UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
SEPTEMBER 2014 – 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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

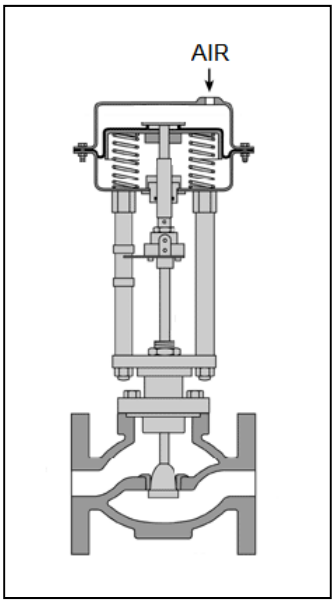
D. 210 psig

QUESTION: 2

Refer to the drawing of a pneumatically-operated valve (see figure below). The valve actuator may be shown with or without applied air pressure.

Which one of the following describes the type of valve shown, and the valve's fail position on loss of air to the actuator?

	Valve Type	Fail Position
A.	Ball	Open
B.	Ball	Closed
C.	Globe	Open
D.	Globe	Closed



QUESTION: 3

During a local inspection of a manually operated three-inch gate valve, the valve stem is observed to be flush with the top of the handwheel. Two inches of unthreaded valve stem is visible between the handwheel and the packing gland. The handwheel is mounted to the valve body and valve stem such that the handwheel can be rotated in either direction, but cannot change its axial position.

Which one of the following describes the position of the valve?

A. The valve is fully open or nearly fully open.

B. The valve is fully closed or nearly fully closed.

C. The valve may be in any position because it has a rising stem.

D. The valve may be in any position because it has a non-rising stem.

QUESTION: 4

A steam flow measuring instrument uses density compensation and square root compensation to convert the differential pressure across a flow element to flow rate in lbm/hr.

The purpose of square root compensation in this flow measuring instrument is to convert _____ to _____.

A. differential pressure; mass flow rate

B. differential pressure; volumetric flow rate

C. volumetric flow rate; mass flow rate

D. volumetric flow rate; differential pressure

QUESTION: 5

Because of a thermocouple temperature display failure, the millivolt output of a thermocouple circuit is being converted to a temperature value using conversion tables. The tables are based on a thermocouple reference junction temperature of 32°F. The actual reference junction is located in a panel that is maintained at 96°F. Room temperature surrounding the panel is 72°F.

What adjustment must be made to the temperature value taken from the conversion tables to calculate the actual temperature at the measuring tip of the thermocouple?

A. Add 64°F.

B. Subtract 64°F.

C. Add 40°F.

D. Subtract 40°F.

QUESTION: 6

A fission chamber neutron monitoring instrument is operating in the proportional region. If a complete loss of fission chamber gas pressure occurs, the instrument indication will fail...

A. upscale.

B. downscale.

C. as is.

D. to midscale.

QUESTION: 7

A Geiger Mueller detector with a "pancake" probe (sometimes called a frisker) is being used to monitor for skin contamination. During frisking, the probe is more likely to detect contamination if the probe is held _____ than one-half inch from the skin; and is moved _____ than two inches per second.

A. farther; faster

B. farther; slower

C. closer; faster

D. closer; slower

QUESTION: 8

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

The flow control valve is positioned by a tank level controller that can maintain a stable water level anywhere between 10 percent above and 10 percent below the controller setpoint.

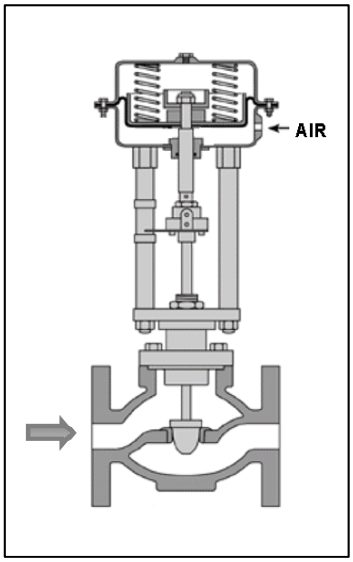
Which one of the following describes the characteristics of the tank level controller?

A. Direct acting with proportional only control.

B. Direct acting with proportional plus integral control.

C. Reverse acting with proportional only control.

D. Reverse acting with proportional plus integral control.



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.

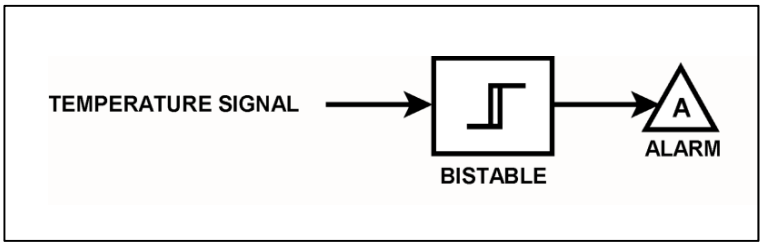
If the current temperature is 150°F, which one of the following describes the alarm circuit response as temperature slowly decreases to 110°F?

A. The alarm is currently actuated and will not turn off.

B. The alarm will actuate at 130°F and will not 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 would result from operating a motor-driven centrifugal pump for extended periods with the discharge valve shut and no recirculation flow?

A. No damage, because the pump and motor are designed to operate with the discharge valve shut.

B. Pump overheating, cavitation, and ultimately pump failure.

C. Excessive motor current, damage to motor windings, and ultimately motor failure.

D. Pump and motor overspeed, and tripping on high motor current.

QUESTION: 11

A centrifugal pump is taking suction from an open water storage tank. The pump is located at the base of the tank, takes a suction from the bottom of the tank, and discharges to a pressurized system.

Given:

- The tank is filled to a level of 26 feet with 60°F water.
- The pump is currently operating at 50 gpm.
- The pump requires 30 feet of net positive suction head.

Which one of the following describes the current pump status, and how the pump flow rate will be affected as the level in the storage tank decreases?

A. The pump is currently cavitating; pump flow rate will decrease continuously as tank level decreases.

B. The pump is currently cavitating; pump flow rate will remain about the same until the tank empties.

C. The pump is currently not cavitating; pump flow rate will gradually decrease with tank level and then rapidly decrease when cavitation begins at a lower tank level.

D. The pump is currently not cavitating; pump flow rate will gradually decrease with tank level and then rapidly decrease as the pump becomes air bound when the tank empties.

QUESTION: 12

Centrifugal pumps A and B are identical except that pump A uses a single-suction impeller while pump B uses a double-suction impeller. If both pumps are pumping water at the same inlet temperature, inlet pressure, and flow rate, single-suction pump A typically will have the _____ impeller axial thrust and the _____ required net positive suction head.

A. greater; greater

B. greater; smaller

C. smaller; greater

D. smaller; smaller

QUESTION: 13

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

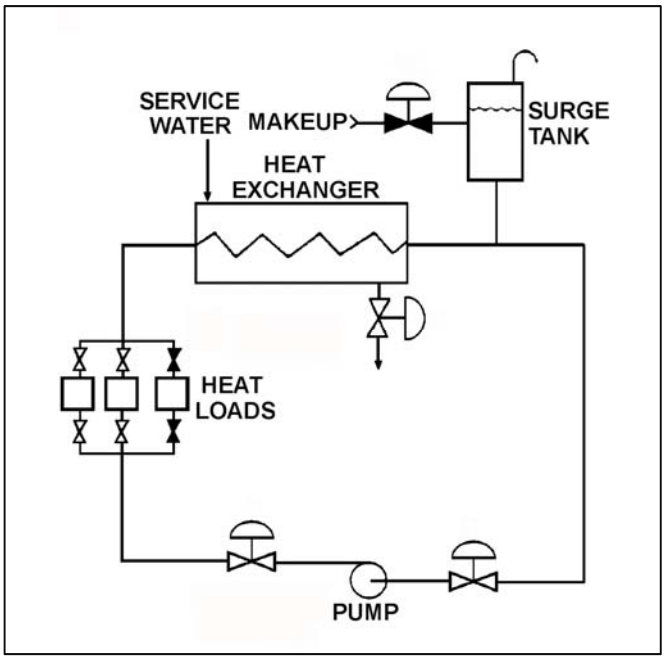
The pump is unable to achieve its rated volumetric flow rate due to cavitation. Which one of the following will enable the pump to achieve a higher volumetric flow rate before cavitation occurs?

A. Decrease the service water flow rate.

B. Operate the system at a lower pressure.

C. Move the surge tank connection closer to the suction of the pump.

D. Remove the existing pump motor and install a motor with a higher horsepower rating.



QUESTION: 14

A motor-driven radial-flow centrifugal pump is operating to provide makeup water from a constant head source to a vented storage tank that is 30 feet tall. The pump is located at the base of the tank and discharges directly into the bottom of the tank. As the tank water level increases from 20 to 25 feet, the pump discharge pressure will _____; and the pump motor current will _____.

A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase

QUESTION: 15

The starting current in a typical AC induction motor is typically much higher than the full-load running current because...

A. starting torque is lower than full-load running torque.

B. starting torque is higher than full-load running torque.

C. rotor speed during start is too low to generate significant counter electromotive force in the stator.

D. rotor current during start is too low to generate significant counter electromotive force in the stator.

QUESTION: 16

A reactor 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 of the RV.

Given the following information:

Reactor core rated thermal power	=	2,950 MW
Core decay heat rate	=	0.5% rated thermal power
RHR system heat removal rate	=	5.3×10^7 Btu/hr
RHR and RV coolant c_p	=	1.05 Btu/lbm-°F
Combined RV and RHR inventory	=	425,000 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 parallel-flow lube oil heat exchanger (see figure below). Assume that lube oil (LO) inlet temperature is greater than cooling water (CW) inlet temperature.

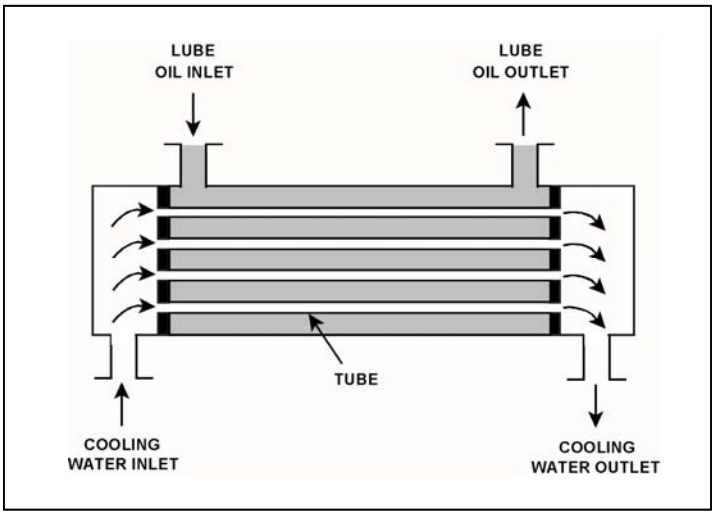
Unlike a counter-flow heat exchanger, in a parallel-flow heat exchanger the _____ temperature can never be greater than the _____ temperature.

A. CW outlet; LO outlet

B. CW outlet; LO inlet

C. LO outlet; CW outlet

D. LO outlet; CW inlet



QUESTION: 18

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

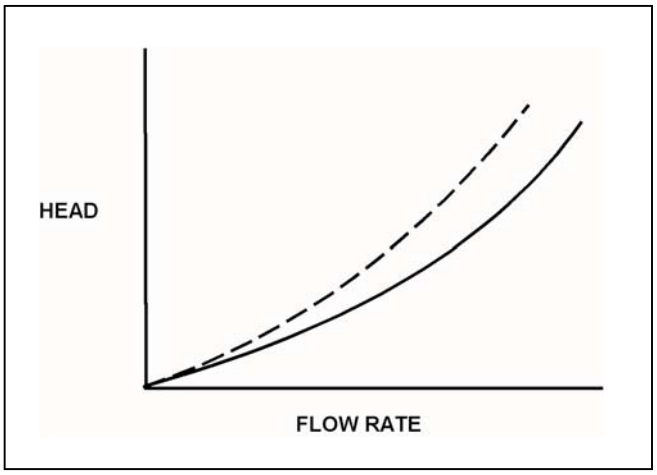
Which one of the following will cause the system curve to shift from the solid curve toward the dashed curve?

A. The main condenser tubes are cleaned.

B. The main condenser tubes become increasingly fouled.

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

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



QUESTION: 19

What percentage of impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 25?

A. 99 percent

B. 96 percent

C. 88 percent

D. 75 percent

QUESTION: 20

Demineralizer 1A was removed from service after it became saturated with chloride ions while processing condensate with 10 times the normal chloride concentration. Replacement demineralizer 1B has restored the condensate chloride 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 chloride concentration will...

A. remain the same, because demineralizer 1A resin has already been conditioned by previous operation.

B. remain the same, because demineralizer 1A resin can no longer remove chloride ions from the condensate.

C. increase, only due to the volume of water contained in demineralizer 1A mixing with the incoming condensate.

D. increase, due to both the volume of water contained in demineralizer 1A mixing with the incoming condensate and the release of chloride ions from the resin.

QUESTION: 21

A main generator is being paralleled to an infinite power grid. Generator voltage has been properly adjusted and the synchroscope is rotating slowly in the counterclockwise direction.

If the generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position, which one of the following is most likely to occur?

A. The breaker will close and the generator will supply only MW to the grid.

B. The breaker will close and the generator will supply both MW and MVAR to the grid.

C. The breaker will close and then open due to overcurrent.

D. The breaker will close and then open due to reverse power.

QUESTION: 22

If a breaker is racked to the TEST position, the...

A. remote position indication for the breaker is still operational.

B. breaker can only be operated remotely from its associated remote control panel.

C. electrical jumpers must be connected to the operating coils to operate the breaker.

D. normal breaker opening and closing operations cannot be tested because the TEST position is for overload testing only.

QUESTION: 23

The ideal moderator has a _____ macroscopic absorption cross section for thermal neutrons and a _____ average logarithmic energy decrement.

A. small; large

B. small; small

C. large; large

D. large; small

QUESTION: 24

Which one of the following does not affect K_{eff}?

A. Core dimensions

B. Core burnup

C. Moderator-to-fuel ratio

D. Installed neutron sources

QUESTION: 25

Given the following stable initial conditions for a reactor:

Power level = 1.0×10^{-8} percent
K_{eff} = 0.999
Core $\bar{\beta}_{eff}$ = 0.006

What will the stable reactor period be following an addition of positive 0.15% ΔK/K reactivity to the reactor? (Assume the stable reactor period occurs before the reactor reaches the point of adding heat.)

A. 30 seconds

B. 50 seconds

C. 80 seconds

D. 110 seconds

QUESTION: 26

Which one of the following describes how and why the void coefficient of reactivity changes as void fraction increases during a control rod withdrawal at 80 percent power?

A. Becomes less negative, due to the increased absorption of neutrons by U-238.

B. Becomes less negative, due to a greater fraction of neutrons lost to leakage from the core.

C. Becomes more negative, due to the reduction in the fast fission contribution to the neutron population.

D. Becomes more negative, due to a greater fractional loss of moderator for a 1 percent void increase at higher void fractions.

QUESTION: 27

During a reactor startup with the reactor coolant at 520°F, excessive control rod withdrawal results in a 10-second reactor period with reactor power low in the intermediate range. Without any further operator action, which one of the following coefficients of reactivity will respond first to reduce the rate of power increase?

A. Doppler

B. Pressure

C. Void

D. Moderator

QUESTION: 28

A control rod that was initially at position 06 is being withdrawn three more notches. After the withdrawal, the control rod will be classified as a _____ rod; and the blade tip for this control rod will be positioned 36 inches from the _____ position.

A. deep; fully inserted

B. deep; fully withdrawn

C. shallow; fully inserted

D. shallow; fully withdrawn

QUESTION: 29

Criticality has been achieved during a xenon-free reactor startup with core neutron flux level low in the intermediate range. A stable positive 60-second reactor period has been established. Now the operator begins inserting control rods in an effort to stabilize the core neutron flux level near its current value. The operator stops inserting control rods exactly when the reactor period indicates infinity.

Immediately after the operator stops inserting the control rods, the reactor period will become _____; and the core neutron flux level will _____.

A. positive; increase exponentially

B. positive; increase linearly

C. negative; decrease exponentially

D. negative; decrease linearly

QUESTION: 30

A reactor has been operating at 100 percent power for one month following a refueling outage with axial neutron flux distribution peaked in the bottom half of the core. An inadvertent reactor scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. Reactor power is increased to 60 percent over the next 4 hours and then stabilized.

During the one-hour period immediately after power level is stabilized at 60 percent, the core axial neutron flux peak will be located _____ in the core than the pre-scram peak location; and the core axial neutron flux peak will be moving _____.

A. higher; upward

B. higher; downward

C. lower; upward

D. lower; downward

QUESTION: 31

With Xe-135 initially at equilibrium, which one of the following power changes produces the greatest change in equilibrium Xe-135 negative reactivity?

A. 0 percent to 10 percent

B. 30 percent to 40 percent

C. 60 percent to 70 percent

D. 90 percent to 100 percent

QUESTION: 32

Gadolinium (Gd-155, Gd-157) is used instead of boron (B-10) as the _____ material; when compared to boron, gadolinium has a much _____ cross section for absorbing thermal neutrons.

A. control rod; larger

B. burnable poison; larger

C. control rod; smaller

D. burnable poison; smaller

QUESTION: 33

A reactor startup is in progress. Control rod withdrawal was stopped several minutes ago to assess criticality. Which one of the following is a combination of indications that together support a declaration that the reactor has reached criticality?

A. Period is stable at positive 200 seconds; source range count rate is stable.

B. Period is stable at infinity; source range count rate is stable.

C. Period is stable at positive 200 seconds; source range count rate is slowly increasing.

D. Period is stable at infinity; source range count rate is slowly increasing.

QUESTION: 34

Criticality has just been achieved during a reactor startup at 160°F. The main steam isolation valves are closed (*i.e.*, no steam flow from reactor). The operator withdraws control rods as necessary to establish a stable positive 60-second reactor period. No additional operator actions are taken.

How will reactor power and reactor period respond after the control rod withdrawal is completed? (Assume a negative moderator temperature coefficient.)

A. Reactor power will increase and stabilize at the POAH; reactor period will remain nearly constant until the POAH is reached and then stabilize at infinity.

B. Reactor power will increase and stabilize at the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

C. Reactor power will increase and stabilize above the POAH; reactor period will remain nearly constant until the POAH is reached and then stabilize at infinity.

D. Reactor power will increase and stabilize above the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

QUESTION: 35

A reactor is initially operating at steady-state 20 percent power when power is increased to 40 percent. In comparison to the operating conditions at 20 percent power, when the plant stabilizes at 40 percent power, reactor vessel pressure will be _____, and reactor vessel water temperature will be _____.

A. higher; higher

B. higher; the same

C. the same; higher

D. the same; the same

QUESTION: 36

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor trip 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.

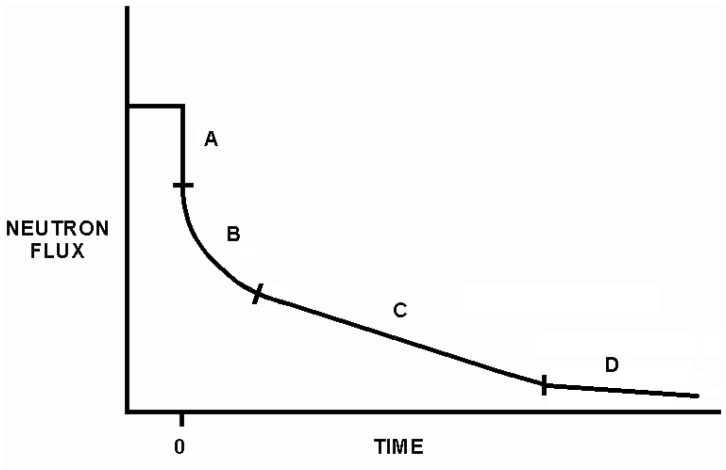
In which section of the curve does the production rate of source neutrons primarily determine the slope of the curve?

A. A

B. B

C. C

D. 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. The tanks are surrounded by atmospheric pressure. All level detectors have been calibrated and are producing the same level indication.

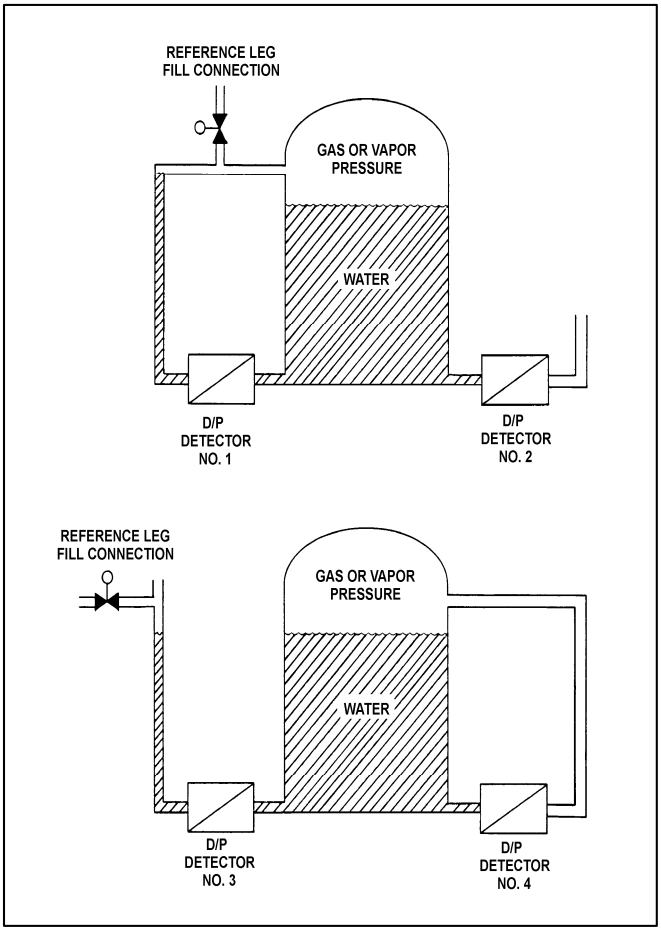
If a leak in the top of each tank causes a complete loss of overpressure in both tanks, which detector(s) will produce the highest level indication(s)?

A. No. 1 only

B. No. 2 only

C. No. 1 and 4

D. No. 2 and 3



QUESTION: 38

Saturated steam at 900 psia enters an ideal high pressure (HP) turbine and exhausts at 240 psia. How much heat, if any, must be added to the HP turbine exhaust to produce saturated steam at 240 psia?

A. 0 Btu/lbm

B. 11 Btu/lbm

C. 111 Btu/lbm

D. 155 Btu/lbm

QUESTION: 39

A nuclear power plant is operating at 100 percent power when the only in-service steam jet air ejector is inadvertently isolated from the main condenser. The operator verifies that condenser cooling water system parameters have not changed. If no operator action is taken over the next 60 minutes, condenser pressure will...

A. remain the same.

B. slowly decrease.

C. slowly increase and stabilize at a slightly higher pressure.

D. slowly and continuously increase towards atmospheric pressure.

QUESTION: 40

A nuclear power plant has a thermal power rating of 3,200 MW. When the plant operates at 100 percent power, the main generator produces 1,200 MW at a 0.95 power factor. Plant modifications are planned that will upgrade the feedwater heaters and moisture separator/reheaters without changing the plant's thermal power rating. If the plant modifications improve plant thermal efficiency by 2 percent, what will be the resulting main generator electrical output at 100 percent reactor power with the same power factor?

A. 1,204 MW

B. 1,224 MW

C. 1,244 MW

D. 1,264 MW

QUESTION: 41

A centrifugal water pump was returned to service after maintenance. However, the operator failed to vent the pump.

Compared to normal pump operating conditions, after the pump is started the operator will see a _____ flow rate and a _____ discharge head.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

QUESTION: 42

Which one of the following will decrease the head loss occurring in an operating cooling water system?

A. Shifting two heat exchangers from parallel to series operation.

B. Increasing the flow rate in the system by positioning a flow control valve more open.

C. Replacing a 10 foot length of 10-inch diameter pipe with a 20 foot length of 10-inch diameter pipe.

D. Replacing a 20 foot length of 12-inch diameter pipe with a 20 foot length of 10-inch diameter pipe.

QUESTION: 43

Which one of the following describes a heat transfer process in which convection is the dominant mode of heat transfer?

A. From the reactor fuel to the core barrel during core uncovery.

B. From the reactor fuel to the steam outlet of the reactor vessel during a station blackout.

C. From the fuel pellet centerline to the fuel clad during normal operation at 100 percent power.

D. Through the tube walls in a main condenser during normal operation at 100 percent power.

QUESTION: 44

Subcooled reactor coolant enters the bottom of a fuel assembly in a reactor operating at power. As the coolant flows upward through the fuel assembly, boiling occurs and the coolant exits the fuel assembly at the saturation temperature.

If the coolant had remained subcooled, average fuel temperature would have been _____ because boiling is a _____ efficient method of heat transfer.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

QUESTION: 45

A reactor is operating at full power with a fuel bundle that is experiencing each of the following modes of heat transfer somewhere along its length.

Which one of the following causes the first reduction in the local fuel cladding heat transfer rate as the coolant flows upward through the fuel bundle?

A. Nucleate boiling

B. Stable film boiling

C. Partial film boiling

D. Single-phase convection

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

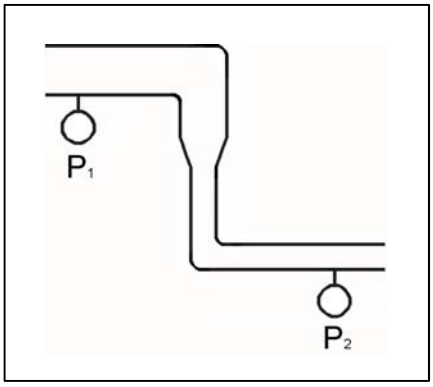
The pressure decrease due to friction head loss between P_1 and P_2 is _____; and the direction of flow is from _____.

A. 2 psig; left to right

B. 2 psig; right to left

C. 6 psig; left to right

D. 6 psig; right to left



QUESTION: 47

The linear heat generation rate (LHGR) for a reactor core is acceptable if _____ is being maintained at _____.

A. $LHGR_{limit}/LHGR_{measured}$; 0.95

B. $LHGR_{measured}/LHGR_{limit}$; 1.05

C. $LHGR_{limit}/LHGR_{measured}$; 1.10

D. $LHGR_{measured}/LHGR_{limit}$; 1.15

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

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

Given the following initial stable core parameters:

Reactor power = 50 percent
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 1,250°F

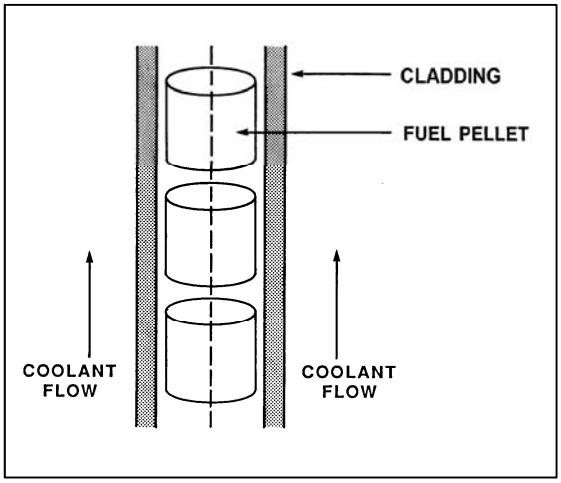
Assume the total heat transfer coefficient and the reactor coolant temperature do not change. What will the stable fuel centerline temperature be if reactor power is increased to 75 percent?

A. 1,425°F

B. 1,600°F

C. 1,750°F

D. 1,875°F



QUESTION: 50

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

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

A. Reactor A, due to the higher average power capacity.

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

C. Reactor B, due to the lower average power capacity.

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

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

SEPTEMBER 2014 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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