**UNITED STATES NUCLEAR REGULATORY COMMISSION**
**BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION**
**SEPTEMBER 2006--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% is required to pass this portion of the NRC operator licensing written examination. All examination papers will be collected 3.0 hours after the examination starts. This examination applies to a typical 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 GUIDELINES FOR THE NRC**
**GENERIC FUNDAMENTALS EXAMINATION**

During the administration of this examination the following rules apply:

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

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 time.

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 of 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 booklet, then examination aids - steam table booklets, handouts, and scrap paper used during the examination.

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 HANDOUT SHEET

## EQUATIONS

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

$\ell^* = 1 \times 10^{-4}$ sec

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

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

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

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

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

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

$CR_1(1 - K_{eff1}) = CR_2(1 - K_{eff2})$

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

Eff. = Net Work Out/Energy In

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

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

## CONVERSIONS

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

QUESTION: 1

Consider a 6-inch globe valve and a 6-inch gate valve in the same water system application. Typically, the valve that requires the most linear disk travel from fully closed to fully open is the _____ valve; and the valve that produces the smallest pressure drop when fully open is the _____ valve.

A. gate; gate

B. gate; globe

C. globe; gate

D. globe; globe

QUESTION: 2

After an adjustment of the packing gland on a valve that had a minor packing leak, the operator attempts to operate the valve but finds that the valve is stuck. What is the most probable cause?

A. The disk separated from the valve stem as a result of overtightening the packing gland.

B. The maintenance technician overtightened the packing gland, causing the stem to bind.

C. The valve was overtorqued in the closed direction during the packing gland adjustment.

D. The operator placed the valve in the wrong position for adjusting the packing gland.

QUESTION: 3

In a comparison between ball valves and butterfly valves in the same liquid process system application, the valves that typically would allow more leakage when fully closed and under high differential pressure are _____ valves, and the valves that typically would cause the higher system pressure drop when fully open are _____ valves.

A. ball; butterfly

B. ball; ball

C. butterfly; butterfly

D. butterfly; ball

QUESTION: 4

Refer to the drawing of a reactor vessel and differential pressure (D/P) level detector that was recently calibrated at normal operating conditions (see figure below). Assume that the associated reactor vessel level instrument does not use density compensation.

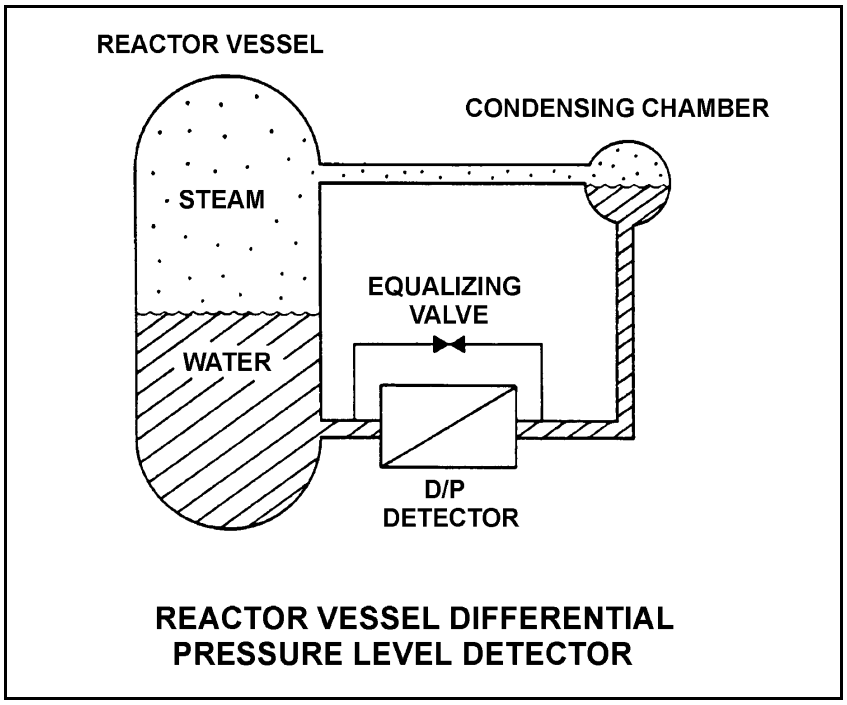
With the nuclear power plant shut down at reduced reactor vessel temperature and pressure, the reactor vessel level instrument will indicate _____ than actual water level; the D/P currently sensed by the D/P detector is_____ than the D/P for the same reactor vessel water level at normal operating conditions.

A. higher; smaller

B. higher; larger

C. lower; smaller

D. lower; larger




**REACTOR VESSEL DIFFERENTIAL PRESSURE LEVEL DETECTOR**

QUESTION: 5

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

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

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

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

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

QUESTION: 6

Fission chamber detectors are used to monitor reactor power/neutron level in a shutdown reactor as well as a reactor operating at full power (and all power levels in between). At what power levels and why is it necessary to compensate the output of the detectors for gamma interactions with the fission chambers?

A. Only when operating at high power levels, because gamma flux is <u>not</u> proportional to reactor power at high power levels.

B. Only when shutdown or at low power levels, because gamma flux is <u>not</u> proportional to reactor power at low power levels.

C. At all power levels, because gamma interactions produce smaller detector pulses than neutron interactions.

D. At all power levels, because gamma interactions produce larger detector pulses than neutron interactions.

QUESTION: 7

Which one of the following contains the pair of radiation detector types that are the most sensitive to a low intensity field of beta and gamma radiation.

A. Geiger-Mueller and scintillation

B. Geiger-Mueller and ion chamber

C. Ion chamber and scintillation

D. Ion chamber and proportional

QUESTION: 8

The water level in a water storage tank is being controlled by an automatic bistable level controller. If water level increases to 70%, the controller bistable turns off to open a tank drain valve. When water level decreases to 60%, the controller bistable turns on to close the drain valve.

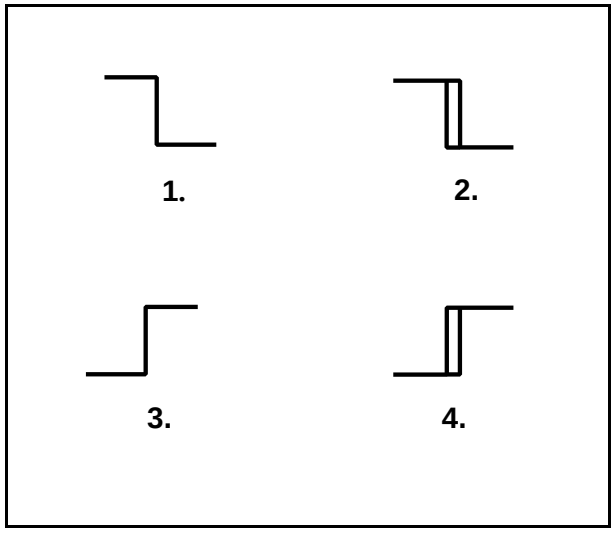
Which one of the following bistable symbols indicates the characteristics of the bistable used in the level controller?

A. 1.

B. 2.

C. 3.

D 4.



QUESTION: 9

A proportional-derivative controller senses an increase in the controlled parameter above the controller set point. The derivative function causes the controller output signal to...

A. increase until the controlled parameter equals the controller set point, at which time the output signal becomes constant.

B. remain directly proportional to the difference between the controlled parameter and the controller set point.

C. increase until the controlled parameter equals the controller set point, at which time the output signal becomes zero.

D. change at a rate that is directly proportional to the rate of change of the controlled parameter.

QUESTION: 10

A centrifugal pump is taking suction on an open storage tank that has been filled to a level of 40 feet with 10,000 gallons of 60°F water. The pump is located at the base of the tank, takes a suction from the bottom of the tank, and discharges through a fire hose.

Given:

- The pump is currently operating at its design flow rate of 200 gpm and a total developed head of 150 feet.
- The pump requires 4 feet of net positive suction head (NPSH).

How will the centrifugal pump flow rate be affected as the water storage tank level decreases?

A. Flow rate will remain constant until the pump becomes air bound when the tank empties.

B. Flow rate will remain constant until the pump begins to cavitate at a tank level of about 4 feet.

C. Flow rate will gradually decrease until the pump becomes air bound when the tank empties.

D. Flow rate will gradually decrease until the pump begins to cavitate at a tank level of about 4 feet.

QUESTION: 11

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

Given:

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

At which one of the following elevations above the reservoir water level will the fire hose spray nozzle first be unable to provide flow? (Disregard all sources of system frictional head loss.)

A. 91 feet

B. 106 feet

C. 121 feet

D. 136 feet

QUESTION: 12

A section of reactor coolant piping is being hydrostatically tested to 1,400 psig using a positive displacement pump. The operating characteristics of the positive displacement pump are shown below, identifying ideal, expected, and actual pump performance.

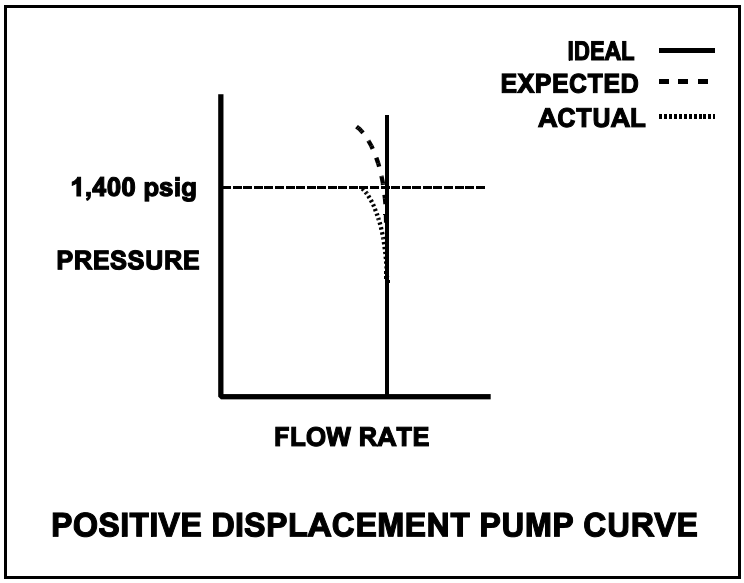
Which one of the following could cause the observed difference between the expected and the actual pump performance?

A. Pump internal leakage is greater than expected.

B. Reactor coolant piping boundary valve leakage is greater than expected.

C. Available NPSH has decreased more than expected, but remains slightly above required NPSH.

D. A relief valve on the pump discharge piping has opened prior to its setpoint of 1,400 psig.



QUESTION: 13

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

A. throttled; throttled

B. throttled; fully open

C. fully open; throttled

D. fully open; fully open

QUESTION: 14

Consider two identical single-speed ac induction motors, one of which is connected to a radial-flow centrifugal pump and the other to a reciprocating-type positive displacement pump (PDP). Both pumps are taking suction at the same elevation from a vented water storage tank.

Each pump has a maximum design backpressure of 800 psig, and each is operating with the following initial conditions:

| | |
|---|---|
| Flow rate: | 200 gpm |
| Backpressure: | 400 psig |
| Motor current: | 100 amps |

If the backpressure for each pump increases to 600 psig, the centrifugal pump will have a _____ flow rate than the PDP; and the centrifugal pump will have a _____ motor current than the PDP.

A. lower; higher

B. lower; lower

C. higher; higher

D. higher; lower

QUESTION: 15

Which one of the following causes starting current to be greater than running current for a typical ac induction motor?

A. The rotor does not develop maximum induced current flow until it has achieved synchronous speed.

B. After the motor starts, resistors are added to the electrical circuit to limit the running current.

C. A large amount of starting current is required to initially establish the rotating magnetic field.

D. The rotor field induces an opposing voltage in the stator that is proportional to rotor speed.

QUESTION: 16

The rate of heat transfer between two liquids in a heat exchanger will be <u>decreased</u> if the: (Assume single-phase conditions and a constant specific heat capacity.)

A. temperature of both liquids is decreased by 20°F.

B. temperature of both liquids is increased by 20°F.

C. flow rate of the colder liquid is decreased by 10%.

D. flow rate of the hotter liquid is increased by 10%.

QUESTION: 17

Tube scaling in a parallel flow heat exchanger causes heat transfer rate to decrease because the...

A. surface area of the tubes decreases.

B. cooling fluid outlet temperature decreases.

C. thermal conductivity of the scale is very low.

D. flow through the heat exchanger becomes more turbulent.

QUESTION: 18

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

Assume that the size of the cooling water tube rupture does not change, and that 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% power, the flow rate of main condenser cooling water inleakage at 60% power is _____ because the main condenser pressure at 60% power is _____.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

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%

B. 96%

C. 88%

D. 75%

QUESTION: 20

There is a temperature limit on the water entering a demineralizer because excessively hot water...

A. will decompose the resin beads.

B increases the potential for channeling.

C. causes the filter element to swell and release the resin.

D. will dislodge and wash the resin fines off the filter element.

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 thermal overload device for a large motor protects the motor from...

A. sustained overcurrent by opening the motor breaker or motor line contacts.

B. sustained overcurrent by opening contacts in the motor windings.

C. instantaneous overcurrent by opening the motor breaker or motor line contacts.

D. instantaneous overcurrent by opening contacts in the motor windings.

QUESTION: 23

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, $4.25 \times 10^5$ delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted in the reactor during this same time interval?

A. $1.5 \times 10^6$

B. $6.5 \times 10^6$

C. $1.5 \times 10^7$

D. $6.5 \times 10^7$

QUESTION: 24

Nuclear reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle (BOC) and reactor B is operating near the end of a fuel cycle (EOC). Both reactors are operating at 100% thermal power.

Which reactor would have the lower $K_{eff}$ five minutes after a reactor scram?

A. Reactor A, because the control rods will add more negative reactivity near the BOC.

B. Reactor A, because the power coefficient is more negative near the BOC.

C. Reactor B, because the control rods will add more negative reactivity near the EOC.

D. Reactor B, because the power coefficient is more negative near the EOC.

QUESTION: 25

A nuclear reactor core is exactly critical well below the point of adding heat during a plant startup. A small amount of positive reactivity is then added to the core, and a stable positive reactor period is established.

With the stable positive reactor period, the following is observed:

| Time | Power Level |
|---|---|
| 0 sec | $3.16 \times 10^{-7}$% |
| 90 sec | $1.0 \times 10^{-5}$% |

Which one of the following will be the reactor power at time = 120 seconds?

A. $3.16 \times 10^{-5}$%

B. $5.0 \times 10^{-5}$%

C. $6.32 \times 10^{-5}$%

D. $1.0 \times 10^{-4}$%

QUESTION: 26

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (ev) resonance peak in U-238 for a nuclear reactor operating at 50% power (see figure below).

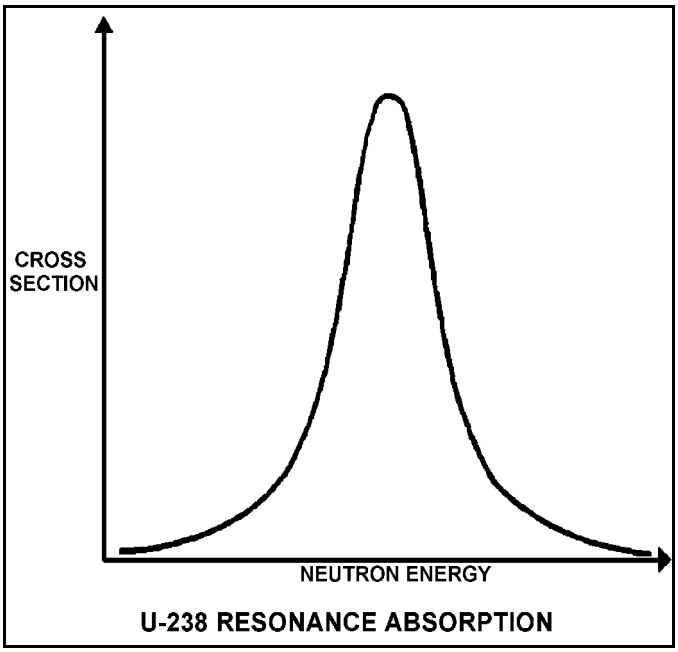
If fuel temperature decreases by 50°F, the area under the curve will _____ and positive reactivity will be added to the core because _____.

A. decrease; fewer neutrons will be absorbed by U-238 overall

B. decrease; fewer 6.7 ev neutrons will be absorbed by U-238 at the resonance energy

C. remain the same; fewer neutrons will be absorbed by U-238 overall

D. remain the same; fewer 6.7 ev neutrons will be absorbed by U-238 at the resonance energy



QUESTION: 27

Which one of the following is the primary reason the void coefficient becomes less negative with core burnup toward the end of core life?

A. The thermal neutron flux increases.

B. The thermal diffusion length decreases.

C. The fuel centerline temperature increases.

D. The control rod density decreases.

QUESTION: 28

A nuclear reactor is exactly critical at the point of adding heat during a reactor startup. Reactor pressure is stable at 600 psig and main steam isolation valves are open. Then, control rods are manually withdrawn for 5 seconds.

Assuming the reactor does not scram, when conditions stabilize, reactor power will be _____ and reactor vessel temperature will be _____.

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher

QUESTION: 29

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

Core average thermal neutron flux = $1 \times 10^{12}$ n/cm$^2$-sec
Control rod tip thermal neutron flux = $5 \times 10^{12}$ n/cm$^2$-sec

If the control rod is slightly withdrawn such that the control rod tip is located in a thermal neutron flux of $1 \times 10^{13}$ n/cm$^2$-sec, then the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A. 0.5

B. 1.4

C. 2.0

D. 4.0

QUESTION: 30

Following a seven day shutdown, a reactor startup is performed and a nuclear power plant is taken to 100% power over a 16-hour period. After reaching 100% power, what type of reactivity will the operator need to add to compensate for core xenon-135 changes over the next 24 hours?

A. Negative only

B. Negative, then positive

C. Positive only

D. Positive, then negative

QUESTION: 31

A nuclear reactor is initially operating at 60% power with equilibrium core xenon-135. Power is increased to 80% over a 2-hour period. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 24 hours after the power change is completed?

A. Greater than 80% and decreasing slowly

B. Greater than 80% and increasing slowly

C. Less than 80% and decreasing slowly

D. Less than 80% and increasing slowly

QUESTION: 32

Why are burnable poisons installed in a nuclear reactor core?

A. To shield reactor fuel from thermal neutron flux until later in core life

B. To compensate for control rod burnout that occurs over core life

C. To flatten the radial thermal neutron flux distribution at the end of core life

D. To ensure a negative moderator temperature coefficient early in core life

QUESTION: 33

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor scram occurred. Reactor pressure is being maintained at 600 psig in anticipation of commencing a reactor startup.

Four hours after the scram, with reactor pressure still at 600 psig, which one of the following will cause the fission rate in the reactor core to increase?

A. Reactor vessel pressure is allowed to increase by 20 psig.

B. Reactor coolant temperature is allowed to increase by 3°F.

C. The operator fully withdraws the first group of control rods.

D. An additional two hours is allowed to pass with no other changes in plant parameters.

QUESTION: 34

A nuclear reactor startup is in progress for a reactor that is in the middle of a fuel cycle. The reactor is at normal operating temperature and pressure. The main steam isolation valves are open and the main turbine bypass (also called steam dump) valves are closed. The reactor is near criticality.

Reactor period is stable at infinity when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser. The operator immediately ensures no control motion is occurring and takes no further action. Assume that the reactor vessel water level remains stable, the reactor does not scram, and no other protective actions occur.

As a result of the valve failure, reactor period will initially become _____; and reactor power will stabilize _____ the point of adding heat.

A. positive; at

B. positive; above

C. negative, but soon turn; at

D. negative, but soon turn; above

QUESTION: 35

With a nuclear reactor on a constant period, which one of the following power changes requires the shortest time to occur?

A. 1% power to 4% power

B. 5% power to 15% power

C. 20% power to 35% power

D. 40% power to 60% power

QUESTION: 36

Shortly after a reactor trip, reactor power indicates $5 \times 10^{-2}$% when a stable negative reactor period is attained. Approximately how much additional time is required for reactor power to decrease to $5 \times 10^{-3}$%?

A. 90 seconds

B. 180 seconds

C. 270 seconds

D. 360 seconds

QUESTION: 37

Refer to the drawing of four differential pressure level detectors (see figure below).

The tanks are identical and are being maintained at 30 psia with a water level of 20 feet. They are surrounded by standard atmospheric pressure. The water temperatures in the tanks and reference legs are the same.

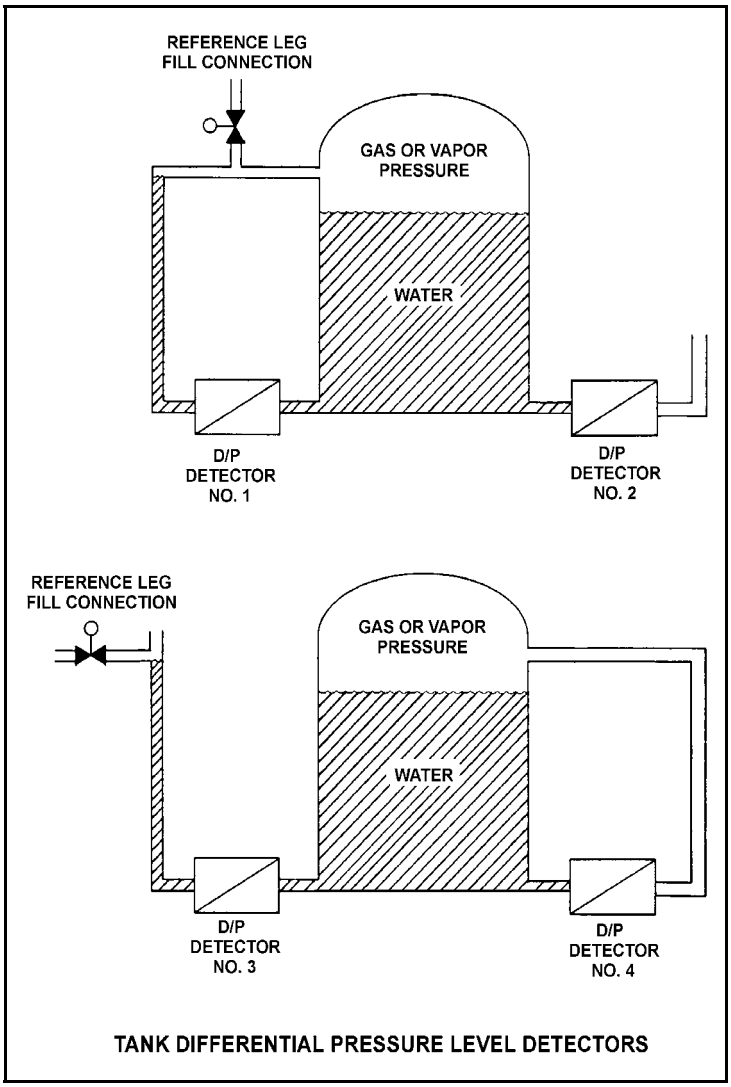
If each detector experiences a ruptured diaphragm, which detector(s) will cause indicated tank level to decrease? (Assume actual tank water level remains constant.)

A. No. 1 only

B. No. 2 only

C. No. 1, 2, and 3

D. No. 2, 3, and 4




TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 38

Water enters an ideal convergent-divergent nozzle with the following parameters:

Pressure = 300 psia
Temperature = 102°F
Velocity = 50 ft/sec

The velocity of the water at the throat of the nozzle is 200 ft/sec.

Given that nozzles convert enthalpy to kinetic energy, and assuming no heat transfer to or from the nozzle, what is the approximate pressure of the water at the throat of the nozzle?

A. 296 psia

B. 150 psia

C. 75 psia

D. 50 psia

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

If the moisture content of the steam supplied to a turbine decreases, steam cycle efficiency will increase because the...

A. enthalpy of the steam being supplied to the turbine has increased.

B. mass flow rate of the steam through the turbine has increased.

C. reheat capacity of the turbine extraction steam has increased.

D. the operating temperature of the turbine blading has increased.

QUESTION: 41

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,000 psig.

Given the following information:

Centrifugal Pumps

| | |
|---|---|
| Shutoff head: | 1,500 psig |
| Maximum design pressure: | 2,000 psig |

Positive Displacement Pumps

| | |
|---|---|
| Maximum design pressure: | 2,000 psig |

Which one of the following pump configurations will supply the lowest makeup flow rate to the system if system pressure is at 1,700 psig?

A. Two CPs in series

B. Two CPs in parallel

C. One PDP and one CP in series (CP supplying PDP)

D. One PDP and one CP in parallel

QUESTION: 42

A reactor shutdown has been performed because of leakage from the main condenser cooling water system into the main condenser through a tube leak.

Given the following initial conditions:

Main condenser pressure is 1.0 psia.
Main condenser cooling water system pressure is 10 psig.
Main condenser cooling water inlet temperature is 60°F.
Cooling water leak rate into the main condenser is 100 gpm.

If the main condenser is brought to atmospheric pressure, with no changes to the main condenser cooling water system parameters, what will be the approximate rate of cooling water leakage into the main condenser?

A. 17 gpm

B. 28 gpm

C. 42 gpm

D. 65 gpm

QUESTION: 43

The power range nuclear instruments have been adjusted to 100% based on a heat balance calculation. Which one of the following will result in indicated reactor power being lower than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 20°F higher than actual feedwater temperature.

B. The reactor coolant pump heat input term was omitted from the heat balance calculation.

C. The feedwater flow rate used in the heat balance calculation were 10% higher than actual flow rates.

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

QUESTION: 44

Subcooled reactor coolant flows into the bottom of a fuel assembly coolant channel and exits the top of the channel as a saturated steam-water mixture with a 98% moisture content. How does the convective heat transfer coefficient in the coolant channel change as the coolant travels upward along the channel?

A. Increases only

B. Increases, then decreases

C. Decreases only

D. Decreases, then increases

QUESTION: 45

Which one of the following is the expected mechanism of fuel damage if a fuel rod exceeds the critical heat flux at 100% power?

A. Loss of pellet integrity

B. Loss of clad integrity

C. Pellet-clad interaction

D. Clad creep

QUESTION: 46

Reactor coolant flow that bypasses the core is necessary to...

A. provide a source of water to the incore thermocouples to ensure they measure a representative coolant temperature.

B. act as a neutron reflector to minimize fast neutron leakage.

C. ensure that recirculation pump flow rate is adequate to prevent pump overheating.

D. provide cooling to prevent excessive boiling in the bypass region.

QUESTION: 47

A nuclear reactor is operating at steady-state 80% reactor power near the beginning of a fuel cycle with core power distribution peaked radially at the center of the core and axially in the bottom half of the core. Only reactor recirculation flow rate adjustments are used to maintain a constant reactor power over the next two months.

Neglecting any change in reactor poison distribution, during the next two months the maximum radial peaking factor will _____, and the maximum axial peaking factor will _____.

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

QUESTION: 48

A BWR core consists of 30,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,350 MW of thermal power. If the total peaking factor for a node is 1.6, what is the maximum local linear power density being produced in the node?

A. 4.0 kW/ft

B. 6.0 kW/ft

C. 8.0 kW/ft

D. 10.0 kW/ft

QUESTION: 49

A nuclear power plant is operating at 60% reactor power. Which one of the following will result in the highest critical power ratio? (Assume neutron flux distribution does not change.)

A. 25% power increase using only recirculation flow

B. 25% power increase using only control rods

C. 25% power decrease using only recirculation flow

D. 25% power decrease using only control rods

QUESTION: 50

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

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the lower average power capacity.

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

C. Reactor B due to the higher average power capacity.

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

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

SEPTEMBER 2006 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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