



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 21, 1996

NOTE TO: Document Control Desk

FROM: Debbie McCain, Licensing Assistant
Division of Reactor Controls
and Human Factors
Operating Licensing Branch

SUBJECT: OCTOBER 1996 GENERIC FUNDAMENTALS EXAMINATION (GFE)

Enclosed please find the October, 1996 GFE examination and answer key to be placed in the PDR. If you have any questions I can be contacted at 415-1065.

A handwritten signature in cursive script that reads "Debbie McCain".

Debbie McCain, Licensing Assistant
Division of Reactor Controls
and Human Factors
Operating Licensing Branch

Enclosure:
As stated

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UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 - FORM A

Please Print

Name: _____
Facility: _____
Docket No.: _____
Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

Answer all the test items using the answer sheet provided. Each item has equal point value. A score of at least 80% is required to pass this portion of the written licensing examination. All examination papers will be collected 2.5 hours after the examination starts. This examination applies to a typical boiling water reactor (BWR) power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 44		
REACTOR THEORY	45 - 72		
THERMODYNAMICS	73 - 100		
TOTALS	100		

All work done on this examination is my own. I have neither given nor received aid.

Applicant's Signature

RULES AND GUIDELINES FOR THE
GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

1. Print your name in the blank provided on the cover sheet of the examination.
2. Fill in the name of your facility.
3. Fill in your individual docket number.
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 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 not received or been given any assistance in completing the examination.
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

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

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

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

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

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

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

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

$$\text{SUR} = 26.06 / \tau$$

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

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

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

$$\lambda_{\text{eff}} = 0.1 \text{ seconds}^{-1}$$

$$P = P_0 10^{\text{SUR}(t)}$$

$$P = P_0 e^{(t/\tau)}$$

$$A = A_0 e^{-\lambda t}$$

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

$$CR_1 (1 - K_{\text{eff}1}) = CR_2 (1 - K_{\text{eff}2})$$

$$1/M = CR_1 / CR_x$$

$$\text{DRW} \propto \phi_{\text{tip}}^2 / \phi_{\text{avg}}^2$$

$$F = PA$$

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

$$\dot{W}_{\text{pump}} = \dot{m} \Delta P v$$

$$E = IR$$

$$\text{Eff.} = \text{Net Work Out} / \text{Energy In}$$

$$v(P_2 - P_1) + \frac{(\bar{v}_2^2 - \bar{v}_1^2)}{2g_c} + \frac{g(z_2 - z_1)}{g_c} = 0$$

$$g_c = 32.2 \text{ lbf} \cdot \text{ft} / \text{lbf} \cdot \text{sec}^2$$

CONVERSIONS

$$1 \text{ Mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ hp} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ Btu} = 778 \text{ ft-lbf}$$

$$^{\circ}\text{C} = (5/9)(^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = (9/5)(^{\circ}\text{C}) + 32$$

$$1 \text{ Curie} = 3.7 \times 10^{10} \text{ dps}$$

$$1 \text{ kg} = 2.21 \text{ lbm}$$

$$1 \text{ gal}_{\text{water}} = 8.35 \text{ lbm}$$

$$1 \text{ ft}^3_{\text{water}} = 7.48 \text{ gal}$$

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 1

Which one of the following is a difference between a typical relief valve and a typical safety valve?

- A. The actuator closing spring on a relief valve is in a compressed state whereas the actuator closing spring on a safety valve acts in tension.
- B. A relief valve gradually opens as pressure increases above the setpoint pressure whereas a safety valve fully opens at the setpoint pressure.
- C. Relief valves are capable of being gagged whereas safety valves are not.
- D. The blowdown of a relief valve is greater than the blowdown of a safety valve.

QUESTION: 2

To verify that a manual valve in an operating system is closed, the operator should observe valve position indication and operate the valve handwheel in the:

- A. open direction until flow sounds are heard, then close the valve using normal force.
- B. close direction using normal force and verify there is no substantial handwheel movement.
- C. close direction until it stops, then close it an additional one-half turn using additional force if necessary.
- D. open direction until the valve stem moves in the open direction, then close the valve using normal force.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 3

A vertical safety valve with a 3-inch diameter disk has a spring applying 1000 lbf to the top of the valve disk in opposition to system pressure. Which one of the following is the approximate system pressure at which the safety valve will begin to open? (Neglect the effect of atmospheric pressure.)

- A. 35 psi
- B. 111 psi
- C. 142 psi
- D. 444 psi

QUESTION: 4

A surveillance test procedure is being performed on a typical Limitorque motor-operated valve (MOV) used in an emergency core cooling system (ECCS) application. The declutch lever has been operated and released and the valve is being manually/locally opened by a technician. The MOV breaker is closed as required by the surveillance test procedure. During operation of the valve handwheel an ECCS actuation signal is received that normally energizes the valve motor and closes the valve.

How will the valve be affected by the actuation signal?

- A. The handwheel will disengage and the valve will automatically close.
- B. The handwheel will disengage and the valve will remain in the current position.
- C. The handwheel will remain engaged and the valve will automatically close.
- D. The handwheel will remain engaged and the technician can continue to open the valve.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 5

When comparing a globe valve and a gate valve in the same application, a gate valve has a _____ pressure drop when fully open and is the _____ choice for throttling.

- A. higher; better
- B. lower; better
- C. higher; poorer
- D. lower; poorer

QUESTION: 6

A plant is operating at 100% power. A steam flow measuring instrument that uses density compensation and square root extraction is being used to measure main steam flow rate.

If the steam pressure sensed by the density compensation circuit decreases, indicated steam flow rate will _____ and if square root extraction is removed, indicated steam flow rate will _____.

- A. increase; increase
- B. increase; decrease
- C. decrease; increase
- D. decrease; decrease

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

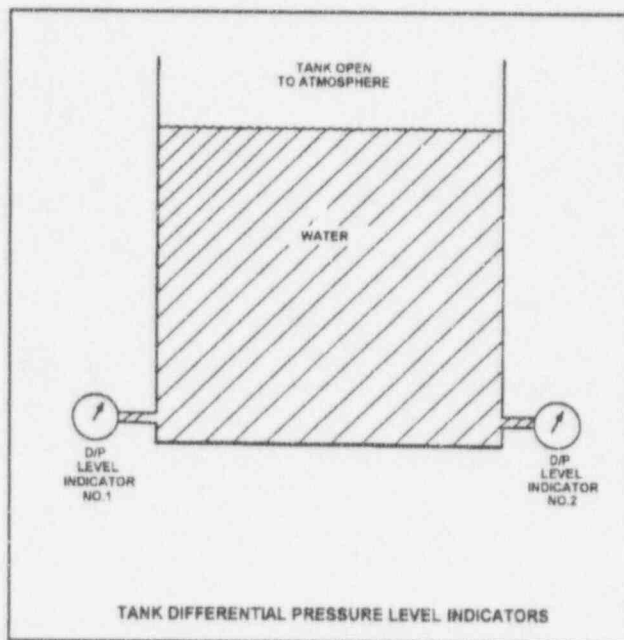
QUESTION: 7

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator No. 1 was calibrated at 200°F water temperature and indicator No. 2 was calibrated at 100°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

- A. Indicator 1 at all water temperatures
- B. Indicator 2 at all water temperatures
- C. Indicator 1 below 150°F, indicator 2 above 150°F
- D. Indicator 2 below 150°F, indicator 1 above 150°F



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 8

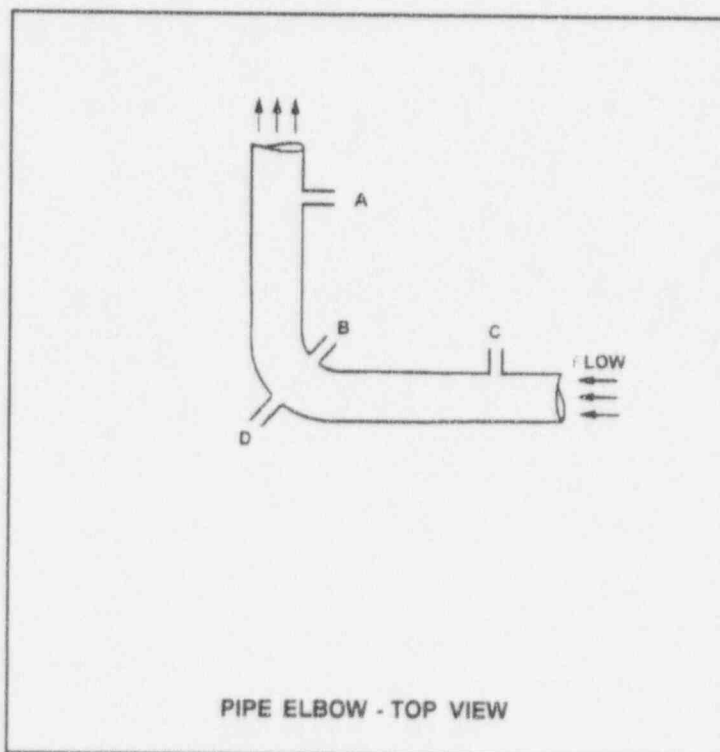
Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

<u>DETECTOR</u>	<u>TAPS</u>
AD	A and D
BD	B and D
CD	C and D

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap D ruptures?

- A. All detectors will fail high.
- B. All detectors will fail low.
- C. Two detectors will fail high and one will fail low.
- D. Two detectors will fail low and one will fail high.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

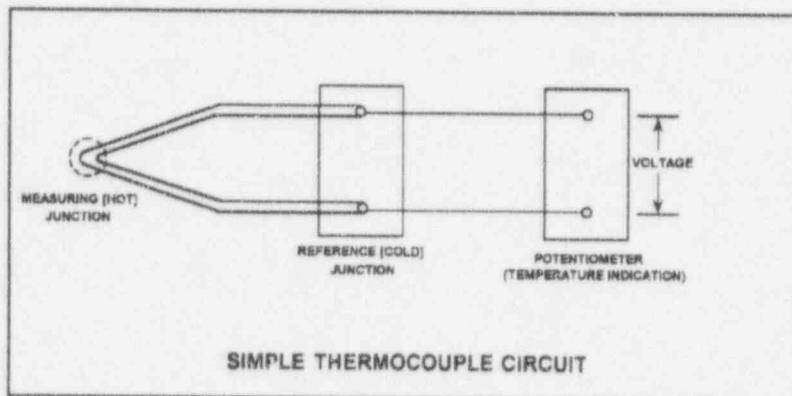
QUESTION: 9

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 150°F .
Reference junction temperature is currently 90°F . Indicator range is from 0°F to 2000°F .

If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

- A. Minimum instrument reading (0°F)
- B. 60°F
- C. 90°F
- D. Maximum instrument reading (2000°F)



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 10

A cooling water system is operating at steady-state conditions indicating 600 gpm with 50 psid across the flow transmitter venturi. If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately:

- A. 63 psid.
- B. 75 psid.
- C. 97 psid.
- D. 112 psid.

QUESTION: 11

The reactor scrammed due to a loss-of-coolant accident 1 hour ago. To verify adequate reactor vessel water level, the source range monitors (SRMs) are inserted. As the SRMs enter the core, count rate begins to increase and then stabilizes.

If the SRMs enter a voided section of the core, count rate will suddenly:

- A. increase due to increased neutron migration length.
- B. increase due to decreased moderator neutron absorption.
- C. decrease due to increased neutron leakage.
- D. decrease due to decreased fast fission.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 12

Which one of the following will cause an upscale failure of a fission chamber neutron detector?

- A. The detector electrode high voltage power supply output has decreased due to setpoint drift.
- B. The detector chamber has become flooded with water due to leakage around the electrodes.
- C. The power supply to the amplifier circuits for the neutron monitoring instrument drawer has failed.
- D. The uranium-235 in the detector coating has been transformed to uranium-236 by neutron absorption.

QUESTION: 13

A Geiger-Mueller radiation detector is located in a radiation field consisting of beta, gamma, and fast neutron radiation. Assuming each type of radiation enters the detector gas chamber and ionizes the detector gas, which one of the following describes the resulting detector pulse sizes?

- A. Beta radiation will produce a larger pulse size than either gamma or fast neutron radiation.
- B. Gamma radiation will produce a larger pulse size than either beta or fast neutron radiation.
- C. Fast neutron radiation will produce a larger pulse size than either beta or gamma radiation.
- D. Beta, gamma, and fast neutron radiation will produce pulse sizes that are equal in magnitude.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 14

Many reactor vessel water level instruments are designed with a condensing chamber in the reference leg. The purpose of the condensing chamber is to:

- A. provide a steady source of makeup water to the reference leg during normal operations.
- B. provide reference leg compensation for the reactor pressure exerted on the variable leg.
- C. prevent reference leg flashing during a rapid depressurization of the reactor vessel.
- D. ensure the reference leg temperature remains near the temperature of the water in the reactor vessel.

QUESTION: 15

A diesel generator is supplying a bus with the governor operating in the isochronous mode. If a large electrical load on the bus trips, generator frequency will:

- A. initially increase, and then decrease and stabilize below the initial value.
- B. initially increase, and then decrease and stabilize at the initial value.
- C. initially increase, and then decrease and stabilize above the initial value.
- D. remain constant during and after load change.

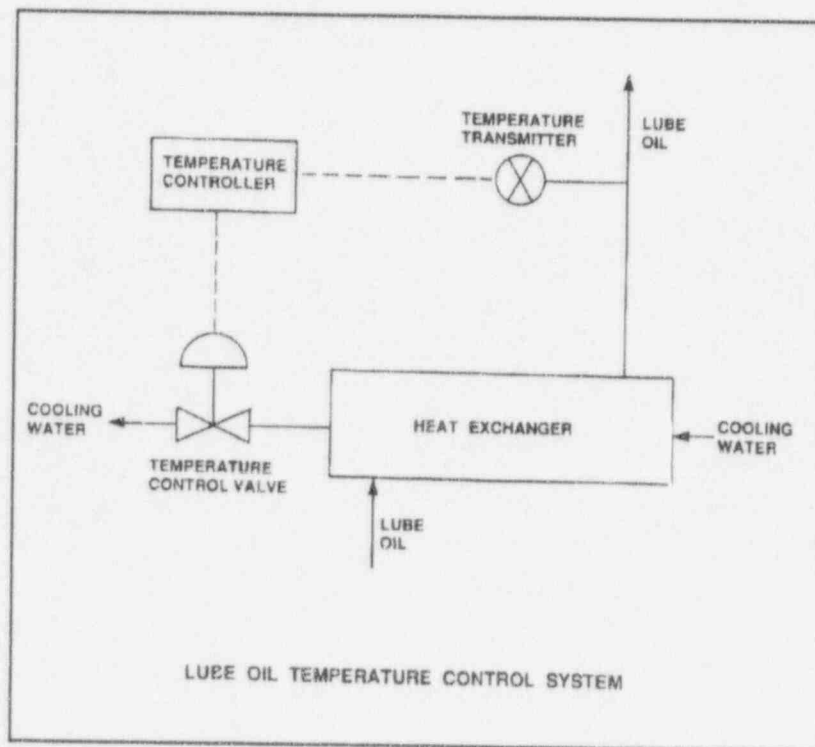
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 16

Refer to the drawing of a lube oil temperature control system (see figure below). The temperature control valve is currently 50% open.

If the cooling water inlet temperature decreases, the temperature controller will throttle the temperature control valve more _____, causing cooling water differential temperature through the heat exchanger to _____.

- A. closed; decrease
- B. closed; increase
- C. open; decrease
- D. open; increase



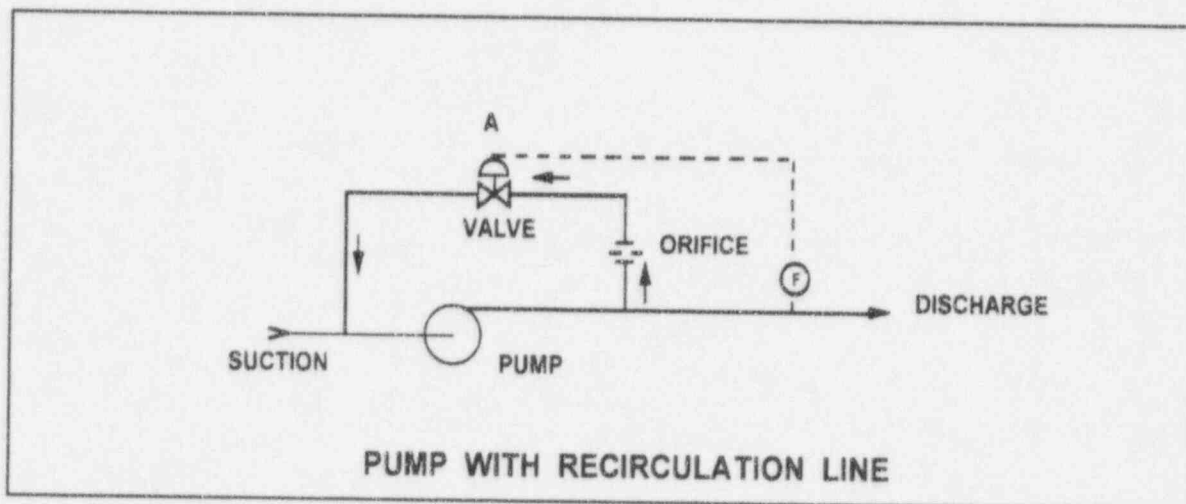
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 17

Refer to the drawing of a pump with recirculation line (see figure below).

Which one of the following describes the response of the pump if a complete flow blockage occurs in the discharge line just downstream of the flow transmitter?

- A. The pump will overheat after a relatively short period of time due to a loss of both main flow and recirculation flow.
- B. The pump will overheat after a relatively long period of time due to a loss of main flow only.
- C. The pump will overheat after a relatively long period of time due to a loss of recirculation flow only.
- D. The pump will be able to operate under these conditions indefinitely due to sustained main flow.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 18

A centrifugal fire water pump is taking a suction on an open storage tank and discharging through a 4-inch diameter fire hose and through a nozzle located 50 feet above the pump.

Which one of the following will cause the pump to operate at shutoff head?

- A. The fire hose is replaced with a 6-inch diameter fire hose.
- B. The fire hose is replaced with a 2-inch diameter fire hose.
- C. Pump speed is increased until steam formation at the eye of the pump prevents pump flow.
- D. Pump speed is decreased until pump discharge pressure is insufficient to cause flow.

QUESTION: 19

A variable speed motor-driven centrifugal pump is operating at rated speed in an open system. If the pump speed is decreased by 50%, available net positive suction head (NPSH) will _____ and required NPSH will _____.

- A. increase; decrease
- B. increase; remain the same
- C. decrease; decrease
- D. decrease; remain the same

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 20

A reactor recirculation pump is circulating reactor coolant at 150°F. After several hours the reactor coolant temperature has increased to 200°F.

Assuming recirculation pump flow rate (gpm) is constant, recirculation pump motor amps will have _____ because _____.

- A. decreased; coolant density has decreased
- B. decreased; system head losses have increased
- C. increased; coolant density has increased
- D. increased; system head losses have decreased

QUESTION: 21

Which one of the following changes in pump operating parameters will directly lead to pump cavitation in a centrifugal pump that is operating in an open system?

- A. Steadily decreasing pump speed
- B. Steadily increasing pump suction pressure
- C. Steadily increasing pump discharge pressure
- D. Steadily increasing pump inlet temperature

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 22

A centrifugal pump is operating at maximum design flow, delivering water through two parallel valves. Valve A is 1/2 open, and valve B is 1/4 open.

Which one of the following will occur if both valves are fully opened?

- A. The pump will immediately operate at shutoff head.
- B. The pump available net positive suction head (NPSH) will increase.
- C. The pump required NPSH will decrease.
- D. The pump will immediately operate at runout conditions.

QUESTION: 23

A typical single-stage radial-flow centrifugal pump is being returned to service following maintenance on its ac motor. Which one of the following will occur when the pump is started if two of the three motor power leads were inadvertently swapped during restoration?

- A. The motor breaker will trip on overcurrent.
- B. The motor will not turn and will emit a humming sound.
- C. The pump will rotate in the reverse direction with reduced or no flow rate.
- D. The pump will rotate in the normal direction with reduced flow rate.

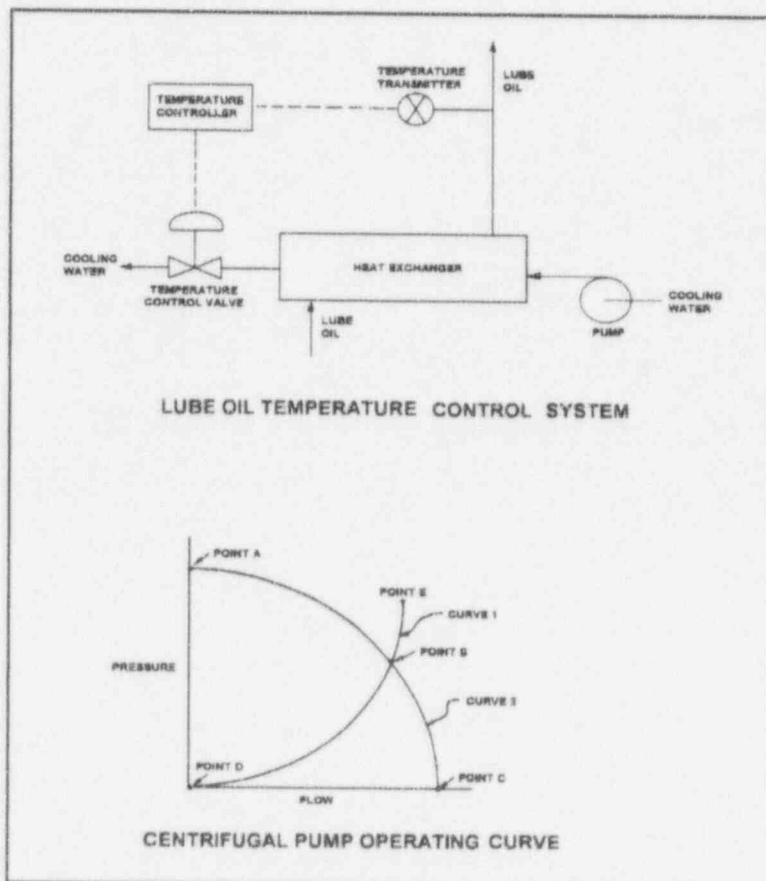
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 24

Refer to the drawing of a lube oil temperature control system and the associated centrifugal pump operating curve (see figure below).

The pump is operating at point B on the operating curve. If the temperature control valve modulates farther closed, operating point B will be located on curve _____, closer to point _____ . (The options below assume that curves 1 and 2 remain exactly as shown in the figure.)

- A. 1; D
- B. 2; A
- C. 1; E
- D. 2; C



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 25

A variable-speed positive displacement pump is operating at 100 rpm with a flow rate of 60 gpm in an open system. To decrease pump flow rate to 25 gpm, pump speed must be decreased to approximately:

- A. 17 rpm.
- B. 33 rpm.
- C. 41 rpm.
- D. 62 rpm.

QUESTION: 26

A motor-driven centrifugal pump exhibited indications of pump failure while being started. Which one of the following pairs of indications will occur if the pump failure is a sheared impeller shaft?

- A. Excessive duration of high starting current and motor breaker trips
- B. Excessive duration of high starting current and no change in system flow rate
- C. Lower than normal running current and motor breaker trips
- D. Lower than normal running current and no change in system flow rate

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 27

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

- A. The relationship between generator output voltage and current can be described as purely resistive.
- B. 80% of the energy input to the generator produces useful output.
- C. 80% of the generator output will be converted to useful power.
- D. This information characterizes the generator as a dc generator.

QUESTION: 28

A diesel generator (D/G) is supplying both kW and kVAR to an electrical bus in parallel with the grid. Assuming D/G and bus voltage do not change, if the D/G voltage regulator setpoint is increased slightly, then D/G kW will _____ and D/G amps will _____.

- A. remain the same; increase
- B. remain the same; remain the same
- C. increase; increase
- D. increase; remain the same

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 29

If the voltage supplied by an ac generator to an isolated electrical bus is held constant while loads (kW) are added to the bus, the current supplied by the generator will increase in direct proportion to the _____ of the change in kW.
(Assume power factor does not change.)

- A. cube root
- B. square root
- C. amount
- D. square

QUESTION: 30

A variable-speed centrifugal pump is operating at 600 rpm with the following parameters:

Pump motor current = 10 amperes
Pump head = 50 psi
Pump flow rate = 200 gpm

What will be the new value of pump head if the pump speed is increased such that the current requirements are now 640 amperes?

- A. 400 psi
- B. 600 psi
- C. 800 psi
- D. 1,200 psi

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 31

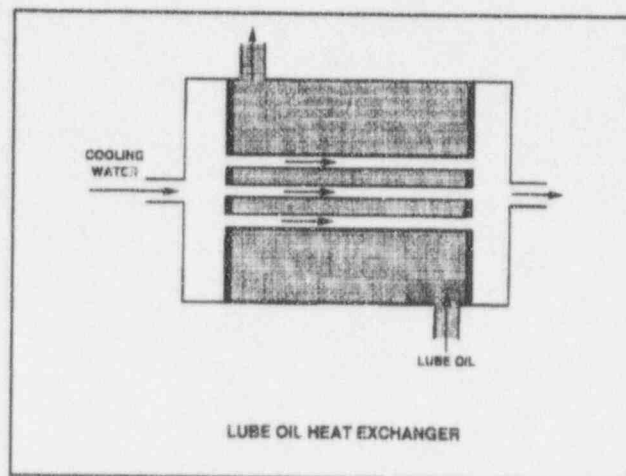
Refer to the drawing of a lube oil heat exchanger (see figure below).

Given the following existing conditions:

C_{p-oil}	$= 1.1 \text{ Btu/lbm-}^{\circ}\text{F}$
$C_{p-water}$	$= 1.0 \text{ Btu/lbm-}^{\circ}\text{F}$
\dot{m}_{oil}	$= 1.8 \times 10^4 \text{ lbm/hr}$
\dot{m}_{water}	$= 1.65 \times 10^4 \text{ lbm/hr}$
$T_{oil \text{ in}}$	$= 115^{\circ}\text{F}$
$T_{oil \text{ out}}$	$= 90^{\circ}\text{F}$
$T_{water \text{ out}}$	$= 110^{\circ}\text{F}$
$T_{water \text{ in}}$	$= ?$

Which one of the following is the cooling water inlet temperature ($T_{water \text{ in}}$) for this heat exchanger?

- A. 50°F
- B. 60°F
- C. 75°F
- D. 80°F



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

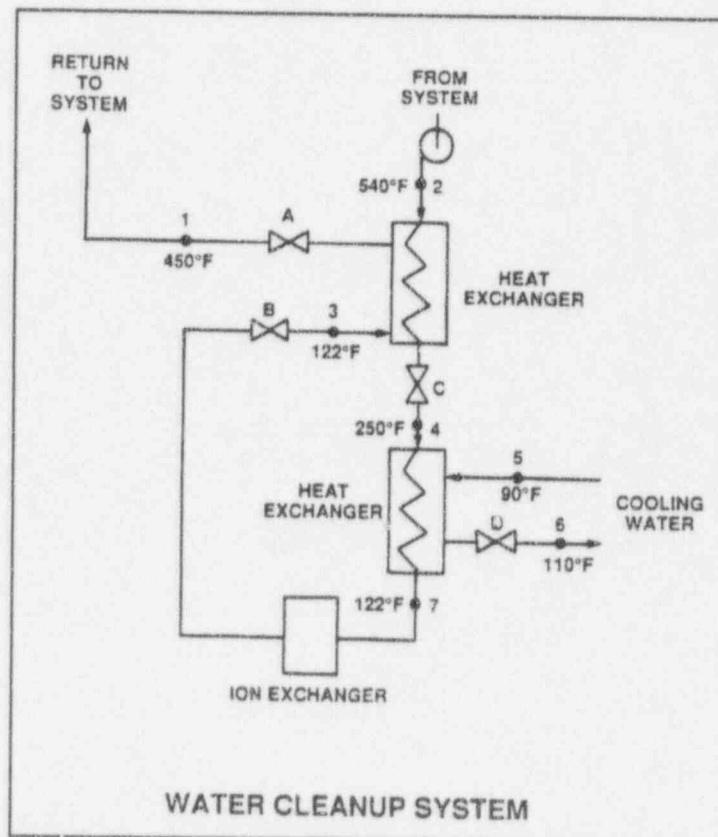
QUESTION: 32

Refer to the drawing of a water cleanup system (see figure below).

Valves A, B, and C are fully open. Valve D is 20% open. All temperatures are as shown. Valve D is then quickly opened to 100%.

The temperature at point:

- A. 3 will increase.
- B. 4 will decrease.
- C. 5 will decrease.
- D. 7 will increase.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 33

A parallel-flow heat exchanger and a counter-flow heat exchanger are being used in the same water-to-water cooling application. Each heat exchanger has the same mass flow rates and inlet temperatures. Each heat exchanger is constructed of the same materials and has the same heat transfer area.

Under these conditions, the parallel-flow heat exchanger will have the _____ heat transfer rate because _____.

- A. higher; the average ΔT across the tubes is greater
- B. higher; the average outlet temperature of the two fluids is higher
- C. lower; the average ΔT across the tubes is smaller
- D. lower; the average outlet temperature of the two fluids is lower

QUESTION: 34

Whenever possible, a heat exchanger should be placed in service by introducing both fluids gradually and simultaneously to:

- A. maximize the heat transferred across the heat exchanger tubes.
- B. minimize erosion damage to the heat exchanger tubes.
- C. provide maximum temperature control of the system being cooled.
- D. prevent excessive thermal stresses in the heat exchanger.

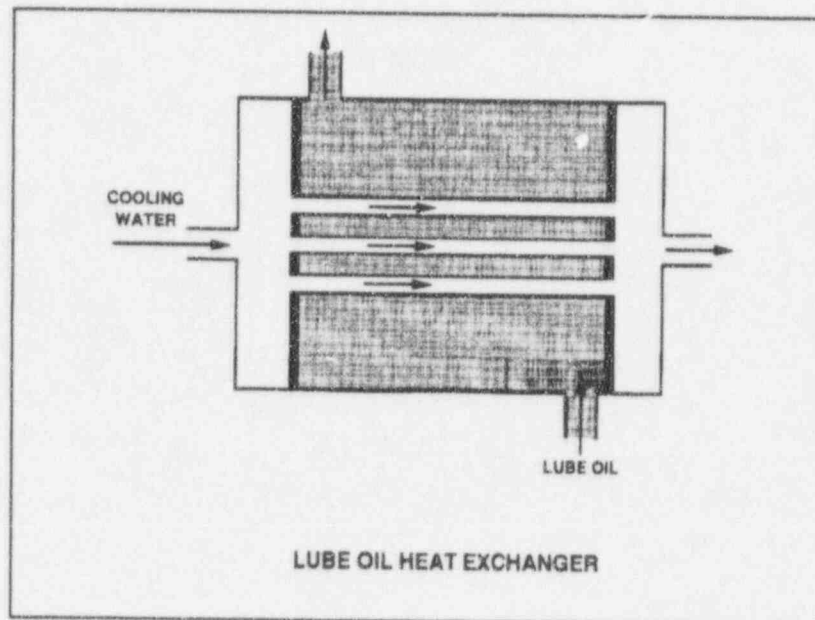
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 35

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

As tube fouling increases in the lube oil heat exchanger, cooling water outlet temperature will _____ and lube oil outlet temperature will _____. (Assume flow rates do not change.)

- A. increase; decrease
- B. increase; increase
- C. decrease; increase
- D. decrease; decrease



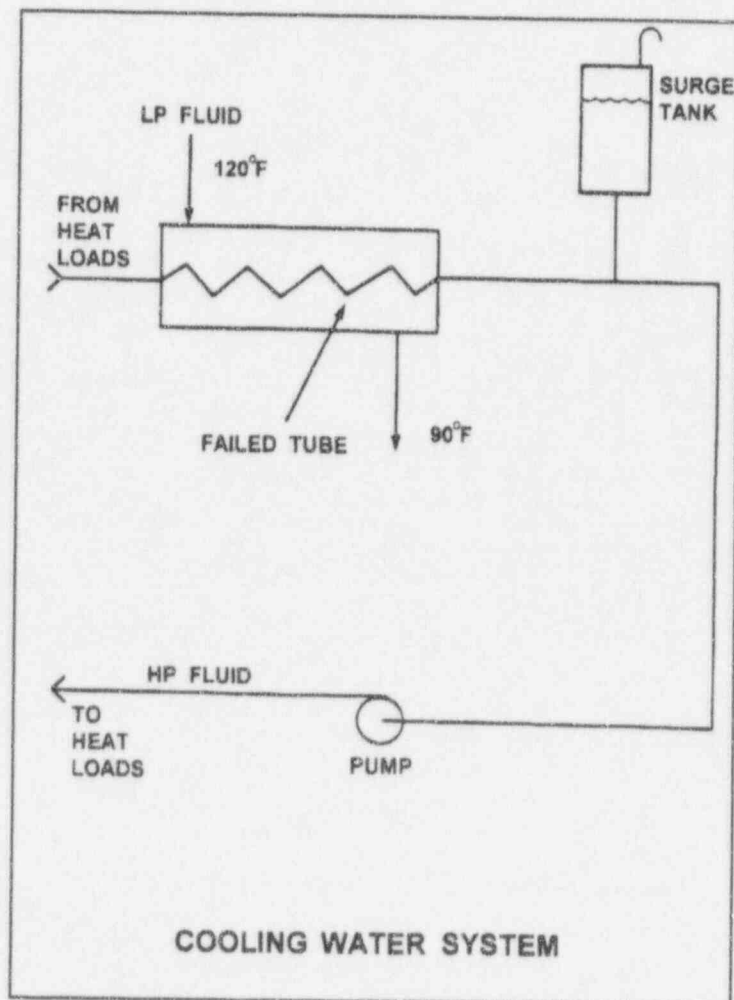
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 36

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

Which one of the following will occur as a result of a tube failure in the heat exchanger?

- A. High pressure fluid inventory increases.
- B. Pressure in the low pressure system decreases.
- C. Temperature in the low pressure system increases.
- D. Level in the surge tank decreases.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 37

A higher than expected differential pressure across an operating demineralizer will be caused by:

- A. depletion of the cation resin.
- B. channeling through the resin bed.
- C. insufficient resin backwash.
- D. decreased demineralizer outlet conductivity.

QUESTION: 38

The cation resin in a mixed-bed demineralizer releases _____ ions into solution while removing _____ ions from solution.

- A. negative; negative
- B. negative; positive
- C. positive; negative
- D. positive; positive

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 39

Which one of the following conditions will lead to channeling in a demineralizer?

- A. Suspended solids and insoluble particles forming a mat on the surface of the resin bed
- B. A sudden 30°F decrease in the temperature of the influent to the demineralizer
- C. Exhaustion of the resin bed due to high conductivity of the demineralizer influent
- D. Operation of the demineralizer with influent flow rate at 10% below design flow rate

QUESTION: 40

Which one of the following describes a benefit of using charged springs (in lieu of a closing coil or solenoid operator) to close some large motor breakers?

- A. Springs produce faster breaker closing.
- B. Springs can be repaired or replaced without removing the breaker from service.
- C. Springs provide stored energy to allow local cycling of the breaker upon loss of control power.
- D. Springs will keep the breaker contacts firmly seated after closing to minimize arcing and prevent inadvertent opening.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 41

A thermal overload device for a large motor protects the motor from:

- A. sustained overcurrent by opening the motor breaker.
- B. sustained overcurrent by magnetically opening motor line contacts at the motor.
- C. instantaneous overcurrent by opening the motor breaker.
- D. instantaneous overcurrent by magnetically opening motor line contacts at the motor.

QUESTION: 42

A main generator is being prepared for paralleling with the grid. Which one of the following conditions will cause the main generator to immediately supply reactive power (MVAR) to the grid when the generator output breaker is closed?

- A. Generator voltage is 1% higher than grid voltage.
- B. Generator voltage is 1% lower than grid voltage.
- C. The synchroscope is turning slowly in the clockwise direction.
- D. The synchroscope is turning slowly in the counterclockwise direction.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 43

Two identical 1000 MW electrical generators are being connected to the same electrical bus. Generator A is currently supplying the bus. Generator A and B output indications are as follows:

<u>Generator A</u>	<u>Generator B</u>
4160 volts	4140 volts
60.2 hertz	60.8 hertz
25 MW	0 MW
10 MVAR	0 MVAR

When the output breaker for generator B is closed, which generator is more likely to trip on reverse power?

- A. Generator A due to the higher initial voltage
- B. Generator A due to the lower initial frequency
- C. Generator B due to the lower initial voltage
- D. Generator B due to the higher initial frequency

QUESTION: 44

A typical main generator is being paralleled to the grid. Generator voltage equals grid voltage and the synchroscope is rotating slowly in the clockwise direction. The generator breaker is closed just prior to the synchroscope pointer reaching the 12 o'clock position.

Which one of the following will occur after the breaker is closed?

- A. The breaker will remain closed and the generator will supply only MW to the grid.
- B. The breaker will remain closed and the generator will supply both MW and MVAR to the grid.
- C. The breaker will open due to overcurrent.
- D. The breaker will open due to reverse power.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 45

Which one of the following will decrease the ability of the coolant to moderate neutrons in a reactor operating at saturated conditions?

- A. Decreasing moderator temperature
- B. Decreasing feedwater inlet temperature
- C. Decreasing reactor pressure vessel pressure
- D. Increasing reactor recirculation system flow

QUESTION: 46

When comparing a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to:

- A. require a greater number of collisions to become a thermal neutron.
- B. be captured by U-238 at a resonant energy peak between 1 eV and 1000 eV.
- C. be born with a lower kinetic energy.
- D. cause thermal fission of a U-235 nucleus.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 47

The effective multiplication factor (K_{eff}) describes the ratio of the number of fission neutrons at the end of one generation to the number of fission neutrons at the _____ of the _____ generation.

- A. beginning; next
- B. beginning; previous
- C. end; next
- D. end; previous

QUESTION: 48

Which one of the following is a reason for installing excess reactivity (k_{excess}) in the core?

- A. To compensate for burnout of Xe-135 and Sm-149 during power changes
- B. To ensure the fuel temperature coefficient remains negative throughout core life
- C. To compensate for the negative reactivity added by the power defect during a power increase
- D. To compensate for the conversion of U-238 to Pu-239 over core life

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 49

A reactor startup is being performed with xenon-free conditions. Rod withdrawal is stopped just prior to criticality and neutron count rate is allowed to stabilize. No additional operator actions are taken.

During the next 30 minutes count rate will:

- A. remain essentially constant.
- B. slowly decrease and stabilize due to long-lived delayed neutron precursors.
- C. slowly decrease to its prestartup level due to buildup of xenon-135.
- D. slowly increase to criticality due to long-lived delayed neutron precursors.

QUESTION: 50

During a reactor startup, the intermediate range monitor readings increase from 30% to 50% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

- A. 357 seconds
- B. 235 seconds
- C. 155 seconds
- D. 61 seconds

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 51

A reactor is exactly critical at the point of adding heat with a xenon-free core. Reactor vessel temperature is 175°F. The operator then inserts control rods until a negative 100 second period is attained and then stops control rod motion.

When rod motion is stopped, reactor period will immediately _____ until power approaches the equilibrium subcritical multiplication source range level and then approach _____.

- A. stabilize at negative 100 seconds; infinity.
- B. stabilize at negative 100 seconds; zero.
- C. lengthen and then stabilize; infinity.
- D. lengthen and then stabilize; zero.

QUESTION: 52

A reactor is shut down with the reactor vessel head removed for refueling. The core is covered by 23 feet of water with a temperature of 100°F.

Which one of the following can both increase and decrease K_{eff} depending on core burnout?

- A. A spent fuel assembly is removed from the core.
- B. Refueling water temperature decreases to 95°F.
- C. A fresh neutron source is installed in the core.
- D. Movable incore source range instrumentation is repositioned to increase source range count rate.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 53

Compared to operating at a low power level, the fuel temperature (Doppler) coefficient of reactivity at a high power level is _____ negative due to _____. (Assume the same core age.)

- A. less; buildup of fission product poisons
- B. more; improved pellet-to-clad heat transfer
- C. less; higher fuel temperature
- D. more; increased neutron flux

QUESTION: 54

Neutron flux shaping in a reactor core reduces radial power peaking:

- A. in the center of the core caused by a high number density of fuel assemblies.
- B. at the periphery of the core caused by moderator reflection of thermal leakage neutrons.
- C. throughout the core caused by uneven burnout of control rod poison material.
- D. throughout the core caused by loading fuel assemblies of various fuel enrichments.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 55

Which one of the following describes the change in magnitude (absolute value) of differential control rod worth during the complete withdrawal of a fully-inserted control rod?

- A. Increases, then decreases
- B. Decreases, then increases
- C. Increases continuously
- D. Decreases continuously

QUESTION: 56

A reactor is exactly critical below the point of adding heat (POAH) during a normal reactor startup. If a control rod is manually withdrawn for 5 seconds, reactor power will:

- A. increase to a stable critical power level below the POAH.
- B. increase temporarily, then decrease and stabilize at the original value.
- C. increase to a stable critical power level at the POAH.
- D. increase temporarily, then decrease and stabilize below the original value.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 57

Which one of the following conditions will cause the associated individual control rod worth(s) to increase?

- A. During a small power change, fuel temperature increases.
- B. With the reactor shut down, reactor coolant temperature increases from 100°F to 200°F.
- C. During a small power change, the percentage of voids increases.
- D. During a control pattern adjust, the local thermal neutron flux surrounding a control rod decreases while the core average thermal neutron flux remains the same.

QUESTION: 58

A reactor has been operating at full power for several weeks. Xenon-135 is being produced as a fission product in approximately _____ of all fissions.

- A. 100%
- B. 30%
- C. 3%
- D. 0.3%

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 59

A reactor has been operating at full power for one month when power is decreased and stabilized at 25% over 2 hours. Which one of the following will be the status of core xenon-135 concentration 24 hours after power reaches 25%?

- A. At equilibrium
- B. Increasing toward a peak
- C. Decreasing toward a valley
- D. Decreasing toward equilibrium

QUESTION: 60

Following a seven day shutdown, a reactor startup is performed and a 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 xenon changes over the next 24 hours?

- A. Negative only
- B. Negative, then positive
- C. Positive, then negative
- D. Positive only

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 61

A fission product poison can be differentiated from all other fission products in that a fission product poison will:

- A. be produced in direct proportion to the fission rate in the core.
- B. remain radioactive for thousands of years after the final reactor criticality.
- C. depress the power production in some core locations and cause peaking in others.
- D. migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

QUESTION: 62

A reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period and stabilized. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 10 hours after the power change?

- A. Greater than 75% and decreasing slowly
- B. Greater than 75% and increasing slowly
- C. Less than 75% and decreasing slowly
- D. Less than 75% and increasing slowly

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 63

A reactor had been operating at 100% power for two weeks when power was reduced to 50% over a 1-hour period. In order to maintain reactor power stable during the next 24 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, then insert rods slowly.
- C. Insert rods slowly during the entire period.
- D. Insert rods slowly at first, then withdraw rods slowly.

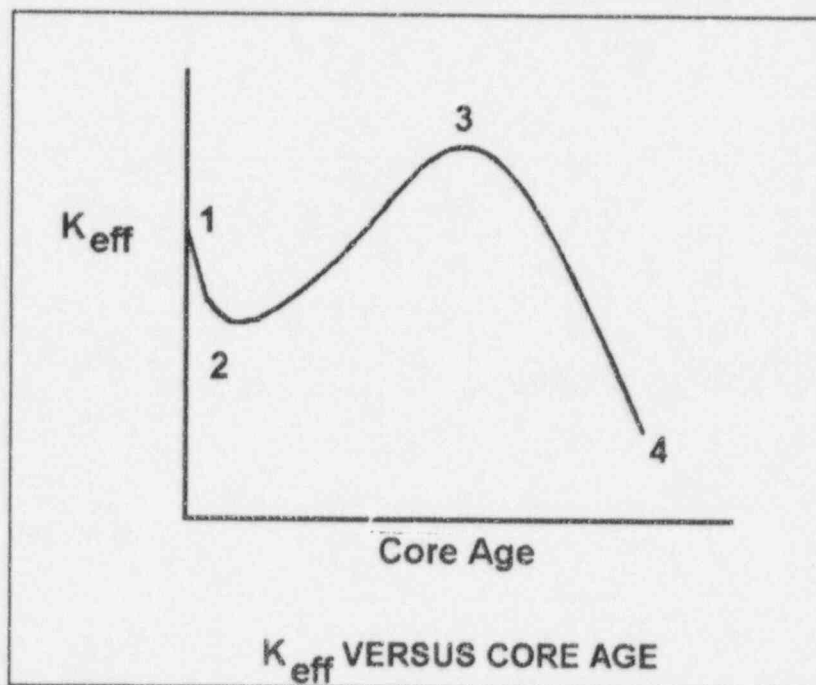
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 64

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:

- A. depletion of U-235.
- B. depletion of U-238.
- C. burnout of burnable poisons.
- D. buildup of fission product poisons.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 65

During a reactor startup, the operator adds 1.0% $\Delta K/K$ of positive reactivity by withdrawing control rods, thereby increasing equilibrium source range neutron level from 220 cps to 440 cps.

Approximately how much additional positive reactivity is required to raise the equilibrium source range neutron level to 880 cps?

- A. 4.0% $\Delta K/K$
- B. 2.0% $\Delta K/K$
- C. 1.0% $\Delta K/K$
- D. 0.5% $\Delta K/K$

QUESTION: 66

A reactor is critical just below the point of adding heat (POAH) at a temperature of 160°F. Which one of the following will result in reactor power increasing and stabilizing at the POAH? (Assume a negative moderator temperature coefficient.)

- A. Reactor recirculation flow increases 10%.
- B. Reactor coolant temperature increases 3°F.
- C. A single control rod moves in one notch.
- D. Core xenon-135 concentration decreases.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 67

A reactor is critical well below the point of adding heat when a small amount of positive reactivity is added to the core. If the same amount of negative reactivity is added to the core 1 minute later, reactor power will stabilize at:

- A. the initial power level.
- B. somewhat higher than the initial power level.
- C. somewhat lower than the initial power level.
- D. the subcritical multiplication equilibrium level.

QUESTION: 68

A reactor is operating at 100% power at the end of core life. The greatest contribution to core heat production is being provided by the fission of:

- A. U-235 and U-238.
- B. U-238 and Pu-239.
- C. U-235 and Pu-239.
- D. U-238 and Pu-241.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 69

A reactor startup is in progress with a current K_{eff} of 0.95 and a current equilibrium source range count rate of 120 cps. Which one of the following equilibrium count rates will occur when K_{eff} becomes 0.98?

- A. 210 cps
- B. 245 cps
- C. 300 cps
- D. 375 cps

QUESTION: 70

Which one of the following power changes requires the greatest amount of positive reactivity addition?

- A. 3% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 60% power

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 71

A plant is operating at 100% power at the end of core life when a single main steam isolation valve suddenly closes. Prior to a reactor scram, reactor power will initially:

- A. increase due to positive reactivity addition from the void coefficient only.
- B. increase due to positive reactivity addition from the void and moderator coefficients.
- C. decrease due to negative reactivity addition from the Doppler coefficient only.
- D. decrease due to negative reactivity addition from the Doppler and moderator temperature coefficients.

QUESTION: 72

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the longest amount of time to occur?

- A. 3% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 60% power

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

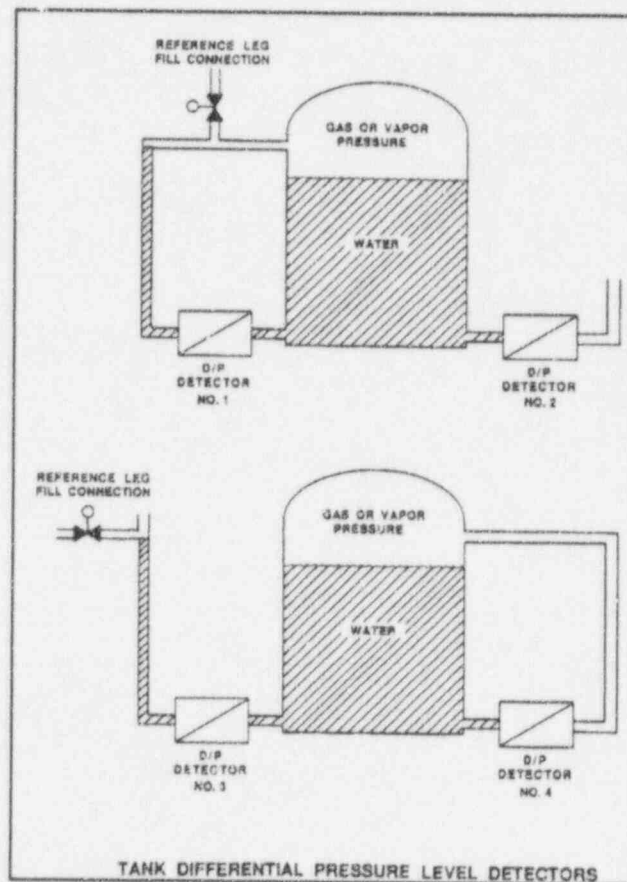
QUESTION: 73

Refer to the drawing of four tank differential pressure level detectors (see figure on next page).

The tanks are identical and are being maintained at 17 psia and the same constant water level. They are surrounded by standard atmospheric pressure. The water in the tank and reference leg is at the same temperature.

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 and 3
- D. No. 2 and 4



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 74

Consider a saturated water/steam mixture at 500°F with a quality of 90%. If the pressure of the mixture is decreased with no heat gain or loss, the temperature of the mixture will _____ and the quality of the mixture will _____. (Assume the mixture remains saturated.)

- A. decrease; decrease
- B. decrease; increase
- C. remain the same; decrease
- D. remain the same; increase

QUESTION: 75

A plant is operating at 50% power. Main steam at a main turbine steam inlet valve has the following properties:

Pressure: 900 psia
Quality: 98%

The main turbine steam chest pressure is 400 psia. Which one of the following is the approximate quality of the steam in the steam chest?

- A. 97%
- B. 98%
- C. 99%
- D. 100%

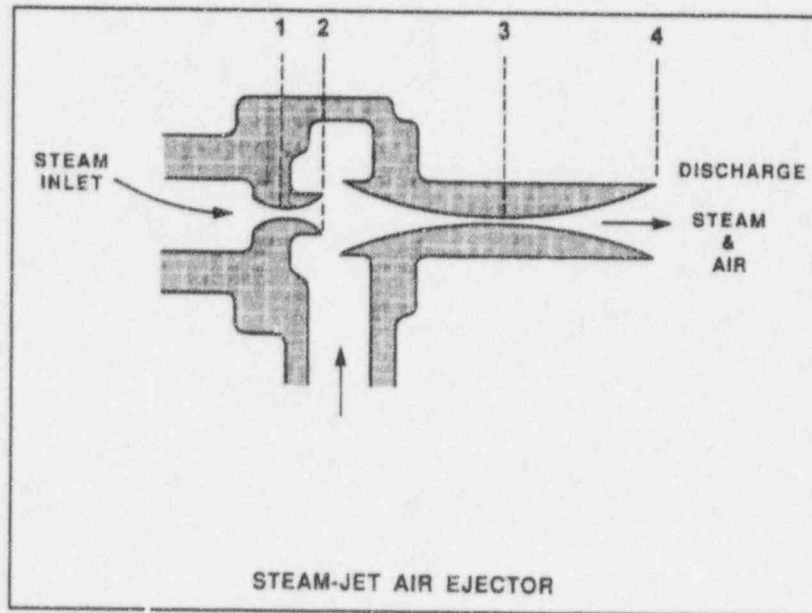
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OCTOBER 1996 BWR - FORM A

QUESTION: 76

Refer to the drawing of a steam-jet air ejector (see figure below).

In the figure of an operating steam-jet air ejector, steam flowing from 1 to 2 undergoes a pressure _____ and a velocity _____.

- A. increase; decrease
- B. increase; increase
- C. decrease; decrease
- D. decrease; increase



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 77

A plant is operating at 90% of rated power. Main condenser pressure is 1.69 psia and hotwell condensate temperature is 120°F.

Which one of the following describes the effect of a 5% decrease in cooling water flow rate through the main condenser?

- A. Overall steam cycle efficiency will increase because the turbine will be operating more efficiently.
- B. Overall steam cycle efficiency will increase because condensate depression will decrease.
- C. Overall steam cycle efficiency will decrease because the turbine will be operating less efficiently.
- D. Overall steam cycle efficiency will decrease because condensate depression will increase.

QUESTION: 78

The location in a main turbine that experiences the greatest amount of blade erosion is in the _____ stage of the _____ pressure turbine.

- A. last; high
- B. last; low
- C. first; high
- D. first; low

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 79

A centrifugal pump is operating at rated flow and pressure in an open system. A break occurs in the pump discharge piping resulting in a loss of pump back-pressure.

Under these conditions, the pump will be operating at a _____ flow rate and drawing _____ electrical power.

- A. lower; less
- B. higher; less
- C. lower; more
- D. higher; more

QUESTION: 80

An 80 gpm leak has developed in a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

- A. 69 gpm
- B. 60 gpm
- C. 51 gpm
- D. 40 gpm

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 81

Which one of the following will minimize the possibility of water hammer?

- A. Draining the discharge line of a centrifugal pump after shutdown
- B. Draining condensate out of steam lines before and after initiating flow
- C. Starting a centrifugal pump with its discharge valve fully open
- D. Starting a positive displacement pump with its discharge valve partially closed

QUESTION: 82

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. 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 lower than actual feedwater temperature.
- B. The reactor recirculation pump heat input term was omitted from the heat balance calculation.
- C. The feedwater flow rate used in the heat balance calculation was lower than actual feedwater flow rate.
- D. The steam pressure used in the heat balance calculation was lower than actual steam pressure.

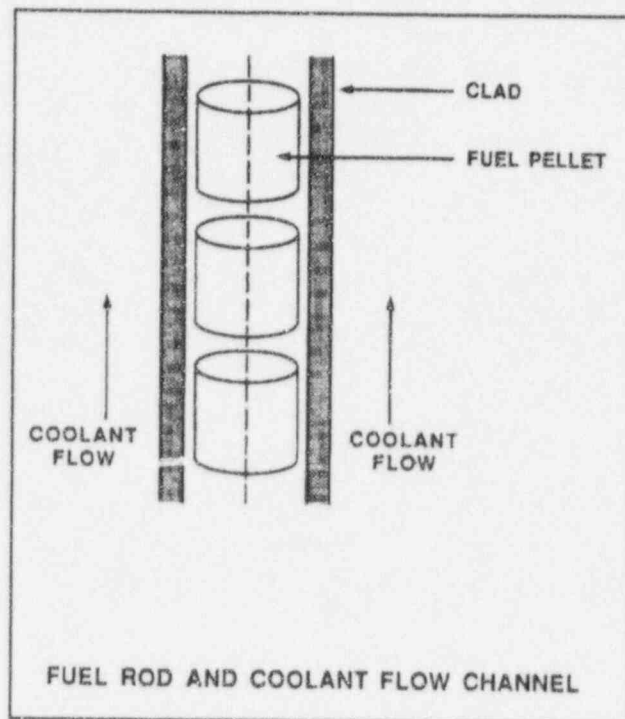
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 83

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

What is the primary method of heat transfer through the gap between the reactor fuel and the fuel clad?

- A. Radiation
- B. Conduction
- C. Convection
- D. Natural circulation



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 84

During a plant outage, 6% of the main condenser tubes were plugged. The following 100% power conditions existed before the outage:

Main condenser pressure:	1.20 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	92°F

After the outage, the plant was returned to 100% power. The following 100% power conditions existed after the outage:

Main condenser pressure:	1.31 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	?

If the total heat transfer rate in the main condenser is the same, which one of the following will be the final cooling water outlet temperature?

- A. 94°F
- B. 96°F
- C. 98°F
- D. 100°F

QUESTION: 85

Which one of the following is a characteristic of subcooled nucleate boiling but not saturated nucleate boiling?

- A. T_{Clad} equals T_{Sat}
- B. T_{Clad} is greater than T_{Sat}
- C. $T_{\text{Bulk Coolant}}$ equals T_{Sat}
- D. $T_{\text{Bulk Coolant}}$ is less than T_{Sat}

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 86

For boiling to occur, the coolant adjacent to the fuel rod must have sufficient heat flux for vapor bubble formation. Select the characteristic below that will aid in bubble formation.

- A. Surface scratches or cavities in the fuel clad
- B. Subsurface void defect in the fuel clad
- C. Increased coolant velocity past the fuel rod
- D. Chemically inert material dissolved in the coolant

QUESTION: 87

Two reactors have the same rated power level and are currently operating at 50% power with a normal neutron flux distribution in each core. The reactors are identical except that one core has core orifices and the other core does not. Each reactor has the same core mass flow rate.

The orificed core will have the _____ critical power and the _____ core differential pressure.

- A. higher; higher
- B. higher; lower
- C. lower; higher
- D. lower; lower

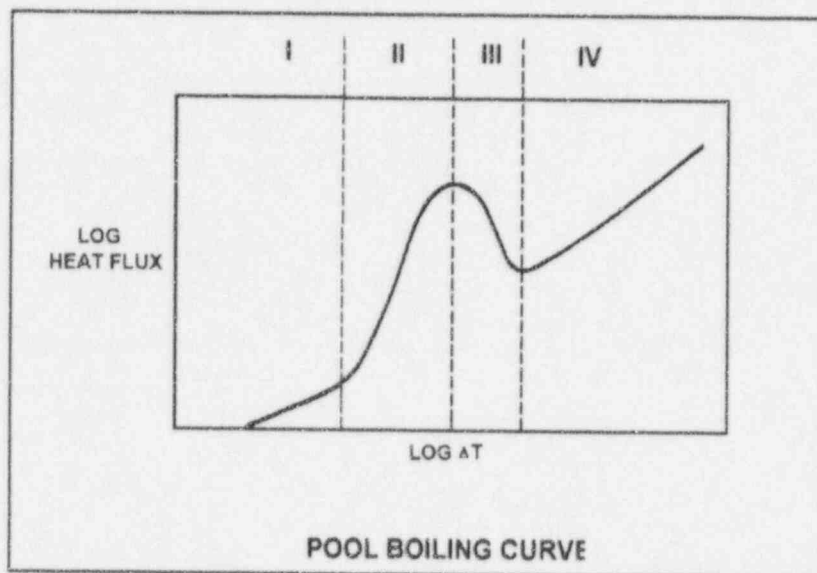
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 88

Refer to the drawing of a pool boiling curve (see figure below).

Which region of the curve contains the point at which the hottest locations of the reactor core normally operate to transfer heat from the cladding to the coolant at 100% power?

- A. Region I
- B. Region II
- C. Region III
- D. Region IV



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 89

A reactor is operating at steady state 70% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become farther from the onset of transition boiling? (Assume reactor power does not change unless stated.)

- A. Recirculation flow rate increases.
- B. Reactor pressure increases.
- C. Feedwater temperature increases.
- D. Associated bundle power increases.

QUESTION: 90

Reactors A and B are identical. Reactor A is operating at 75% power and reactor B is operating at 50% power with neutron flux radially and axially peaked in the center of each core. Recirculation mass flow rate through each core is the same.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B has the _____ critical power and the _____ coolant flow rate.

- A. lower; lower
- B. lower; higher
- C. higher; lower
- D. higher; higher

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 91

A reactor is operating at 70% power. Recirculation flow rate is increased by 5%.

Which one of the following statements describes the initial response of the boiling boundary within the core?

- A. It physically moves up the fuel rods, because fewer Btus per pound mass of water are now being transferred.
- B. It physically moves up the fuel rods, because more Btus per pound mass of water are now being transferred.
- C. It physically moves down the fuel rods, because more Btus per pound mass of water are now being transferred.
- D. It physically moves down the fuel rods, because fewer Btus per pound mass of water are now being transferred.

QUESTION: 92

Which one of the following is responsible for the clad failure caused by operating the reactor above the limit for linear heat generation rate?

- A. Fission product gas expansion causes clad internal design pressure to be exceeded.
- B. Corrosion buildup on the fuel clad surface reduces heat transfer and promotes transition boiling.
- C. The zirconium-water reaction causes accelerated oxidation of the clad at high temperatures.
- D. The difference between thermal expansion rates of the fuel pellets and the clad causes severe clad stress.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 93

The 2200°F maximum peak fuel cladding temperature limit is imposed because:

- A. the thermal conductivity of zircaloy decreases rapidly at temperatures above 2200°F causing an unacceptably sharp rise in the fuel centerline temperature.
- B. any cladding temperature higher than this correlates to a fuel centerline temperature above the fuel melting point.
- C. the rate of the zircaloy-steam reaction becomes significant at temperatures above 2200°F.
- D. 2200°F is approximately 500°F below the fuel cladding melting temperature.

QUESTION: 94

Which one of the following describes the fuel-to-coolant thermal conductivity at the end of core life (EOL) as compared to the beginning of core life (BOL)?

- A. Smaller at EOL due to fuel pellet densification
- B. Smaller at EOL due to contamination of fill gas with fission product gases
- C. Larger at EOL due to reduction in gap between fuel pellets and clad
- D. Larger at EOL due to greater temperature difference between fuel pellets and coolant

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 95

A step increase in reactor power results in a fuel cladding surface temperature increase from 560°F to 590°F at steady state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel cladding surface temperature 6 seconds after the power change?

- A. 579°F
- B. 575°F
- C. 570°F
- D. 567°F

QUESTION: 96

A reactor is operating at 65% of rated thermal power with power distribution peaked radially in the center of the core and axially toward the bottom of the core. Reactor power is then increased to 75% over the next 2 hours using only shallow control rods that are centrally-located.

Neglecting any effect from reactor poisons, when power is stabilized at 75%, the radial peaking factors generally will have increased in the _____ half of the center fuel bundles and the axial peaking factors generally will have increased in the _____ half of the center fuel bundles.

- A. bottom; top
- B. bottom; bottom
- C. top; top
- D. top; bottom

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 97

If reactor feedwater temperature suddenly decreases by 10°F during operation at 75% power, critical power will _____ and bundle power will _____. (Assume the reactor does not scram.)

- A. increase; increase
- B. decrease; increase
- C. increase; decrease
- D. decrease; decrease

QUESTION: 98

Reactor power will be closest to the critical power if a reactor is operating with a _____ axial power distribution and a _____ recirculation flow. (Assume a constant total reactor power for each of the following core conditions.)

- A. top-peaked; low
- B. top-peaked; high
- C. bottom-peaked; low
- D. bottom-peaked; high

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 BWR - FORM A

QUESTION: 99

Which one of the following will prevent brittle fracture failure of a reactor vessel?

- A. Manufacturing the reactor vessel from low carbon steel
- B. Operating above the reference temperature for nil-ductility transition (RT_{NDT}).
- C. Maintaining the number of reactor vessel heatup/cooldown cycles within limits
- D. Maintaining reactor vessel heatup/cooldown rates within limits

QUESTION: 100

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

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

- A. Reactor A due to the fewer number of heatup/cooldown cycles
- B. Reactor A due to the higher average power capacity
- C. Reactor B due to the greater number of heatup/cooldown cycles
- D. Reactor B due to the lower average power capacity

*** FINAL ANSWER KEY ***

OCTOBER 1996 GENERIC FUNDAMENTALS EXAM
BOILING WATER REACTOR - ANSWER KEY

FORM			ANS	FORM			ANS	FORM			ANS	FORM			ANS
A	B			A	B			A	B			A	B		
1	29		B	26	54		D	51	79		C	76	4		D
2	30		B	27	55		C	52	80		B	77	5		C
3	31		C	28	56		A	53	81		C	78	6		B
4	32		A	29	57		C	54	82		A	79	7		D
5	33		D	30	58		C	55	83		A	80	8		A
6	34		C	31	59		D	56	84		C	81	9		B
7	35		B	32	60		B	57	85		B	82	10		DELETED
8	36		B	33	61		C	58	86		D	83	11		B
9	37		A	34	62		D	59	87		D	84	12		A
10	38		D	35	63		C	60	88		D	85	13		D
11	39		C	36	64		D	61	89		C	86	14		A
12	40		B	37	65		C	62	90		D	87	15		A
13	41		D	38	66		D	63	91		B	88	16		B
14	42		A	39	67		A	64	92		A	89	17		A
15	43		B	40	68		C	65	93		D	90	18		D
16	44		B	41	69		A	66	94		D	91	19		A
17	45		B	42	70		A	67	95		B	92	20		D
18	46		D	43	71		B	68	96		C	93	21		C
19	47		A	44	72		A	69	97		C	94	22		C
20	48		A	45	73		C	70	98		D	95	23		A
21	49		D	46	74		A	71	99		A	96	24		B
22	50		D	47	75		D	72	100		B	97	25		A
23	51		C	48	76		C	73	1		D	98	26		A
24	52		B	49	77		A	74	2		B	99	27		B
25	53		C	50	78		B	75	3		A	100	28		B

UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 - FORM A

Please Print

Name: _____
Facility: _____
Docket No.: _____
Start Time: _____ Stop Time: _____

INSTRUCTIONS TO CANDIDATE

Answer all the test items using the answer sheet provided. Each item has equal point value. A score of at least 80% is required to pass this portion of the written licensing examination. All examination papers will be collected 2.5 hours after the examination starts. This examination applies to a typical pressurized water reactor (PWR) power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 44		
REACTOR THEORY	45 - 72		
THERMODYNAMICS	73 - 100		
TOTALS	100		

All work done on this examination is my own. I have neither given nor received aid.

Applicant's Signature

RULES AND GUIDELINES FOR THE
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 the name of your facility.
3. Fill in your individual docket number.
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 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 not received or been given any assistance in completing the examination.
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

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

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

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

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

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

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

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

$$\text{SUR} = 26.06 / \tau$$

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

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

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

$$\lambda_{\text{eff}} = 0.1 \text{ seconds}^{-1}$$

$$P = P_0 10^{\text{SUR}(t)}$$

$$P = P_0 e^{(t/\tau)}$$

$$A = A_0 e^{-\lambda t}$$

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

$$CR_1 (1 - K_{\text{eff}1}) = CR_2 (1 - K_{\text{eff}2})$$

$$1/M = CR_1 / CR_X$$

$$\text{DRW} \propto \phi_{\text{tip}}^2 / \phi_{\text{avg}}^2$$

$$F = PA$$

$$\dot{m} = \rho A \bar{V}$$

$$\dot{W}_{\text{pump}} = \dot{m} \Delta P_v$$

$$E = IR$$

$$\text{Eff.} = \text{Net Work Out} / \text{Energy In}$$

$$v(P_2 - P_1) + \frac{(\bar{V}_2^2 - \bar{V}_1^2)}{2g_c} + \frac{g(z_2 - z_1)}{g_c} = 0$$

$$g_c = 32.2 \text{ lbm-ft/lbf-sec}^2$$

CONVERSIONS

$$1 \text{ Mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ hp} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ Btu} = 778 \text{ ft-lbf}$$

$$^{\circ}\text{C} = (5/9)(^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = (9/5)(^{\circ}\text{C}) + 32$$

$$1 \text{ Curie} = 3.7 \times 10^{10} \text{ dps}$$

$$1 \text{ kg} = 2.21 \text{ lbm}$$

$$1 \text{ gal}_{\text{water}} = 8.35 \text{ lbm}$$

$$1 \text{ ft}^3_{\text{water}} = 7.48 \text{ gal}$$

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

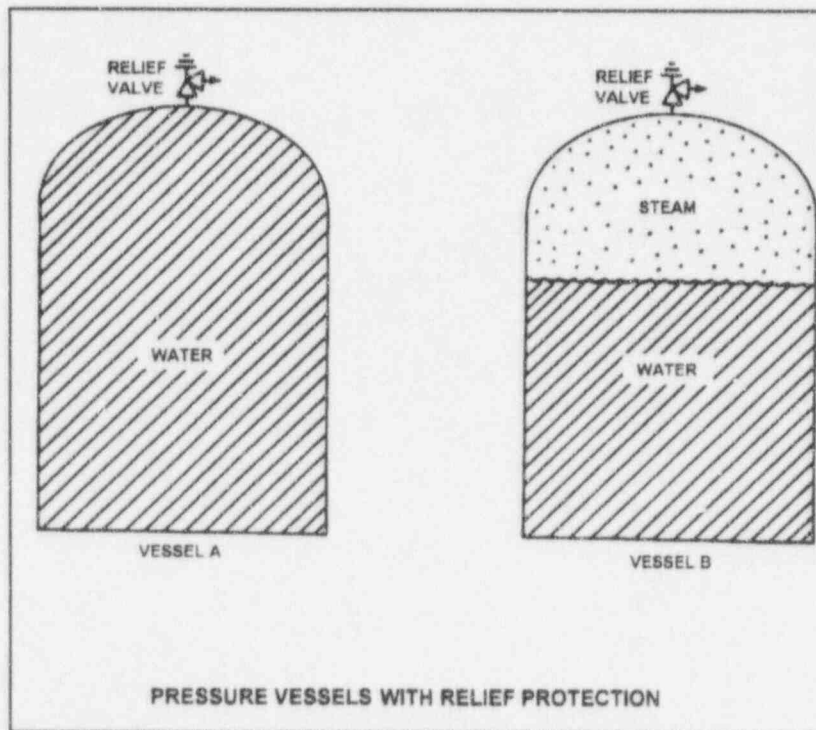
QUESTION: 1

Refer to the drawing of two pressure vessels with relief protection (see figure below).

Vessel A is completely filled with water at 150°F. Vessel B is in a saturated condition containing 1/2 steam (100% quality) and 1/2 water (0% quality). Both vessels are currently pressurized to 50 psig and are protected by identical relief valves.

If both relief valves open simultaneously, the faster pressure reduction will occur in vessel _____ and if both relief valves close at 40 psig, the greater mass loss will have occurred in vessel _____.

- A. A; A
- B. A; B
- C. B; A
- D. B; B



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 2

An adjustment has just been completed on the packing gland of a pneumatically-operated control valve to stop existing stem leakage. Which one of the following will occur if the operator overtightened the packing gland?

- A. Binding of the valve disk with the valve seat
- B. Separation of the valve disk from the valve stem
- C. Misalignment of valve position limit switches
- D. Increased stroke time from fully open to fully closed

QUESTION: 3

A surveillance test procedure is being performed on a typical Limitorque motor-operated valve (MOV) used in an emergency core cooling system (ECCS) application. The declutch lever has been operated and released and the valve is being manually/locally opened by a technician. The MOV breaker is closed as required by the surveillance test procedure. During operation of the valve handwheel an ECCS actuation signal is received that normally energizes the valve motor and closes the valve.

How will the valve be affected by the actuation signal?

- A. The handwheel will disengage and the valve will automatically close.
- B. The handwheel will disengage and the valve will remain in the current position.
- C. The handwheel will remain engaged and the valve will automatically close.
- D. The handwheel will remain engaged and the technician can continue to open the valve.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 4

When comparing a typical gate valve to a typical globe valve in the same application with both valves 50% open, the globe valve has a _____ pressure drop and is the better choice for _____ flow in high-pressure fluid systems.

- A. higher; throttling
- B. higher; isolating
- C. lower; throttling
- D. lower; isolating

QUESTION: 5

A plant is operating at 100% power. A main steam flow measuring instrument uses density compensation and square root extraction to convert the D/P sensed by the steam flow detector to main steam mass flow rate.

If the steam pressure sensed by the density compensation circuit decreases, indicated flow rate will _____ and if square root extraction is removed, indicated flow rate will _____.

- A. increase; increase
- B. increase; decrease
- C. decrease; increase
- D. decrease; decrease

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 6

Which one of the following will cause indicated flow rate to be higher than actual flow rate when using a differential pressure flow detector with a calibrated orifice?

- A. The flow detector equalizing valve is inadvertently opened.
- B. A leak develops in the high pressure sensing line.
- C. Debris becomes lodged in the orifice.
- D. The orifice erodes over time.

QUESTION: 7

A bourdon-tube pressure detector that is indicating 50% of scale is suddenly exposed to a high-pressure transient that permanently distorts the detector. Actual pressure then returns to its original value.

Assuming the detector remains intact, the affected pressure indication will initially go off-scale high, and then:

- A. return to the original pressure.
- B. return to a pressure less than the original pressure.
- C. return to a pressure greater than the original pressure.
- D. become unpredictable until the instrument is calibrated.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

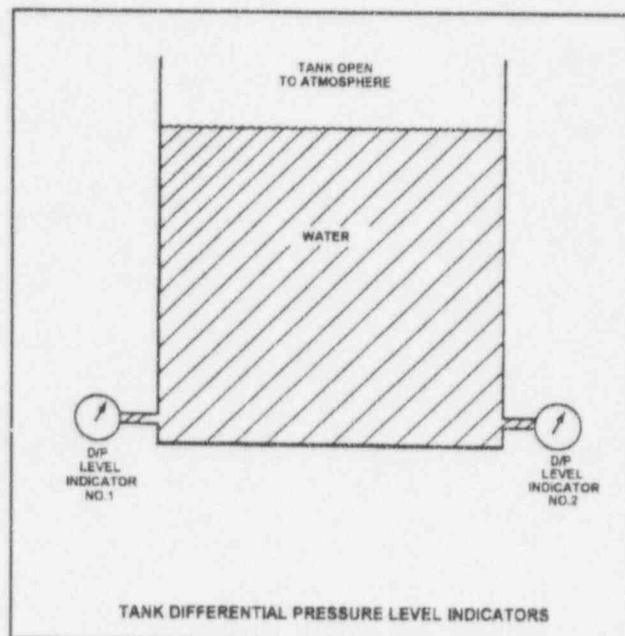
QUESTION: 8

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both are on scale, which indicator will indicate the higher level?

- A. Indicator 1 at all water temperatures
- B. Indicator 2 at all water temperatures
- C. Indicator 1 below 150°F, indicator 2 above 150°F
- D. Indicator 2 below 150°F, indicator 1 above 150°F



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 9

Many steam generator water level instruments are designed with a condensing chamber in the reference leg. The purpose of the condensing chamber is to:

- A. maintain a constant water level in the reference leg during normal operations.
- B. provide reference leg compensation for the steam generator pressure exerted on the variable leg.
- C. prevent reference leg flashing during a rapid depressurization of the steam generator.
- D. ensure the reference leg temperature remains close to the temperature of the variable leg.

QUESTION: 10

A system is monitored by a simple diaphragm pressure detector with its low pressure side vented to the containment. If a main steam break raises containment pressure by 20 psig, the system pressure indication (disregarding any temperature effect on the detector) will:

- A. increase by the square root of 20 psig.
- B. decrease by the square root of 20 psig.
- C. increase by 20 psig.
- D. decrease by 20 psig.

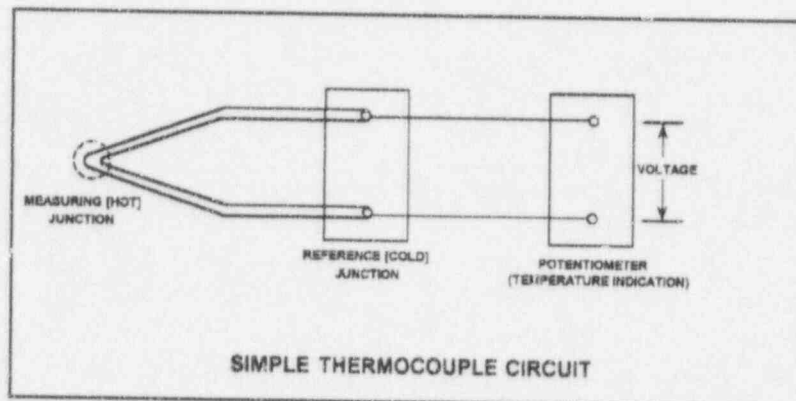
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 11

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 150°F . Reference junction temperature is currently 90°F . Indicator range is from 0°F to 2000°F . If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

- A. Minimum instrument reading (0°F)
- B. 60°F
- C. 90°F
- D. Maximum instrument reading (2000°F)



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 12

A plant has experienced a loss of coolant accident with degraded safety injection flow. One reactor coolant pump is being operated continuously for core cooling. Core voiding is homogeneous and is currently 20%.

Which one of the following describes excore source/startup range neutron level indication as homogeneous core voiding increases from 20% to 100% of the core? (Assume the neutron detectors are located adjacent to the bottom portion of the core.)

- A. Decreases continuously
- B. Decreases, then increases
- C. Increases continuously
- D. Increases, then decreases

QUESTION: 13

An ion chamber radiation detector is exposed to a constant gamma radiation field. If the applied voltage is increased but maintained within the ion chamber region, the rate of ion collection will:

- A. increase with voltage because more secondary ionizations are occurring in the detector.
- B. increase with voltage because less primary ions are recombining in the detector prior to reaching the electrodes.
- C. stay approximately the same because all of the primary ions were already being collected at the lower voltage.
- D. stay approximately the same because the ion chamber is operating at saturated conditions.

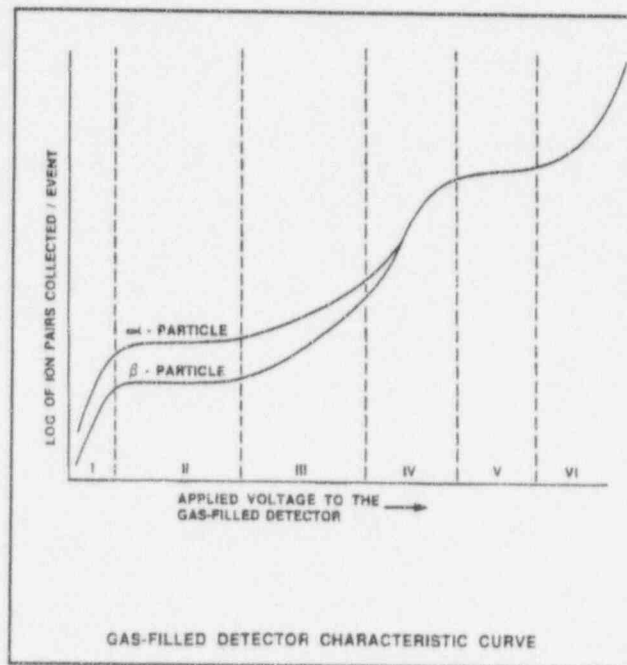
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 14

Refer to the drawing of a gas-filled detector characteristic curve (see figure below).

What is the effect of operating a proportional neutron detector at a voltage near the high end of the proportional region?

- A. Gamma pulses will increase in size while neutron pulses remain essentially the same, causing some gamma pulses to be counted as neutron pulses and yielding a less accurate neutron count rate.
- B. A high gamma radiation field will result in multiple small gamma pulses that combine to form larger pulses, which will be counted as neutron pulses, yielding a less accurate neutron count rate.
- C. Neutron pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.
- D. The positive space charge effect will increase and prevent collection of both gamma and neutron pulses, causing a less accurate neutron count rate.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

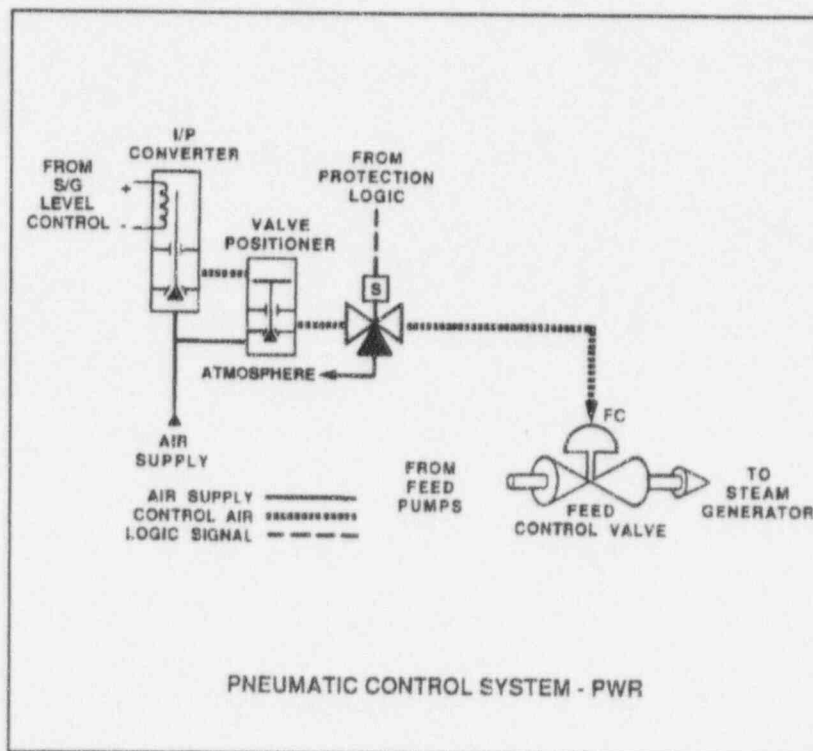
QUESTION: 15

Refer to the drawing of a pneumatic control system (see figure below).

An increasing steam generator (S/G) level will decrease the S/G level control signal and reduce the control air pressure applied to the feed control valve which reduces feedwater flow to the S/G.

If the level control signal is manually increased, how will the pneumatic control system affect steam generator level?

- A. Level will increase because the valve positioner will close more.
- B. Level will decrease because the valve positioner will close more.
- C. Level will increase because the valve positioner will open more.
- D. Level will decrease because the valve positioner will open more.



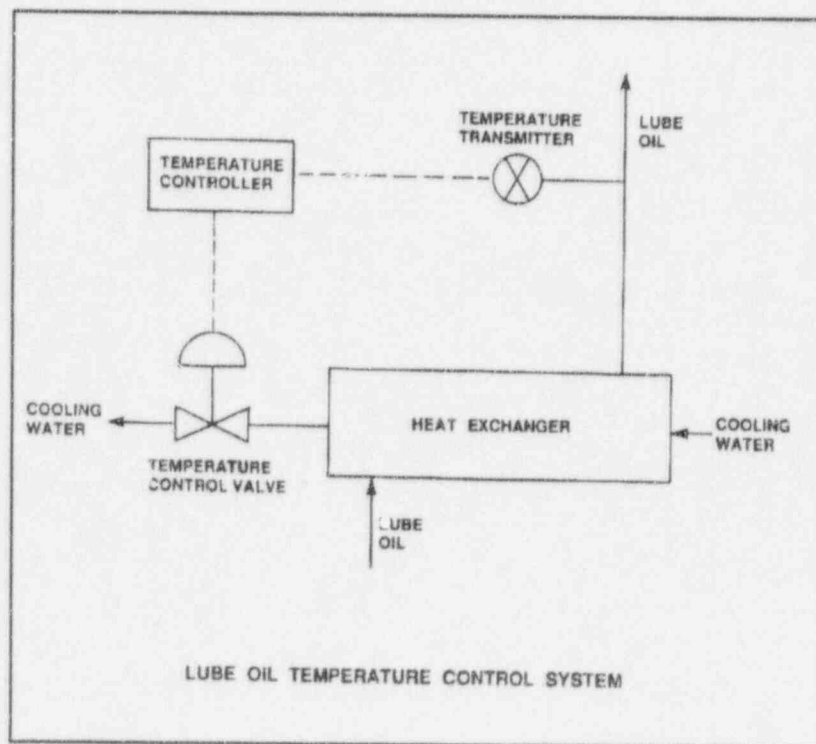
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 16

Refer to the drawing of a lube oil temperature control system (see figure below).

If the cooling water inlet temperature decreases, the temperature controller will throttle the temperature control valve more _____, causing cooling water differential temperature through the heat exchanger to _____.

- A. closed; decrease
- B. closed; increase
- C. open; decrease
- D. open; increase



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 17

An air-operated isolation valve requires 3,200 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation. The area of the actuator diaphragm is 80 square inches.

What is the minimum air pressure (rounded to the nearest psig) required for proper valve operation?

- A. 10 psig
- B. 25 psig
- C. 40 psig
- D. 55 psig

QUESTION: 18

A diesel generator is supplying a bus with the governor operating in the isochronous mode. If a large electrical load on the bus trips, generator frequency will:

- A. initially increase, and then decrease and stabilize below the initial value.
- B. initially increase, and then decrease and stabilize at the initial value.
- C. initially increase, and then decrease and stabilize above the initial value.
- D. remain constant during and after load change.

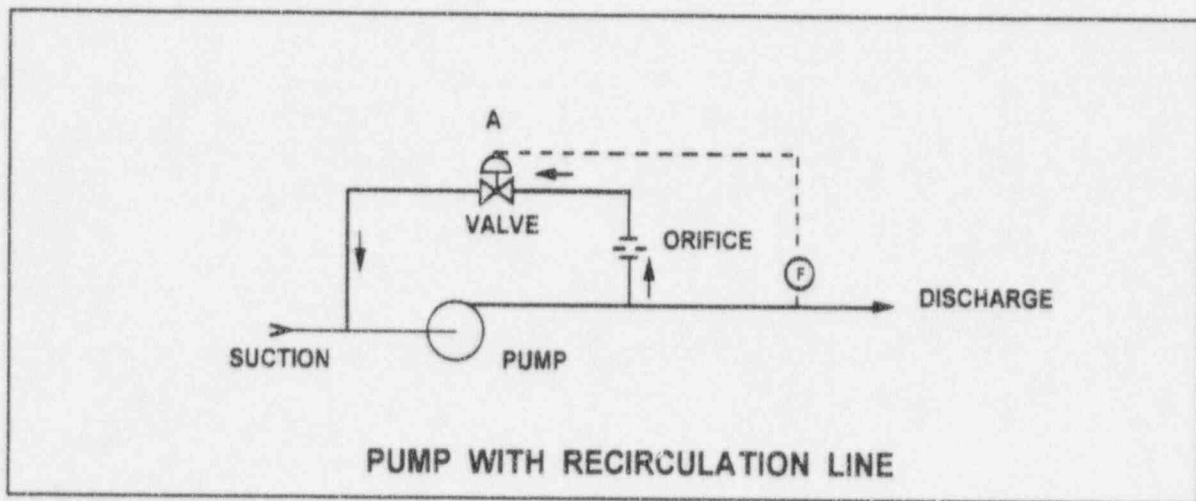
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 19

Refer to the drawing of a pump with recirculation line (see figure below).

Which one of the following describes the response of the pump if a complete flow blockage occurs in the discharge line just downstream of the flow transmitter?

- A. The pump will overheat after a relatively short period of time due to a loss of both main flow and recirculation flow.
- B. The pump will overheat after a relatively long period of time due to a loss of main flow only.
- C. The pump will overheat after a relatively long period of time due to a loss of recirculation flow only.
- D. The pump will be able to operate under these conditions indefinitely due to sustained main flow.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 20

The level in a tank is being controlled by an automatic level controller and is initially at the controller set point. A drain valve is then opened, causing tank level to begin to decrease. The decreasing level causes the controller to begin to open a makeup supply valve. After a few minutes, a new, steady-state tank level below the original level is established, with the supply rate equal to the drain rate.

The controller in this system uses _____ control.

- A. integral (reset) plus derivative (rate)
- B. proportional plus integral (reset)
- C. proportional
- D. bistable

QUESTION: 21

Which one of the following will result in immediate cavitation of a centrifugal pump operating at normal rated flow?

- A. Recirculation flow path is aligned.
- B. Recirculation flow path is isolated.
- C. Pump suction valve is fully closed.
- D. Pump discharge valve is fully closed.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 22

A variable-speed centrifugal fire water pump is taking a suction on an open storage tank and discharging through a 4-inch diameter fire hose and through a nozzle located 50 feet above the pump.

Which one of the following will cause the pump to operate at shutoff head?

- A. The fire hose is replaced with a 6-inch diameter fire hose.
- B. The fire hose is replaced with a 2-inch diameter fire hose.
- C. Pump speed is increased until steam formation at the eye of the impeller prevents pump flow.
- D. Pump speed is decreased until pump discharge pressure is insufficient to cause flow.

QUESTION: 23

A reactor coolant pump (RCP) is circulating reactor coolant at 100°F. After several hours the reactor coolant temperature has increased to 150°F.

Assuming coolant flow rate (gpm) is constant, RCP motor amps will have _____ because _____.

- A. decreased; coolant density has decreased
- B. decreased; system head losses have increased
- C. increased; coolant density has increased
- D. increased; system head losses have decreased

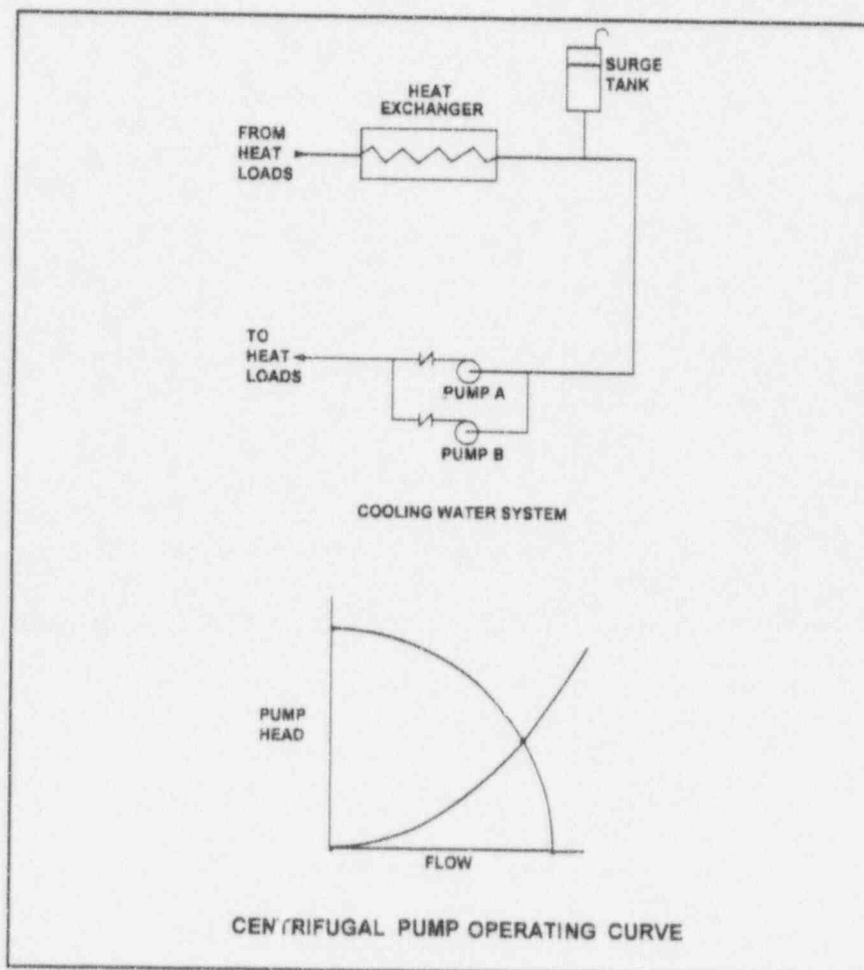
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 24

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below).

Pumps A and B are identical single-speed centrifugal pumps and only pump A is operating. If pump B is started, after the system stabilizes system flow rate will be:

- A. more than twice the original flow.
- B. twice the original flow.
- C. the same; only the pump head will change.
- D. less than twice the original flow.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 25

A variable speed motor-driven centrifugal pump is operating at rated speed in an open system. If the pump speed is decreased by 50%, available net positive suction head (NPSH) will _____ and required NPSH will _____.

- A. increase; decrease
- B. increase; remain the same
- C. decrease; decrease
- D. decrease; remain the same

QUESTION: 26

A positive displacement pump (PDP) is operating in an open system. PDP parameters are as follows:

PDP speed	= 480 rpm
PDP discharge pressure	= 1000 psig
PDP suction pressure	= 10 psig
PDP flow rate	= 60 gpm

Which one of the following changes will cause PDP flow rate to exceed 100 gpm?

- A. PDP speed is increased to 900 rpm.
- B. A second identical discharge path is opened.
- C. PDP suction pressure is increased to 40 psig.
- D. Downstream system pressure is decreased to 500 psig.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 27

A diesel generator (D/G) is supplying both kW and kVAR to an electrical bus in parallel with the grid. Assuming D/G and bus voltage do not change, if the D/G voltage regulator set point is increased slightly, then D/G kW will _____ and D/G amps will _____.

- A. remain the same; increase
- B. remain the same; remain the same
- C. increase; increase
- D. increase; remain the same

QUESTION: 28

An operator can differentiate a locked reactor coolant pump (RCP) rotor from a sheared RCP rotor 30 seconds after the event occurs by observing: (Assume no operator action.)

- A. reactor trip status.
- B. loop flow indications.
- C. RCP ammeter indications.
- D. loop differential temperature indications.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 29

Which one of the following will provide motor protection against electrical damage caused by gradual bearing degradation?

- A. Thermal overload device
- B. Overcurrent trip relay
- C. Underfrequency relay
- D. Undervoltage device

QUESTION: 30

The number of starts for an electric motor in a given period of time should be limited because overheating of the _____ can occur due to the _____ counter electromotive force produced at low rotor speeds.

- A. windings; low
- B. windings; high
- C. commutator and/or slip rings; low
- D. commutator and/or slip rings; high

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 31

A centrifugal pump is operating with the following parameters:

Speed = 1,200 rpm
Current = 40 amperes
Pump head = 20 psi
Pump flow rate = 400 gpm

What will be the approximate value of pump head and current if pump speed is increased to 1,800 rpm?

- A. 36 psi, 95 amps
- B. 36 psi, 135 amps
- C. 45 psi, 95 amps
- D. 45 psi, 135 amps

QUESTION: 32

The rate of heat transfer between two liquids in a heat exchanger will be increased if the: (Assume single-phase conditions and constant specific heat.)

- A. flow rate of the colder liquid is decreased by 10%.
- B. flow rate of the hotter liquid is increased by 10%.
- C. temperature of both liquids is decreased by 20°F.
- D. temperature of both liquids is increased by 20°F.

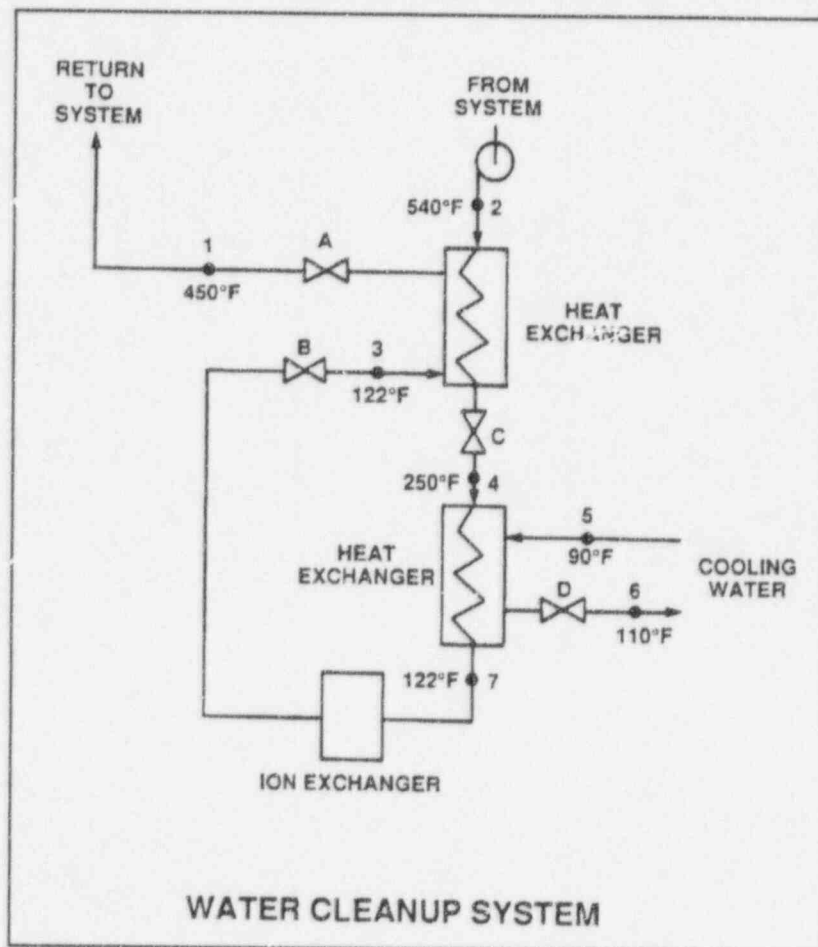
USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 33

Refer to the drawing of a water cleanup system (see figure below).

Valves A, B, and C are fully open. Valve D is 80% open. All temperatures are as shown. If valve D is then throttled to 50%, the temperature at point:

- A. 3 will decrease.
- B. 4 will increase.
- C. 5 will increase.
- D. 6 will decrease.



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 34

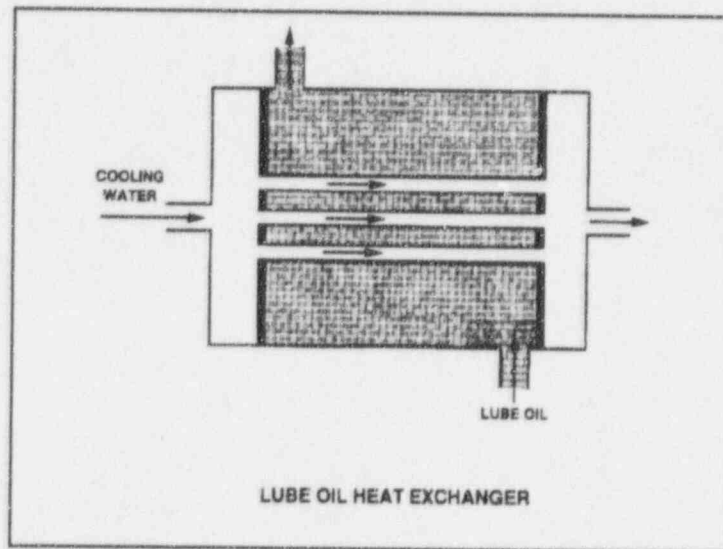
Refer to the drawing of a lube oil heat exchanger (see figure below).

Given the following existing conditions:

C_{p-oil}	$= 1.1 \text{ Btu/lbm-}^{\circ}\text{F}$
$C_{p-water}$	$= 1.0 \text{ Btu/lbm-}^{\circ}\text{F}$
\dot{m}_{oil}	$= 1.2 \times 10^4 \text{ lbm/hr}$
\dot{m}_{water}	$= 1.61 \times 10^4 \text{ lbm/hr}$
$T_{oil \text{ in}}$	$= 170^{\circ}\text{F}$
$T_{oil \text{ out}}$	$= 120^{\circ}\text{F}$
$T_{water \text{ out}}$	$= 110^{\circ}\text{F}$
$T_{water \text{ in}}$	$= ?$

Which one of the following is the approximate cooling water inlet temperature ($T_{water \text{ in}}$) in this heat exchanger?

- A. 65°F
- B. 69°F
- C. 73°F
- D. 77°F



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 35

Which one of the following conditions will lead to channeling in a demineralizer?

- A. Suspended solids and insoluble particles forming a mat on the surface of the resin bed
- B. A sudden 30°F decrease in the temperature of the influent to the demineralizer
- C. Exhaustion of the resin bed due to high conductivity of the demineralizer influent
- D. Operation of the demineralizer with influent flow rate at 10% below design flow rate

QUESTION: 36

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

- A. Low differential pressure indicates flow blockage in the demineralizer.
- B. Low differential pressure indicates that the demineralizer resin bed is exhausted.
- C. High differential pressure indicates flow blockage in the demineralizer.
- D. High differential pressure indicates that the demineralizer resin bed is exhausted.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 37

A plant has been operating normally at 100% power for one month and with the same reactor coolant boron concentration for the last 24 hours.

Which one of the following changes associated with the reactor coolant demineralizers will cause a reduction in reactor coolant boron concentration?

- A. Increase the temperature of the reactor coolant being processed from 95°F to 115°F
- B. Decrease the temperature of the reactor coolant being processed from 115°F to 95°F
- C. Increase the flow rate of reactor coolant being processed from 75 gpm to 100 gpm
- D. Decrease the flow rate of reactor coolant being processed from 75 gpm to 50 gpm

QUESTION: 38

How is typical breaker operation affected when the associated breaker control power transfer switch is placed in the "Local" position?

- A. Control power will be available to provide protective trips and the breaker can be electrically operated only from the control room.
- B. Control power will be removed from both the open and close circuits and the breaker can be electrically operated only from the control room.
- C. Control power will be available to provide protective trips and the breaker can be electrically operated only from the breaker cabinet.
- D. Control power will be removed from both the open and close circuits and the circuit breaker can be electrically operated only from the breaker cabinet.

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 39

Which one of the following is an unsafe practice if performed when working on or near energized electrical equipment?

- A. Cover exposed energized circuits with insulating material to prevent inadvertent contact.
- B. Have a person standing by to deenergize the equipment in the event of an emergency.
- C. Use two hands for balance and to prevent dropping tools onto energized equipment.
- D. Stand on insulating rubber material to prevent yourself from being grounded.

QUESTION: 40

A main generator is being prepared for paralleling with the grid. Which one of the following conditions will cause the main generator to immediately supply reactive power (MVAR) to the grid when the generator output breaker is closed?

- A. Generator voltage is 1% higher than grid voltage.
- B. Generator voltage is 1% lower than grid voltage.
- C. The synchroscope is turning slowly in the clockwise direction.
- D. The synchroscope is turning slowly in the counterclockwise direction.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 41

Two identical 1000 Mw electrical generators are operating in parallel supplying the same electrical bus. The generator output breakers also provide identical protection for the generators. Generator A and B output indications are as follows:

<u>Generator A</u>	<u>Generator B</u>
4160 Volts	4160 Volts
60.2 Hertz	60.2 Hertz
50 Mw	100 Mw
25 MVAR (out)	50 MVAR (out)

A malfunction causes the voltage regulator setpoint for generator B to slowly increase continuously toward a maximum of 4400 volts. If no operator action is taken, which one of the following describes the current indications for generator A?

- A. Current will initially decrease, and then increase until the output breaker for generator B trips on overcurrent.
- B. Current will initially decrease, and then increase until the output breaker for generator A trips on overcurrent.
- C. Current will decrease continuously until the output breaker for generator B trips on reverse power.
- D. Current will decrease continuously until the output breaker for generator A trips on reverse power.

QUESTION: 42

An operator must never open or close a high voltage (greater than 750 Vac) air break disconnect unless:

- A. a parallel path exists for current flow.
- B. the circuit it is in is already deenergized.
- C. the current flowing through it is approximately zero.
- D. the current flowing through it is less than its design current carrying capability.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 43

The following indications are observed in the control room for a normally-open breaker that directly starts/stops a 480 Vac motor:

Red position indicating light is on.
Green position indicating light is off.
Load current indicates 50 amps.
Supply voltage indicates 480 volts.

What is the condition of the breaker?

- A. Open and racked to "test" position
- B. Closed and racked to "test" position
- C. Open and racked in
- D. Closed and racked in

QUESTION: 44

Two identical 1000 Mw electrical generators are being connected to the same electrical bus. Generator A is currently supplying the bus. Generator A and B output indications are as follows:

<u>Generator A</u>	<u>Generator B</u>
4160 Volts	4140 Volts
60.2 Hertz	60.8 Hertz
25 Mw	0 Mw
10 MVAR	0 MVAR

When the output breaker for generator B is closed, which generator is more likely to trip on reverse power?

- A. Generator A due to the higher initial voltage
- B. Generator A due to the lower initial frequency
- C. Generator B due to the lower initial voltage
- D. Generator B due to the higher initial frequency

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 45

When comparing a delayed neutron and a prompt neutron, born from the same fission event, the prompt neutron is more likely to:

- A. become a thermal neutron.
- B. be captured by U-238 at a resonant energy peak between 1 eV and 1000 eV.
- C. be detected by excore nuclear instrumentation.
- D. cause thermal fission of a U-235 nucleus.

QUESTION: 46

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of water at a temperature of 100°F and a boron concentration of 2000 ppm.

Which one of the following will increase K_{eff} ?

- A. An unrodded spent fuel assembly is removed from the core.
- B. Refueling water temperature increases to 105°F.
- C. A new neutron source is installed in the core.
- D. Excore nuclear instrumentation is repositioned to increase source range count rate.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 47

Which one of the following combinations of critical core conditions indicates the most excess reactivity exists in the core?

	<u>CONTROL ROD POSITION</u>	<u>RCS BORON CONCENTRATION</u>
A.	25% inserted	500 ppm
B.	50% inserted	500 ppm
C.	25% inserted	1000 ppm
D.	50% inserted	1000 ppm

QUESTION: 48

A subcritical reactor has an initial source/startup range count rate of 60 cps with a shutdown reactivity of $-2.0\% \Delta K/K$. How much positive reactivity must be added to establish a stable count rate of 300 cps?

- A. $0.4\% \Delta K/K$
- B. $0.6\% \Delta K/K$
- C. $1.4\% \Delta K/K$
- D. $1.6\% \Delta K/K$

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 49

A reactor has a positive 1.0 dpm startup rate with no control rod motion several decades below the point of adding heat (POAH) with a xenon-free core. The operator then inserts control rods until a 0.5 dpm startup rate is attained and then stops control rod motion.

When rod insertion is stopped, reactor startup rate will immediately:

- A. stabilize at 0.5 dpm until power reaches the POAH.
- B. increase, and then stabilize at a value greater than 0.5 dpm until power reaches the POAH.
- C. stabilize, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.
- D. increase, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

QUESTION: 50

Which one of the following isotopes is the most significant contributor to resonance capture of fission neutrons in the reactor core at the end of core life?

- A. U-235
- B. U-238
- C. Pu-239
- D. Pu-240

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 51

During a reactor coolant system (RCS) cooldown, positive reactivity is added to the core (assuming a negative moderator temperature coefficient). This is partially due to:

- A. a decrease in the thermal utilization factor.
- B. an increase in the thermal utilization factor.
- C. a decrease in the resonance escape probability.
- D. an increase in the resonance escape probability.

QUESTION: 52

Compared to operation at a low power level, the fuel temperature coefficient of reactivity at a high power level is _____ negative due to _____. (Assume the same core age.)

- A. less; improved pellet-to-clad heat transfer
- B. more; buildup of fission product poisons
- C. less; higher fuel temperature
- D. more; increased neutron flux

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 53

Which one of the following compares the rate at which reactor power can be increased at the beginning of core life (BOL) and at the end of core life (EOL)?

- A. Slower at EOL due to slower changes in boron concentration
- B. Slower at EOL due to lower control rod worth
- C. Slower at BOL due to slower changes in boron concentration
- D. Slower at BOL due to lower control rod worth

QUESTION: 54

A reactor is operating at end of core life with a steady state 50% power level when the operator withdraws a group of control rods for 5 seconds. (Assume turbine load remains constant and the reactor does not scram/trip.)

Actual reactor power will stabilize _____ the initial power and coolant temperature will stabilize _____ the initial temperature.

- A. at; at
- B. at; above
- C. above; at
- D. above; above

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 55

Which one of the following describes the absolute value of integral control rod worth (negative reactivity) during the complete withdrawal of a fully-inserted control rod?

- A. Increases, then decreases
- B. Decreases, then increases
- C. Increases continuously
- D. Decreases continuously

QUESTION: 56

Neutron flux shaping in a reactor core reduces radial power peaking:

- A. in the center of the core caused by the high number density of fuel assemblies.
- B. at the periphery of the core caused by moderator reflection of thermal leakage neutrons.
- C. throughout the core caused by uneven burnout of control rod poison material.
- D. throughout the core caused by uneven burnout of fuel assemblies.

USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 57

A reactor has been operating at 80% power for four weeks with the controlling rod group inserted 10% from the fully withdrawn position.

Which one of the following will be most significantly affected by inserting the controlling group an additional 5%? (Assume reactor power does not change.)

- A. Total xenon reactivity
- B. Radial power distribution
- C. Quadrant (azimuthal) power distribution
- D. Axial power distribution

QUESTION: 58

A fission product poison can be differentiated from all other fission products in that a fission product poison:

- A. will be produced in direct proportion to the fission rate in the core.
- B. will remain radioactive for thousands of years after the final reactor criticality.
- C. will depress the power production in some core locations and cause peaking in others.
- D. will migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 59

Reactor power is increased from 50% to 60% in 1 hour. The most significant contributor to the initial change in core xenon reactivity is the increase in xenon:

- A. production from fission.
- B. decay to cesium.
- C. absorption of neutrons.
- D. production from iodine decay.

QUESTION: 60

A reactor is initially operating at 50% power with equilibrium core xenon-135. Power is increased to 100% over a 2 hour period and average reactor coolant temperature is adjusted to 588°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 6 hours after the power change?

- A. Greater than 588°F and decreasing slowly
- B. Greater than 588°F and increasing slowly
- C. Less than 588°F and decreasing slowly
- D. Less than 588°F and increasing slowly

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 61

A reactor had been operating at 100% power for two weeks when power was reduced to 10% over a one hour period. In order to maintain plant parameters stable during the next 24 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, then insert rods slowly.
- C. Insert rods slowly during the entire period.
- D. Insert rods slowly at first, then withdraw rods slowly.

QUESTION: 62

Which one of the following combinations of core age (beginning of core life (BOL) or end of core life (EOL)) and long-term power history (20% or 100%) will require the greatest amount of positive reactivity addition to attain reactor criticality during peak core xenon-135 conditions after a reactor trip from equilibrium core xenon conditions?

- A. EOL and 20% power
- B. EOL and 100% power
- C. BOL and 20% power
- D. BOL and 100% power

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 63

Xenon-135 oscillations take about _____ hours to get from maximum xenon-135 negative reactivity to minimum xenon-135 negative reactivity.

- A. 40 to 50
- B. 24 to 28
- C. 12 to 14
- D. 6 to 7

QUESTION: 64

A reactor has been operating at steady state 50% power for one month following a refueling outage. Reactor power is ramped to 100% over the next 2 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the:

- A. increased reactor coolant temperature.
- B. buildup of core Xe-135.
- C. burnout of burnable poisons.
- D. increased fuel temperature.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 65

An estimated critical rod position (ECP) has been calculated for a reactor startup to be performed 15 hours after a reactor trip that ended three months operation at 100% power.

Which one of the following conditions will result in criticality occurring at a lower than estimated critical rod position?

- A. Adjusting reactor coolant system boron concentration to 50 ppm higher than assumed for startup calculations
- B. A malfunction resulting in control rod speed being slower than normal speed
- C. Moving the time of startup from 15 hours to 12 hours following the trip
- D. Using a pretrip reactor power of 90% to determine power defect

QUESTION: 66

During a reactor startup, as K_{eff} increases toward 1.0, the value of $1/M$:

- A. decreases toward zero.
- B. decreases toward 1.0.
- C. increases toward infinity.
- D. increases toward 1.0.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 67

A reactor is critical several decades below the point of adding heat when a small amount of positive reactivity is added to the core. If the same amount of negative reactivity is added to the core 1 minute later, reactor power will stabilize at:

- A. the initial power level.
- B. the subcritical multiplication equilibrium level.
- C. somewhat lower than the initial power level.
- D. somewhat higher than the initial power level.

QUESTION: 68

A reactor has just achieved criticality during a xenon-free reactor startup and power is being increased to take critical data. Instead of stabilizing power at $10^{-5}\%$ per the startup procedure, the operator inadvertently stabilizes power at $10^{-4}\%$.

Assuming reactor coolant system (RCS) temperature and RCS boron concentration do not change, the critical rod height at $10^{-4}\%$ power will be _____ the critical rod height at $10^{-5}\%$ power. (Neglect any effects of source neutrons.)

- A. less than
- B. equal to
- C. greater than
- D. independent of

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 69

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the longest amount of time to occur?

- A. 3% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 60% power

QUESTION: 70

A reactor is operating with the following initial conditions:

Power level = 100%
Coolant boron = 620 ppm
Average coolant temperature = 587°F

After a load decrease reactor conditions are as follows:

Power level = 80%
Coolant boron = 630 ppm
Average coolant temperature = 577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

Total power coefficient = $-1.5 \times 10^{-2}\%$ $\Delta K/K/\%$
Moderator temperature coefficient = $-2.0 \times 10^{-2}\%$ $\Delta K/K/^\circ F$
Differential boron worth = $-1.0 \times 10^{-2}\%$ $\Delta K/K/ppm$

- A. $-0.2\% \Delta K/K$
- B. $+0.2\% \Delta K/K$
- C. $-0.4\% \Delta K/K$
- D. $+0.4\% \Delta K/K$

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 71

Which one of the following power changes requires the greatest amount of positive reactivity addition?

- A. 3% power to 5% power
- B. 5% power to 15% power
- C. 15% power to 30% power
- D. 30% power to 60% power

QUESTION: 72

A reactor has been operating at 100% power for several weeks when a reactor trip occurs. How much time will be required for core heat production to decrease to 1% following the trip?

- A. 1 to 8 days
- B. 1 to 8 hours
- C. 1 to 8 minutes
- D. 1 to 8 seconds

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 73

Which one of the following is arranged from the lowest pressure to the highest pressure?

- A. 2 psig, 12 inches Hg absolute, 8 psia
- B. 2 psig, 18 inches Hg absolute, 8 psia
- C. 12 psia, 20 inches Hg absolute, 2 psig
- D. 12 psia, 30 inches Hg absolute, 2 psig

QUESTION: 74

Consider a saturated water/steam mixture at 500°F with a quality of 90%. If the pressure of the mixture is decreased with no heat gain or loss, the temperature of the mixture will _____ and the quality of the mixture will _____. (Assume the mixture remains saturated.)

- A. decrease; decrease
- B. decrease; increase
- C. remain the same; decrease
- D. remain the same; increase

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 75

Two identical pressurizers are connected to the same location on two identical reactor coolant systems operating at 1000 psia. Pressurizer A volume contains 50% subcooled water (300°F) and 50% nitrogen. Pressurizer B volume contains 50% saturated water and 50% saturated steam.

Which one of the following explains which pressurizer will maintain the highest pressure during a sudden 10% liquid outsurge from each pressurizer?

- A. Pressurizer B due to vaporizing of saturated water as pressure begins to decrease
- B. Pressurizer B due to the expansion characteristics of saturated steam being better than the expansion characteristics of nitrogen
- C. Pressurizer A due to the subcooled water resulting in a smaller amount of energy being lost upon the outsurge
- D. Pressurizer A due to the expansion characteristics of nitrogen being better than the expansion characteristics of saturated steam

QUESTION: 76

Which one of the following is an advantage of condensate depression in the main condenser?

- A. Increased secondary cycle efficiency
- B. Increased feedwater temperature entering the steam generators
- C. Increased net positive suction head available to condensate pumps
- D. Increased inventory in the main condenser hotwell

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 77

A plant is operating at 50% power. Main steam at a main turbine steam inlet valve has the following properties:

Pressure: 900 psia
Quality: 98%

The main turbine steam chest pressure is 400 psia. Which one of the following is the approximate quality of the steam in the steam chest?

- A. 97%
- B. 98%
- C. 99%
- D. 100%

QUESTION: 78

A plant is operating at 90% of rated power. Main condenser pressure is 1.7 psia and hotwell condensate temperature is 120°F.

Which one of the following describes the effect of a 5% decrease in cooling water flow rate through the main condenser?

- A. Overall steam cycle efficiency will increase because the turbine will be operating more efficiently.
- B. Overall steam cycle efficiency will increase because condensate depression will decrease.
- C. Overall steam cycle efficiency will decrease because the turbine will be operating less efficiently.
- D. Overall steam cycle efficiency will decrease because condensate depression will increase.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 79

Which one of the following will minimize the possibility of water hammer?

- A. Draining the discharge line of a centrifugal pump after shutdown
- B. Draining condensate out of steam lines before and after initiating flow
- C. Starting a centrifugal pump with its discharge valve fully open
- D. Starting a positive displacement pump with its discharge valve partially closed

QUESTION: 80

An 80 gpm leak has developed in a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

- A. 69 gpm
- B. 60 gpm
- C. 51 gpm
- D. 40 gpm

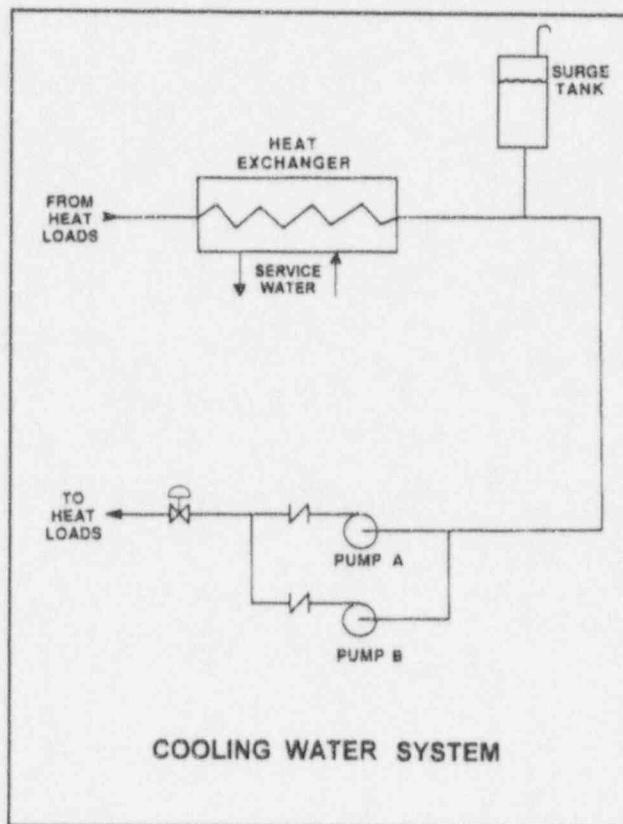
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OCTOBER 1996 PWR - FORM A

QUESTION: 81

Refer to the drawing of a cooling water system in which only pump A is operating and the pump discharge valve is currently 50% open (see figure below).

If pump A is cavitating, which one of the following will reduce or eliminate cavitation in pump A?

- A. Starting pump B
- B. Positioning the discharge valve to 75% open
- C. Lowering the water level in the surge tank by 2 feet
- D. Increasing heat exchanger service water flowrate by 10%



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 82

A cooling water system is supplying 10^6 lbm/hour of flow at a temperature of 100°F . Assuming volumetric flow rate does not change, which one of the following is the mass flow rate that will be supplied by the system if cooling water temperature increases to 140°F ?

- A. 7.5×10^5 lbm/hr
- B. 8.3×10^5 lbm/hr
- C. 9.0×10^5 lbm/hr
- D. 9.9×10^5 lbm/hr

QUESTION: 83

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

- A. Starting a second pump in parallel with the operating pump
- B. Shifting two heat exchangers from parallel to series operation
- C. Replacing a 10 foot section of 10-inch diameter pipe with a 20 foot section of 10-inch diameter pipe
- D. Replacing a 20 foot section of 10-inch diameter pipe with a 20 foot section of 12-inch diameter pipe

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 84

Excessive amounts of gases entrained/dissolved in the cooling fluid passing through a single-phase (liquid) heat exchanger will reduce the overall heat transfer coefficient of the heat exchanger because the:

- A. laminar layer thickness will decrease.
- B. specific heat of the cooling fluid will decrease.
- C. average ΔT across the heat exchanger tubes will decrease.
- D. thermal conductivity of the heat exchanger tubes will decrease.

QUESTION: 85

During a plant outage, 6% of all steam generator (S/G) tubes were plugged. Full-power reactor coolant system flow rate and average coolant temperature (T_{ave}) have not changed. Given the following 100% power conditions before the outage:

$$\begin{aligned} T_{ave} &= 584^{\circ}\text{F} \\ T_{S/G} &= 544^{\circ}\text{F} \end{aligned}$$

Which one of the following will be the approximate S/G pressure when the plant is returned to 100% power after the outage?

- A. 974 psia
- B. 954 psia
- C. 934 psia
- D. 914 psia

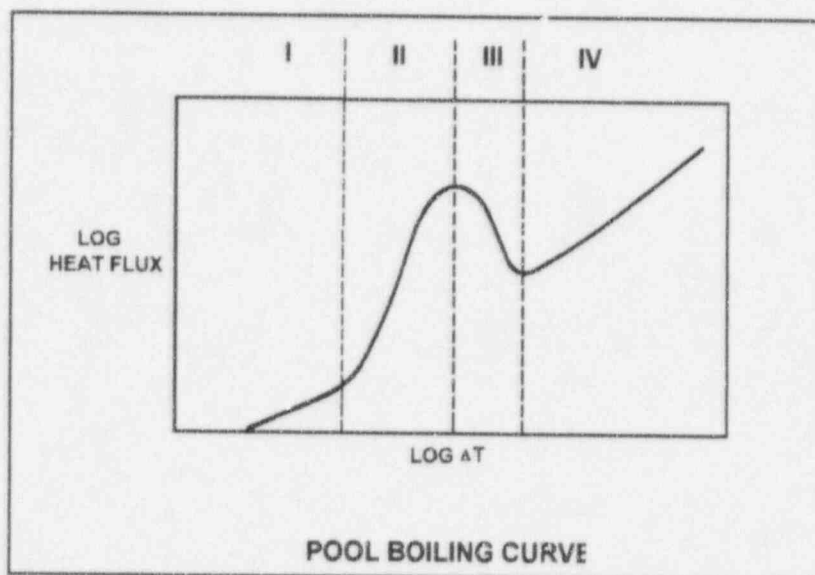
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OCTOBER 1996 PWR - FORM A

QUESTION: 86

Refer to the drawing of a pool boiling curve (see figure below).

Which region of the curve contains the operating point at which the hottest locations of the reactor operate to transfer heat from the cladding to the coolant at 100% power?

- A. Region I
- B. Region II
- C. Region III
- D. Region IV



USNRC GENERIC FUNDAMENTALS EXAMINATION
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QUESTION: 87

Which one of the following is a characteristic of subcooled nucleate boiling but not saturated nucleate boiling?

- A. T_{Clad} equals T_{Sat}
- B. T_{Clad} is greater than T_{Sat}
- C. $T_{\text{Bulk Coolant}}$ equals T_{Sat}
- D. $T_{\text{Bulk Coolant}}$ is less than T_{Sat}

QUESTION: 88

Which one of the following must be present to prevent departure from nucleate boiling from occurring in a reactor core following a pressurizer vapor space instrument line rupture if the leak rate is less than normal makeup capability?

- A. Reactor coolant pump flow capability
- B. Pressurizer level in the indicating range
- C. Emergency core cooling injection capability
- D. Steam generator steaming capability

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 89

A reactor is operating at 100% steady-state power at the end of core life with all control rods fully withdrawn. At what axial location in a typical fuel assembly will the minimum departure from nucleate boiling ratio occur?

- A. At the bottom of the fuel assembly
- B. At the top of the fuel assembly
- C. Between the bottom and the midplane of the fuel assembly
- D. Between the midplane and the top of the fuel assembly

QUESTION: 90

A reactor coolant system cooldown and depressurization is in progress on natural circulation following a loss of offsite power. The following conditions exist:

RCS Tcold:	520°F, decreasing
RCS Thot:	538°F, decreasing
Pressurizer pressure:	2000 psia, decreasing

If cooldown rate is being maintained at 50°F/hour, which one of the following locations is most likely to experience steam formation?

- A. Reactor vessel head
- B. RCS loop hot leg
- C. Steam generator U-tubes
- D. Reactor core

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 91

Single-phase coolant flow resistance (head loss) in a reactor core is directly proportional to coolant _____ and inversely proportional to _____.

- A. temperature; coolant channel cross-sectional area
- B. temperature; fuel assembly length
- C. velocity; coolant channel cross-sectional area
- D. velocity; fuel assembly length

QUESTION: 92

A reactor is shut down with natural circulation core cooling. Decay heat generation is equivalent to 1.0% rated thermal power. Core ΔT has stabilized at 16°F.

When decay heat generation decreases to 0.333% rated thermal power, core ΔT will be approximately:

- A. 2°F.
- B. 4°F.
- C. 8°F.
- D. 10°F.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 93

A reactor coolant system natural circulation cooldown is in progress via the steam generator (S/G) atmospheric steam relief valves (operated in manual control).

If high point voiding interrupts natural circulation, which one of the following will occur? (Assume feed flow rate, relief valve position, and decay heat level are constant.)

- A. S/G pressure decreases and core exit thermocouple (CETC) temperature increases.
- B. S/G pressure decreases and CETC temperature remains constant.
- C. S/G pressure increases and CETC temperature increases.
- D. S/G pressure increases and CETC temperature remains constant.

QUESTION: 94

A reactor is operating at 80% of rated thermal power with power distribution peaked both radially and axially in the center of the core. Reactor power is then increased to 100% over the next two hours using only reactor coolant boron adjustments for reactivity control.

Neglecting any effect from reactor poisons, when power is stabilized at 100%, the radial peaking factor will be _____ and the axial peaking factor will be _____.

- A. higher; lower
- B. higher; higher
- C. the same; lower
- D. the same; higher

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 95

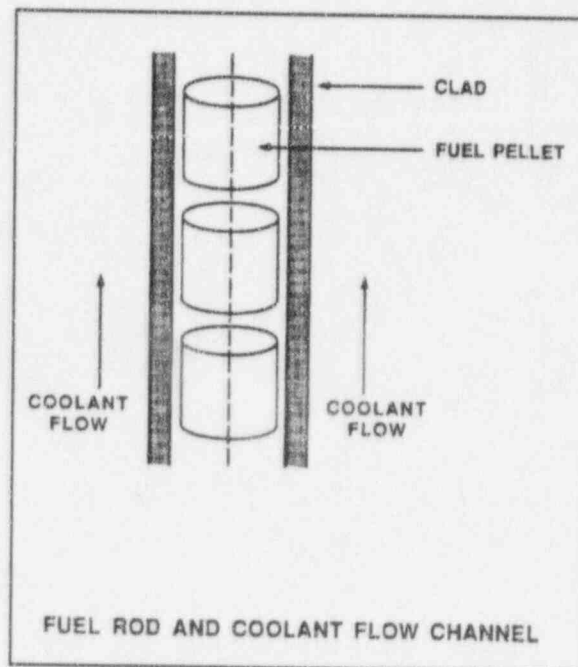
Refer to the drawing of a fuel rod and coolant flow channel at beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power = 100%
 T_{coolant} = 500°F
 $T_{\text{fuel centerline}}$ = 3000°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled?
(Assume reactor power is constant.)

- A. 2000°F
- B. 1750°F
- C. 1500°F
- D. 1250°F



USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 96

Which one of the following will prevent brittle fracture failure of a reactor vessel?

- A. Manufacturing the reactor vessel from low carbon steel
- B. Maintaining reactor vessel heatup/cooldown rates within limits
- C. Maintaining the number of reactor vessel heatup/cooldown cycles within limits
- D. Operating above the reference temperature for nil-ductility transition (RT_{NDT})

QUESTION: 97

Stress on the reactor vessel inner wall is greater during cooldown than heatup because:

- A. heatup stress totally offsets pressure stress at the inner wall.
- B. both pressure stress and cooldown stress are tensile at the inner wall.
- C. cooldown stress and heatup stress are both tensile at the inner wall, but cooldown stress is greater in magnitude.
- D. the tensile cooldown stress at the inner wall is greater in magnitude than the compressive pressure stress at the same location.

USNRC GENERIC FUNDAMENTALS EXAMINATION
OCTOBER 1996 PWR - FORM A

QUESTION: 98

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

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

- A. Reactor A due to the fewer number of heatup/cooldown cycles
- B. Reactor A due to the higher average power capacity
- C. Reactor B due to the greater number of heatup/cooldown cycles
- D. Reactor B due to the lower average power capacity

QUESTION: 99

A plant is shut down with the reactor coolant system at 1200 psia and 350°F. Which one of the following would be most likely to cause pressurized thermal shock of the reactor vessel?

- A. A rapid depressurization followed by a rapid heatup
- B. A rapid depressurization followed by a rapid cooldown
- C. A rapid cooldown followed by a rapid pressurization
- D. A rapid heatup followed by a rapid pressurization

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OCTOBER 1996 PWR - FORM A

QUESTION: 100

Fast neutron irradiation adversely affects the reactor pressure vessel primarily by causing:

- A. metal embrittlement.
- B. brittle fracture.
- C. flaw initiation.
- D. flaw propagation.

*** FINAL ANSWER KEY ***

OCTOBER 1996 GENERIC FUNDAMENTALS EXAM
PRESSURIZED WATER REACTOR - ANSWER KEY

FORM			ANS	FORM			ANS	FORM			ANS	FORM			ANS
A	B			A	B			A	B			A	B		
1	29	B		26	54	A		51	79	D		76	4	C	
2	30	D		27	55	A		52	80	C		77	5	A	
3	31	A		28	56	C		53	81	A		78	6	C	
4	32	A		29	57	A		54	82	B		79	7	B	
5	33	C		30	58	A		55	83	C/D		80	8	A	
6	34	C		31	59	D		56	84	A		81	9	D	
7	35	C		32	60	B		57	85	D		82	10	D	
8	36	B		33	61	B		58	86	C		83	11	D	
9	37	A		34	62	B		59	87	C		84	12	B	
10	38	D		35	63	A		60	88	A		85	13	A	
11	39	A		36	64	C		61	89	B		86	14	B	
12	40	D		37	65	B		62	90	B		87	15	D	
13	41	C		38	66	C		63	91	C		88	16	A/D	
14	42	B		39	67	C		64	92	D		89	17	D	
15	43	C		40	68	A		65	93	D		90	18	A	
16	44	B		41	69	A		66	94	A		91	19	C	
17	45	C		42	70	B/C		67	95	D		92	20	C	
18	46	B		43	71	D		68	96	B		93	21	A	
19	47	B		44	72	B		69	97	B		94	22	D	
20	48	C		45	73	C		70	98	A		95	23	B	
21	49	C		46	74	B		71	99	D		96	24	D	
22	50	D		47	75	D		72	100	B		97	25	B	
23	51	A		48	76	D		73	1	D		98	26	B	
24	52	D		49	77	B		74	2	B		99	27	C	
25	53	A		50	78	B		75	3	A		100	28	A	