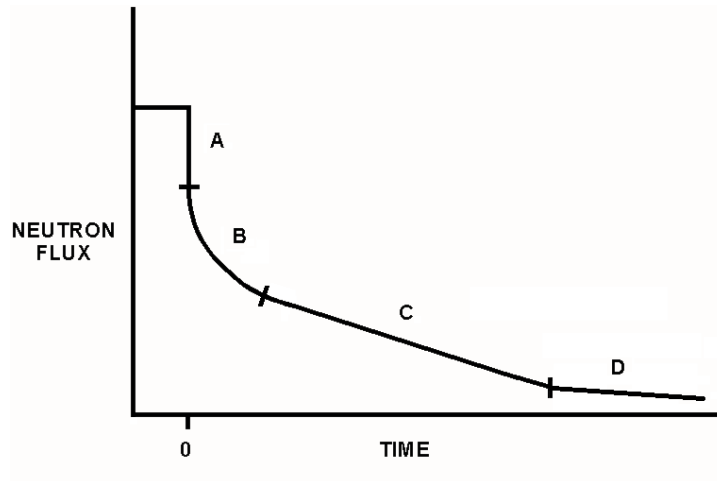
QUESTION: 36

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant reactor that experienced a reactor scram from extended full power operation at time = 0 seconds.   The neutron flux axis has a logarithmic scale while the time axis has a linear scale.

Which section(s) of the curve has/have a slope that is primarily determined by the production rate of delayed neutrons?

A. B only
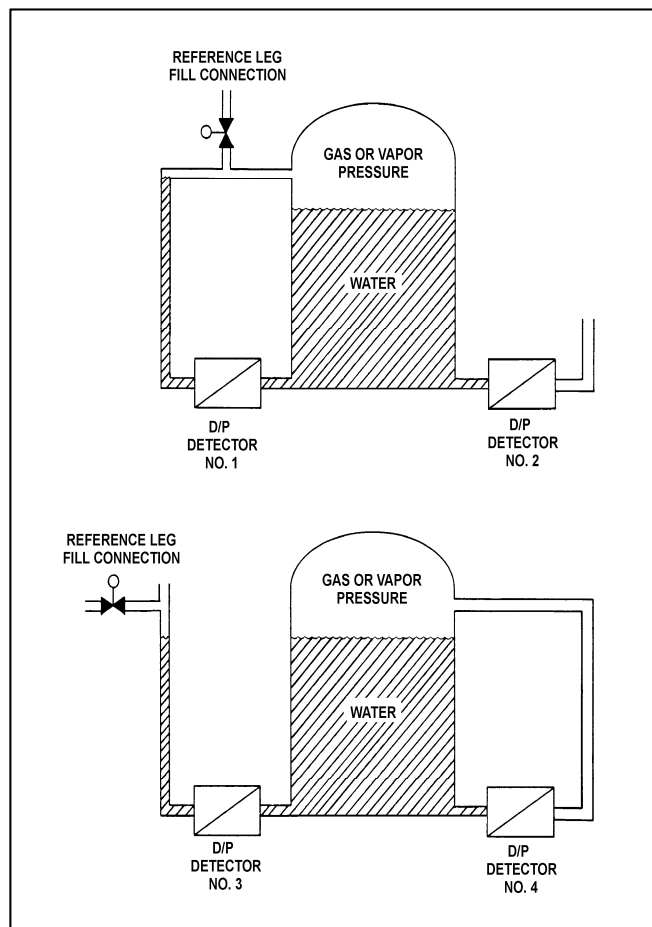
B. B and C

C. C only

D. C and D

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, the same constant water level, and a temperature of 60°F. They are surrounded by atmospheric pressure.

If a leak in the top of each tank causes a complete loss of overpressure, which detector(s) will produce a lower level indication?

A. No. 1 only

B. No. 2 only

C. No. 1 and 4

D. No. 2 and 3

QUESTION: 38

A nuclear power plant is operating with the following main steam parameters at a partially open main turbine steam inlet valve:

Pressure = 1,000 psia
Quality = 100 percent

The main turbine steam chest pressure is 50 psia. Which one of the following describes the steam in the steam chest?

A. Saturated, 98 percent quality

B. Saturated, 99 percent quality

C. Saturated, 100 percent quality

D. Superheated

QUESTION: 39

A main condenser is operating at 28 inches Hg vacuum with a condensate outlet temperature of 92°F. Which one of the following is the approximate amount of condensate depression?

A. 5°F

B. 9°F

C. 13°F

D. 17°F

QUESTION: 40

A nuclear power plant is operating at 80 percent power with 10°F of condensate subcooling. Which one of the following initially will 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

Head loss is...

A. the reduction in discharge pressure experienced by a real pump due to slippage.

B. the reduction in discharge pressure experienced by a real pump due to mechanical friction.

C. the conversion of system fluid pressure and velocity to heat energy because of friction.

D. the change in static pressure in a piping system resulting from changes in elevation.

QUESTION: 42

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: 43

When performing a heat balance calculation to determine core thermal power, the measured thermal power is _____ by a value associated with the recirculation pumps; the adjustment is needed because _____ of the flow energy added to the reactor coolant by the recirculation pumps is converted to thermal energy of the reactor coolant.

A. decreased; nearly all

B. decreased; a small fraction

C. increased; nearly all

D. increased; a small fraction

QUESTION: 44

Which one of the following describes transition (partial film) boiling? (ΔT refers to the difference between the fuel rod surface temperature and the coolant saturation temperature.)

A. A small increase in ΔT causes increased steam blanketing and a reduction in heat flux.

B. The temperature of the heat transfer surface is so high that thermal radiative heat transfer becomes significant and heat flux increases.

C. As the ΔT increases, the increasing number of steam bubbles causes increased agitation and turbulence of the boundary layer, allowing increased heat flux.

D. As the ΔT increases, a few vapor bubbles are formed that may collapse when they enter into the bulk of the fluid.

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 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.

D. 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.

QUESTION: 46

Reactors A and B are operating at steady-state 100 percent power.   The reactors are identical except that reactor A has core orifices and reactor B does <u>not</u>.   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

Which one of the following must be maintained within limits to ensure that peak cladding temperature will not exceed 2,200°F after a design basis loss of coolant accident?

A. Linear heat generation rate

B. Average planar linear heat generation rate

C. Minimum critical power ratio

D. Maximum fraction of limiting critical power ratio

QUESTION: 48

A nuclear power plant is operating at 90 percent power at the end of core life when a signal error causes the turbine control system to open the turbine control valves an additional 5 percent. Assuming the reactor does <u>not</u> scram, the critical power ratio will initially...

A. increase, because reactor power initially increases.

B. decrease, because reactor power initially decreases.

C. increase, because the reactor coolant latent heat of vaporization initially increases.

D. decrease, because the reactor coolant latent heat of vaporization initially decreases.

QUESTION: 49

If reactor feedwater temperature suddenly decreases by $10°F$ during operation at 75 percent power, critical power will initially _____; and bundle power will initially _____.

A. increase; increase

B. decrease; increase

C. increase; decrease

D. decrease; decrease

QUESTION: 50

Which one of the following comparisons will result in a <u>higher</u> probability for brittle fracture of the reactor vessel?

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

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

C. A high oxygen content in the reactor coolant rather than a low oxygen content.

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

*** FINAL ANSWER KEY ***

SEPTEMBER 2013 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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