UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
FEBRUARY 2002--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 4.0 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:

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. Scratch paper is provided for calculations, which may also be done directly on the examination.

8. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.

9. Restroom trips are limited. Only **ONE** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside of the examination room.

10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination.

11. Turn in your examination materials, answer sheet on top, followed by the examination booklet, then examination aids - steam table booklets, handouts, and scratch 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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

Eff. = Net Work Out/Energy In

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

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

CONVERSIONS

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

QUESTION: 1

Which one of the following statements describes the flow rate characteristics of a typical globe valve in an operating water system?

A. The first 25% of valve disk travel in the open direction will produce a greater change in flow rate than the last 25% of valve disk travel.

B. The first 25% of valve disk travel in the open direction will produce a smaller change in flow rate than the last 25% of valve disk travel.

C. The first 25% of valve disk travel in the open direction will produce approximately the same change in flow rate as the last 25% of valve disk travel.

D. A globe valve that has been opened to 25% of valve disk travel will result in approximately 25% of full flow rate.

QUESTION: 2

Which one of the following is <u>not</u> a generally accepted method for locally verifying that a valve is open?

A. Observe local flow rate instrumentation.

B. Check the local valve position indicator indicates "open."

C. Turn the valve operator in the "close" direction and verify that some movement occurs.

D. Attempt to turn the valve operator in the "open" direction and verify that no movement occurs.

QUESTION: 3

When transferring a valve controller from the manual mode to the automatic mode, the automatic valve controller output signal should be _____ the manual valve controller output signal at the time of transfer.

A. equal to

B. less than

C. greater than

D. increasing with

QUESTION: 4

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

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

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

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

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

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

QUESTION: 5

Which one of the following describes the function and use of the backseat on a manual valve?

A. Removes pressure from the packing/stuffing box and is typically used to isolate the stuffing box for valve repacking.

B. Removes pressure from the packing/stuffing box and is typically used when needed to isolate packing leakage.

C. Acts as a backup in case the primary seat leaks and is typically used during system isolation for personnel protection.

D. Acts as a backup in case the primary seat leaks and is typically used when needed to prevent the primary seat from leaking excessively.

QUESTION: 6

Refer to the drawing of a venturi flow element in an operating cooling water system (see figure below).

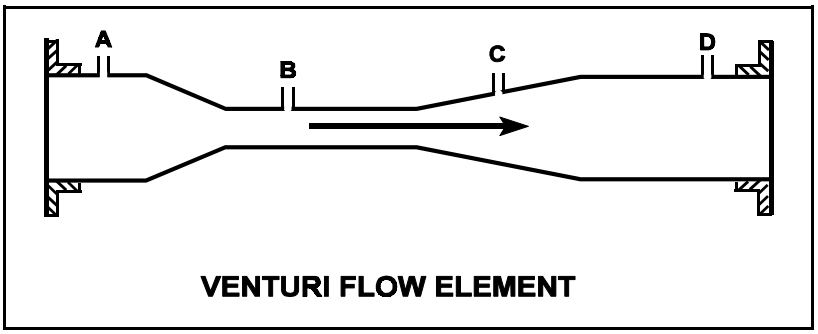
At what point does the lowest pressure exist?

A. Point A

B. Point B

C. Point C

D. Point D



VENTURI FLOW ELEMENT

QUESTION: 7

Which one of the following determines the maximum reactor vessel water level that can be accurately indicated by a wet-reference leg differential pressure (D/P) level instrument?

A. The level at which the variable leg penetrates the reactor vessel

B. The level at which the reference leg penetrates the reactor vessel

C. The difference in elevation between the D/P cell and the reference leg fill connection

D. The difference in elevation between the D/P cell and the bottom of the reactor vessel

QUESTION: 8

A properly calibrated 0 to 100 psia diaphragm pressure detector is connected to a pressurized system; the low pressure side of the detector is vented to the atmosphere. The detector is currently producing a system pressure indication of 75 psia.

If the detector diaphragm ruptures, indicated pressure will be approximately:

A. 0 psia.

B. 15 psia.

C. 60 psia.

D. 90 psia.

QUESTION: 9

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

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

A. unpredictable.

B. less than 50% of scale.

C. 50% of scale.

D. greater than 50% of scale.

QUESTION: 10

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

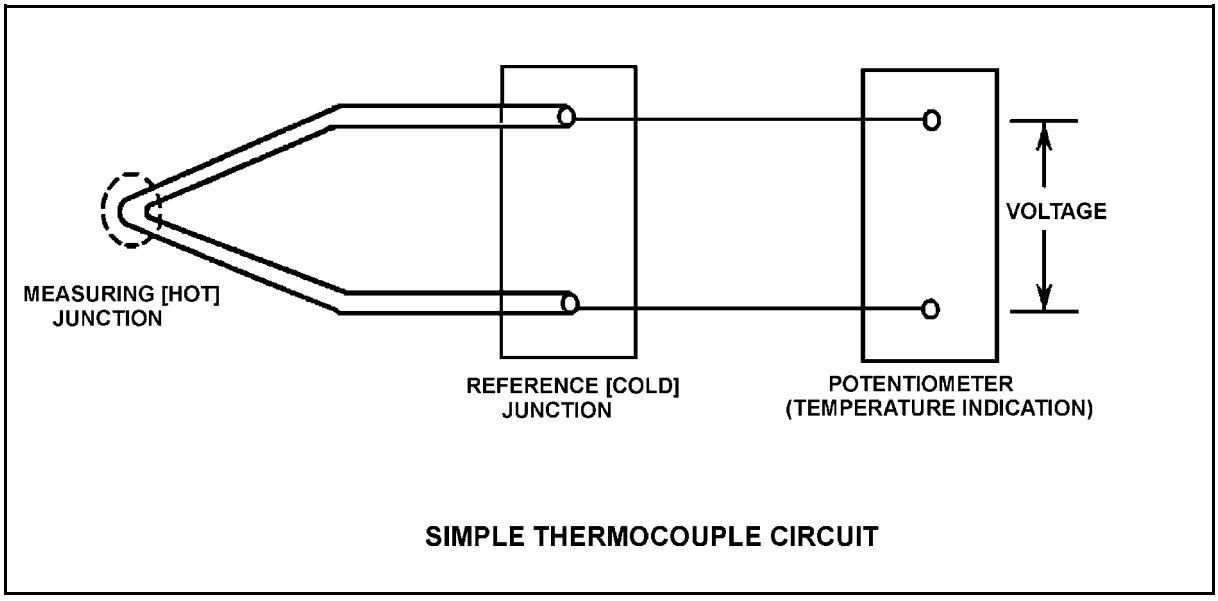
Circuit temperature indication is currently 350°F. If the reference (cold) junction temperature decreases by 10°F, the new temperature indication will be: (Assume measuring junction temperature remains constant.)

A. 340°F.

B. 350°F.

C. 360°F.

D. 370°F.



SIMPLE THERMOCOUPLE CIRCUIT

QUESTION: 11

What is the most common type of sensor used to provide remote position indication of a valve that is normally either fully open or fully closed?

A. Limit switch

B. Reed switch

C. Servo transmitter

D. Linear variable differential transformer

QUESTION: 12

A reactor scrammed due to a loss-of-coolant accident one hour ago. To verify adequate reactor vessel water level, the source range monitors (SRMs) were inserted. As the SRMs entered the core, source range count rate increased and then became relatively stable as the SRMs continued upward into the water-filled region of the core.

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

A. decrease due to increased neutron leakage.

B. decrease due to decreased fast fission.

C. increase due to increased neutron migration length.

D. increase due to decreased moderator neutron absorption.

QUESTION: 13

A fission chamber used for reactor neutron monitoring is operating in the ionization region. If the voltage supplied to the fission chamber is continuously increased, which one of the following operating regions will the detector enter next?

A. Proportional

B. Recombination

C. Geiger-Mueller

D. Limited proportional

QUESTION: 14

Which one of the following describes a characteristic of a self-reading pocket dosimeter (SRPD)?

A. The output of an SRPD is a dose rate in mr/hr.

B. SRPDs can be used to record beta and gamma radiation.

C. SRPD readings must be considered inaccurate when they are dropped.

D. SRPDs hold their charge indefinitely when removed from a radiation field.

QUESTION: 15

An emergency diesel generator (D/G) is operating as the only power source connected to an emergency bus. The governor of the D/G is directly sensing D/G _____ and will directly adjust D/G _____ flow to maintain a relatively constant D/G frequency.

A. load; air

B. load; fuel

C. speed; air

D. speed; fuel

QUESTION: 16

Refer to the drawing of a water storage tank with a level control system (see figure below). The tank water level is being automatically controlled at 50% by a proportional-integral (PI) controller that positions the drain valve. Tank water level is currently stable with 500 gpm entering the tank and the drain valve 50% open.

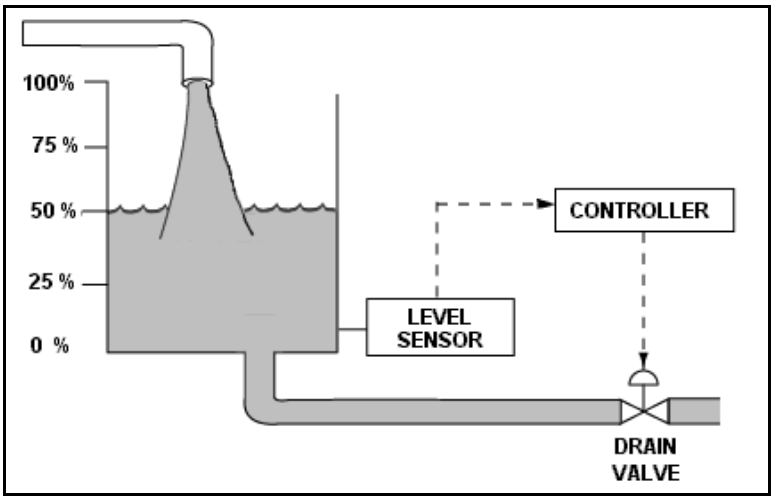
Tank inlet flow rate suddenly increases to 700 gpm and remains constant. When tank water level stabilizes, level will be _____, and the drain valve position will be _____.

A. higher than 50%; more open

B. higher than 50%; the same

C. 50%; more open

D. 50%; the same



QUESTION: 17

An air-operated isolation valve requires 2,800 pounds-force from its diaphragm actuator and 4 inches of stem travel for proper operation. The valve positioner can supply a nominal 117 psig of air pressure to the actuator.

What is the minimum surface area of the actuator diaphragm required for proper valve operation?

A. 24 square inches

B. 48 square inches

C. 94 square inches

D. 138 square inches

QUESTION: 18

A cooling water pump is operating with pump suction parameters as follows:

Suction Temperature: 124°F
Suction Pressure: 11.7 psia

What is the approximiate available net positive suction head (NPSH) for the pump? (Neglect the contribution of the suction fluid velocity to NPSH.)

A. 23 feet

B. 27 feet

C. 31 feet

D. 35 feet

QUESTION: 19

An ac motor-driven centrifugal pump was just started. During the start, motor current remained peaked for 6 seconds before decreasing to standard running current. Normally, the starting current peak lasts about 4 seconds.

Which one of the following could have caused the extended starting current peak?

A. The pump shaft was seized and did not turn.

B. The pump was initially rotating slowly in the reverse direction.

C. The pump discharge check valve was stuck closed and did not open.

D. The pump was initially air bound, and then primed itself after 6 seconds of operation.

QUESTION: 20

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose. Which one of the following will cause the pump to operate at shutoff head?

A. A firefighter inadvertently severs the fire hose.

B. The fire hose becomes partially crimped in a fire door.

C. Fire water storage tank level drops below the pump suction tap.

D. A firefighter adjusts the fire hose nozzle spray pattern from “deluge” to “off”.

QUESTION: 21

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

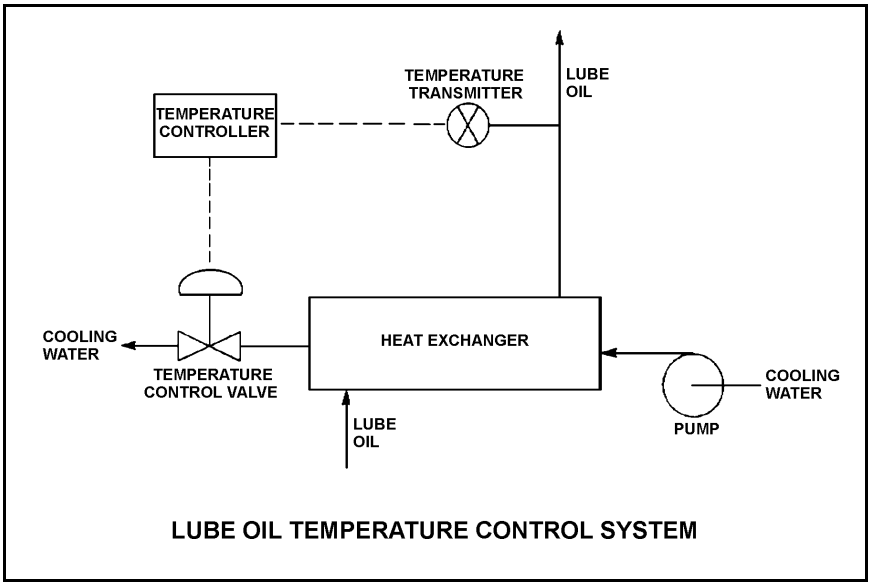
The pump is operating with the temperature control valve one-half open. If the temperature control valve modulates farther closed, system head loss will _____ and pump head will _____.

A. increase, decrease

B. increase, increase

C. decrease, decrease

D. decrease, increase



LUBE OIL TEMPERATURE CONTROL SYSTEM

QUESTION: 22

A centrifugal pump is operating at rated conditions in an open system with all valves fully open. If the pump suction valve is throttled to 50% closed, pump suction pressure will _____ and pump flow rate will _____.

A. increase; decrease

B. decrease; decrease

C. increase; remain the same

D. decrease; remain the same

QUESTION: 23

A centrifugal pump is susceptible to overheating and possible cavitation while operating with its discharge valve closed, unless:

A. the pump is steam driven.

B. the suction valve is also closed.

C. pump seal cooling is provided.

D. minimum flow protection is provided.

QUESTION: 24

A pump that moves liquid by means of a piston within a cylinder that displaces a given volume of fluid for each stroke is a _____ pump.

A. radial

B. screw

C. centrifugal

D. reciprocating

QUESTION: 25

Prior to starting a positive displacement pump, the discharge valve should be open to:

A. prevent rupturing the pump casing.

B. limit the pump motor starting time.

C. ensure the pump casing fills by backflow.

D. reduce pressure fluctuations in the discharge piping.

QUESTION: 26

Which one of the following will result from prolonged operation of an ac motor with excessively high stator temperatures?

A. Decreased electrical current demand due to reduced counter electromotive force

B. Increased electrical current demand due to reduced counter electromotive force

C. Decreased electrical ground resistance due to breakdown of winding insulation

D. Increased electrical ground resistance due to breakdown of winding insulation

QUESTION: 27

A large centrifugal pump is driven by a 200 horsepower 4.16 kV ac motor. The motor breaker control circuit contains the following protection devices: instantaneous overcurrent relay, motor thermal overload relay, control power fuses, and an anti-pumping device.

The pump had been manually started and stopped several times during a 5-minute period when the motor breaker unexpectedly tripped. In this situation, which one of the following is the most likely cause of the breaker trip?

A. Instantaneous overcurrent

B. Motor thermal overload

C. Blown control power fuse

D. Anti-pumping device actuation

QUESTION: 28

A 120 VDC battery is rated at 800 amp-hours for a continuous 50 kW load. Approximately how long will the fully charged battery be able to supply a continuous 50 kW load before the battery rating is exceeded?

A. 115 minutes

B. 90 minutes

C. 75 minutes

D. 60 minutes

QUESTION: 29

A main generator that is connected to an infinite power grid has the following indications:

100 MWe
0 MVAR
2,900 amps
20,000 Vac

If main generator excitation is reduced, amps will _____ and MWe will _____.

A. decrease; decrease

B. increase; decrease

C. decrease; remain the same

D. increase; remain the same

QUESTION: 30

A plant is operating at 80% power in the middle of a fuel cycle. The main generator is connected to an infinite power grid with the following initial main generator output parameters:

Frequency:	60 Hz
Voltage:	25 KV
Reactive Load:	300 MVAR (out)
Real Load:	800 MW

A hydraulic oil system malfunction causes the main turbine steam inlet valves to begin to slowly drift closed. Over the next 10 minutes, the main generator real load decreases to 300 MW. Assuming no operator actions are taken during the load decrease, how will the following main generator output parameters be affected?

	Frequency	Voltage	Reactive Load
A.	Decrease	Decrease	No change
B.	Decrease	No change	Decrease
C.	No change	No change	No change
D.	No change	Decrease	Decrease

QUESTION: 31

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

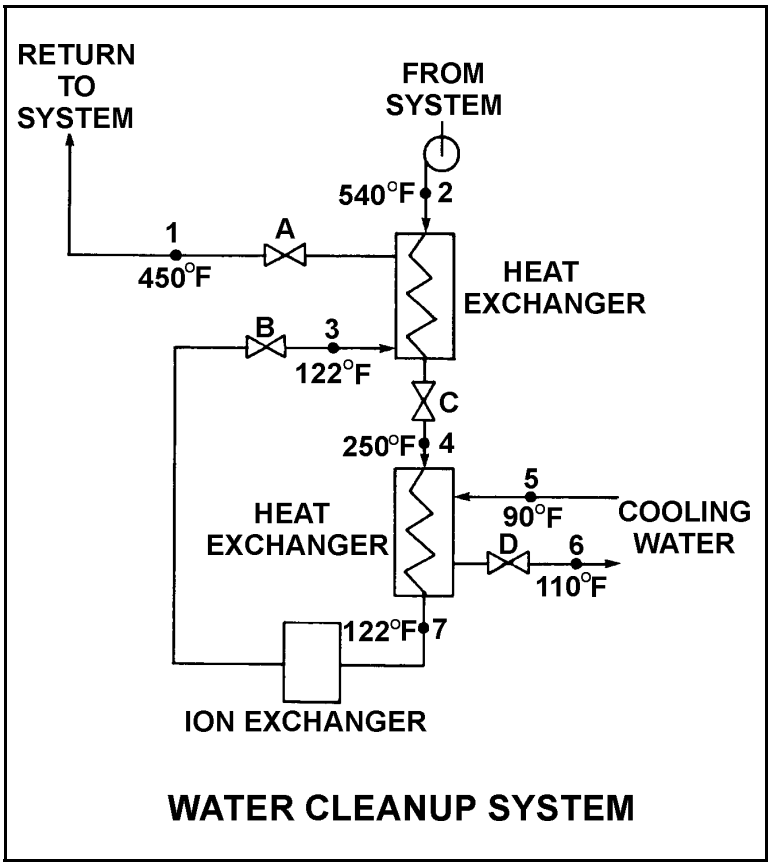
All valves are identical and are initially 50% open. To lower the temperature at point 7, the operator should adjust valve _____ in the open direction.

A. A

B. B

C. C

D. D



QUESTION: 32

Steam has been admitted to a condenser for 25 minutes with no cooling water during a condenser startup. Initiating maximum cooling water flow rate at this time will:

A. reduce the stress on the condenser tubes by gradually cooling the tubes.

B. reduce the stress on the condenser shell because the shell has been pre-warmed.

C. induce large thermal stresses on the condenser shell.

D. induce large thermal stresses on the junctions between the condenser tubes and the tubesheet .

QUESTION: 33

A reactor is operating at steady-state 100% power. Assuming that condenser cooling water inlet temperature and flow rate do not change, if condenser vacuum decreases, condensate temperature will:

A. increase because condensate subcooling has decreased.

B. increase because condenser saturation pressure has increased.

C. decrease because condensate subcooling has increased.

D. decrease because condenser saturation pressure has decreased.

QUESTION: 34

What is the saturation temperature for a boiling water reactor operating at 920 psig?

A. 532.6°F

B. 533.9°F

C. 536.5°F

D. 538.4°F

QUESTION: 35

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

A. To minimize the system head losses

B. To minimize the potential for water hammer

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

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

QUESTION: 36

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

A. surface area of the tubes decreases.

B. cooling fluid outlet temperature decreases.

C. thermal conductivity of the scale is very low.

D. flow through the heat exchanger becomes more turbulent.

QUESTION: 37

A condensate demineralizer differential pressure (D/P) gauge indicates 4 psid at 50% flow. Over the next two days plant power changes have caused condensate flow to vary between 25% and 100%.

Which one of the following combinations of condensate flow and demineralizer D/P, observed during the power changes, indicates an increase in the accumulation of corrosion products in the demineralizer?

	CONDENSATE FLOW	DEMINERALIZER D/P (PSID)
A.	100%	15.0
B.	75%	9.0
C.	60%	5.0
D.	25%	2.0

QUESTION: 38

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

A. will decompose the resin beads.

B increases the potential for channeling.

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

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

QUESTION: 39

The anion resin in a mixed-bed demineralizer releases desirable _____ ions into solution while removing undesirable _____ charged ions from solution.

A. hydroxide; negatively

B. hydroxide; positively

C. hydrogen; negatively

D. hydrogen; positively

QUESTION: 40

During maintenance activities, breakers are opened, tagged, and racked out to:

A. deenergize components and associated control and indication circuits.

B. provide administrative control where safety is not of prime importance.

C. maintain remote indication of breaker position (where available) to ensure personnel safety.

D. permit electricians to locally energize and deenergize main power and control circuits for troubleshooting and repairs.

QUESTION: 41

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

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

Based on these indications, the operator should report that the circuit breaker is _____ and racked _____.

A. open; in

B. closed; in

C. open; out

D. closed; out

QUESTION: 42

Refer to the drawing of a typical valve control circuit for a 480 Vac motor-operated valve (see figure below).

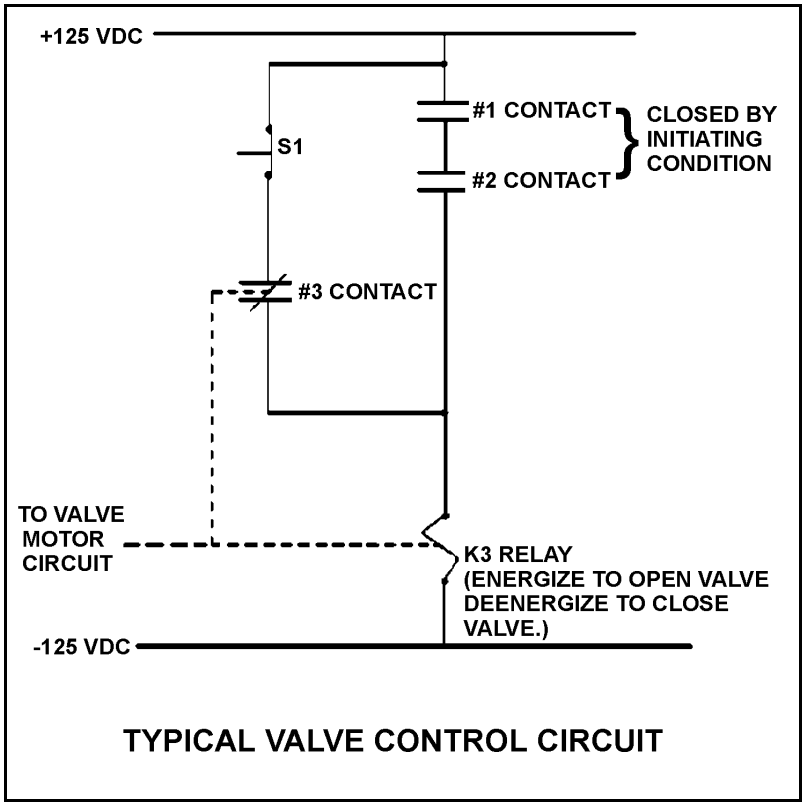
The valve is currently open with the contact configuration as shown. If the S1 pushbutton is depressed, the valve will _____ and when the S1 pushbutton is subsequently released, the valve will _____.

A. close; open

B. remain open; close

C. close; remain closed

D. remain open; remain open



QUESTION: 43

The function of high voltage electrical disconnects is to:

A. protect circuits during overcurrent conditions.

B. protect circuits during undervoltage conditions.

C. isolate equipment electrically during no-load conditions.

D. isolate equipment electrically during overload conditions.

QUESTION: 44

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

Generator A	Generator B
22.5 Kv	22.5 Kv
60.2 Hertz	60.2 Hertz
750 Mw	750 Mw
25 MVAR (VARs out)	50 MVAR (VARs out)

A malfunction causes the voltage regulator for generator B to slowly and continuously increase the terminal voltage for generator B. If no operator action is taken, which one of the following describes the electrical current indications for generator A?

A. Current will decrease continuously until the output breaker for generator A trips on reverse power .

B. Current will decrease continuously until the output breaker for generator B trips on reverse power .

C. Current will initially decrease, and then increase until the output breaker for generator A trips on overcurrent.

D. Current will initially decrease, and then increase until the output breaker for generator B trips on overcurrent.

QUESTION: 45

As compared to a prompt neutron, a delayed neutron, born from the same fission event, requires _____ collisions in the moderator to become thermal and is _____ likely to cause fission of a U-238 nucleus. (Neglect the effects of neutron leakage.)

A. more; more

B. more; less

C. fewer; more

D. fewer; less

QUESTION: 46

Which one of the following will increase the average distance traveled by a fission neutron to become thermal in an operating reactor? (Assume the neutron continues to migrate inside the reactor until it becomes a thermal neutron.)

A. Moderator temperature decreases

B. Average neutron energy decreases

C. Reactor coolant system pressure increases

D. Reactor coolant void percentage increases

QUESTION: 47

Which one of the following conditions describes a reactor that is exactly critical?

A. $K_{eff} = 1$; $\Delta K/K = 0$

B. $K_{eff} = 1$; $\Delta K/K = 1$

C. $K_{eff} = 0$; $\Delta K/K = 0$

D. $K_{eff} = 0$; $\Delta K/K = 1$

QUESTION: 48

The fractional change in neutron population from one generation to the next is called:

A. beta.

B. K_{eff}.

C. lambda.

D. reactivity.

QUESTION: 49

Which one of the following intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period immediately following a reactor scram from steady-state 100% power?

A. Photo-neutron reactions

B. Alpha-neutron reactions

C. Transuranic isotope decay

D. Spontaneous fission reactions

QUESTION: 50

A reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1% $\Delta K/K$ into the reactor core. Assuming no other reactivity additions, what will be the approximate stable reactor period for this reactor until the point of adding heat is reached?

A. 20 seconds

B. 40 seconds

C. 60 seconds

D. 80 seconds

QUESTION: 51

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. The fission process is occurring so rapidly that the delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the average effective delayed neutron fraction.

QUESTION: 52

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 a fuel cycle?

A. U-235

B. U-238

C. Pu-239

D. Pu-240

QUESTION: 53

Which one of the following lists the moderator temperature coefficient (MTC), fuel temperature coefficient (FTC), and void coefficient (VC) in typical order of magnitude from most negative to least negative at 50% power at the middle of core life?

A. FTC, VC, MTC

B. FTC, MTC, VC

C. VC, MTC, FTC

D. VC, FTC, MTC

QUESTION: 54

Rod density is a measure of the total number of control rod notches _____ the core divided by the total number of control rod notches _____ the core.

A. inserted into; available in

B. inserted into; withdrawn from

C. withdrawn from; available in

D. withdrawn from; inserted into

QUESTION: 55

As a control rod is withdrawn from notch position 00 (fully inserted) to notch position 48 (fully withdrawn) the absolute value of integral rod worth will:

A. decrease, then increase.

B. increase, then decrease.

C. decrease continuously.

D. increase continuously.

QUESTION: 56

The main reason for designing and operating a reactor with a flattened neutron flux distribution is to:

A. provide even burnup of control rods.

B. reduce neutron leakage from the core.

C. allow a higher average power density.

D. provide more accurate nuclear power indication.

QUESTION: 57

A reactor is operating at equilibrium full power when a single control rod fully inserts (from the fully withdrawn position). Reactor power is returned to full power with the control rod still fully inserted.

Compared to the initial axial neutron flux shape, the current flux shape will have a:

A. minor distortion, because a fully inserted control rod has zero reactivity worth.

B. minor distortion, because the fully inserted control rod is an axially uniform poison.

C. major distortion, because the upper and lower core halves are loosely coupled.

D. major distortion, because power production along the length of the rod drastically decreases.

QUESTION: 58

A 3400 Mw reactor has been operating at 100% power for several months. Which one of the following describes the contributions of beta decay and neutron capture to Xe-135 removal from the reactor core?

A. Primary - beta decay; secondary - neutron capture

B. Primary - neutron capture; secondary - beta decay

C. Equally from beta decay and neutron capture

D. Not enough information given to make a comparison

QUESTION: 59

Reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating near the end of core life and reactor B is operating near the beginning of core life.

Which reactor is experiencing the most negative reactivity from equilibrium core Xe-135?

A. Reactor A due to a greater concentration of equilibrium core Xe-135

B. Reactor A due to lower competition from the fuel for thermal neutrons

C. Reactor B due to a greater thermal neutron flux in the core

D. Reactor B due to a smaller accumulation of stable fission product poisons

QUESTION: 60

A reactor is operating at the beginning of core life, 100% power, and equilibrium xenon concentration when a scram occurs. When the reactor is taken critical 5 hours later, xenon distribution will be maximum at the _____ of the core.

A. top and center

B. top and outer circumference

C. bottom and center

D. bottom and outer circumference

QUESTION: 61

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 core xenon-135 changes over the next 24 hours?

A. Negative only

B. Negative, then positive

C. Positive only

D. Positive, then negative

QUESTION: 62

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

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

A. Greater than 80% and decreasing slowly

B. Greater than 80% and increasing slowly

C. Less than 80% and decreasing slowly

D. Less than 80% and increasing slowly

QUESTION: 63

A reactor that had been operating at 100% power for about two months was shutdown over a 2-hour period. Following the shutdown, core xenon-135 will reach a new steady-state concentration in _____ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

QUESTION: 64

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

A. control rod; larger

B. burnable poison; larger

C. control rod; smaller

D. burnable poison; smaller

QUESTION: 65

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

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

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

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

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

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

QUESTION: 66

The following data was obtained at steady-state conditions during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
0	180
5	200
10	225
15	257
20	300
25	360
30	450

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

A. Approximately 40 units withdrawn

B. Approximately 50 units withdrawn

C. Approximately 60 units withdrawn

D. Approximately 70 units withdrawn

QUESTION: 67

A reactor is critical at 10^{-6}% power. Control rods are withdrawn for 5 seconds and then stopped, resulting in a stable reactor period of positive 100 seconds.

If control rods had been inserted (instead of withdrawn) for 2 seconds with the reactor initially critical at 10^{-6}% power, the stable reactor period would have been: (Assume equal absolute values of reactivity are added in both cases.)

A. shorter than negative 100 seconds, because reactor power decreases result in smaller delayed neutron fractions.

B. shorter than negative 100 seconds, because reactor power decreases are less limited by delayed neutrons.

C. longer than negative 100 seconds, because reactor power decreases result in larger delayed neutron fractions.

D. longer than negative 100 seconds, because reactor power decreases are more limited by delayed neutrons.

QUESTION: 68

A reactor is being started up with a stable positive 100-second period and power is entering the intermediate range (below the point of adding heat). Assuming no operator action, which one of the following describes the response of reactor period?

A. Prior to reaching the point of adding heat, the fuel temperature increase will add negative reactivity and reactor period will approach infinity.

B. As heat production in the reactor exceeds ambient losses, the temperature of the fuel and moderator will increase, adding negative reactivity, and reactor period will approach infinity.

C. The heat produced by the reactor through all ranges of the intermediate range indication, is insufficient to raise the fuel or moderator temperatures, and reactor period remains constant throughout the intermediate range.

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

QUESTION: 69

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable positive 30-second reactor period. One minute later (prior to reaching the point of adding heat), the operator inserts the same control rod for 25 seconds.

During the insertion, when will the reactor period become negative?

A. Immediately when the control rod insertion is initiated.

B. After the control rod passes through the critical rod height.

C. Just as the control rod passes through the critical rod height.

D. Prior to the control rod passing through the critical rod height.

QUESTION: 70

If a reactor power increase is accomplished using only the control rods, which one of the following would result in the greatest amount of negative reactivity feedback from the void coefficient?

A. A void fraction increase from 5% to 10% at beginning of core life

B. A void fraction increase from 5% to 10% at end of core life

C. A void fraction increase from 40% to 45% at beginning of core life

D. A void fraction increase from 40% to 45% at end of core life

QUESTION: 71

Following a reactor shutdown from three-months operation at full power, core heat production will continue for a period of time. The rate of core heat production will be dependent upon the:

A. amount of fuel that has been depleted.

B. amount of time that has elapsed since K_{eff} decreased below 1.0.

C. amount of time required for the reactor pressure vessel to cool down.

D. rate at which the photoneutron source strength decays following shutdown.

QUESTION: 72

A plant is operating normally at 50% power when a steam break occurs that releases 5% of rated steam flow. Assume no operator or protective actions occur, automatic pressure control returns reactor pressure to its initial value, and feed water injection temperature remains the same.

How will turbine power respond?

A. Decrease and stabilize at a lower power level

B. Increase and stabilize at a higher power level

C. Decrease, then increase and stabilize at the previous power level

D. Increase, then decrease and stabilize at the previous power level

QUESTION: 73

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

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

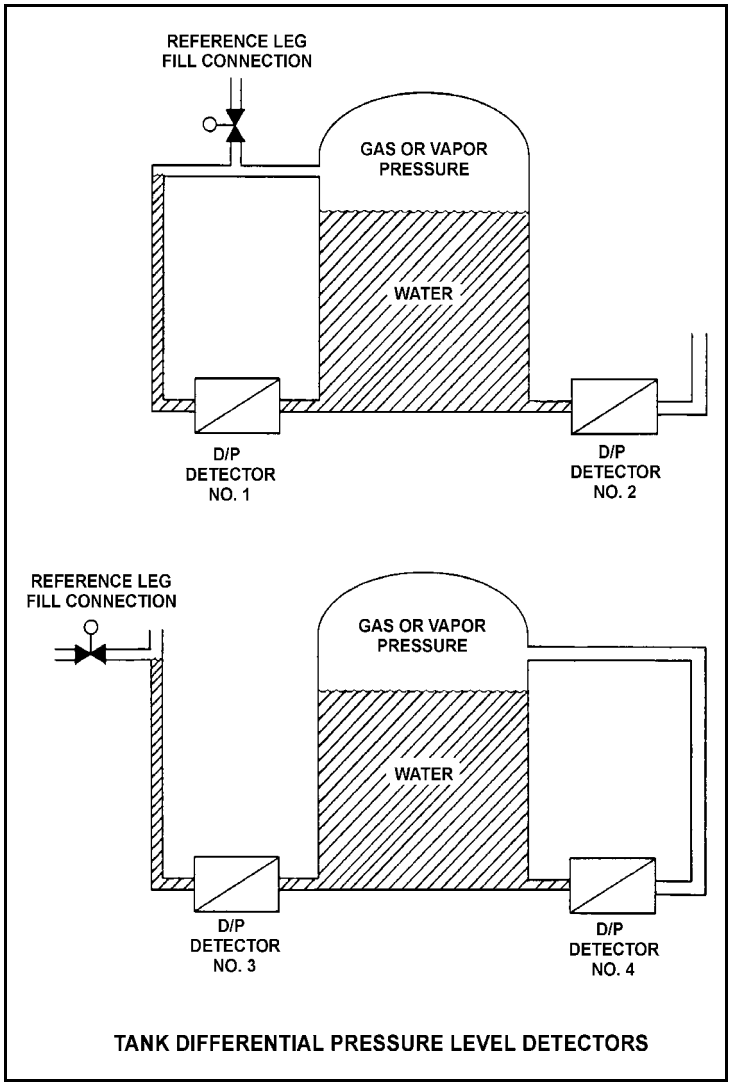
If each detector experiences a ruptured diaphragm, which detector(s) will cause indicated tank level to decrease? (Assume actual tank water level remains constant.)

A. No. 1 only

B. No. 2 only

C. No. 1, 2, and 3

D. No. 2, 3, and 4



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

QUESTION: 74

An open container holds one pound-mass of liquid water at saturated conditions and atmospheric pressure. The addition of 4 Btus will:

A. result in 4°F of superheat.

B. vaporize a portion of the water.

C. increase the density of the water.

D. raise the temperature of the water by 4°F.

QUESTION: 75

Consider a shutdown reactor vessel containing a saturated water/vapor mixture at 500°F. The mixture is currently stable with no net heat gain or loss occurring. Reactor vessel water level is 100 inches above the top of the fuel bundles.

If a leak near the bottom of the vessel results in a loss of 10% of the liquid volume from the vessel, the temperature of the mixture will _____, and the overall quality of the mixture will _____. (Assume the mixture remains saturated.)

A. decrease; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

QUESTION: 76

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

A. decrease; increase

B. increase; decrease

C. increase; increase

D. decrease; decrease

QUESTION: 77

The thermodynamic cycle efficiency of a nuclear power plant can be increased by:

A. decreasing power from 100% to 25%.

B. removing a high-pressure feed water heater from service.

C. lowering condenser vacuum from 29 inches to 25 inches.

D. decreasing the amount of condensate depression (subcooling).

QUESTION: 78

Given the following:

1. A saturated steam-water mixture with an inlet quality of 60% is flowing through a moisture separator.
2. The moisture separator is 100% efficient for removing moisture.

How much moisture will be removed by the moisture separator from 50 lbm of the steam-water mixture?

A. 10 lbm

B. 20 lbm

C. 30 lbm

D. 40 lbm

QUESTION: 79

A single-phase cooling water system is operating at design flow rate. Which one of the following types of energy within the cooling water is increased when the cooling water head is reduced by throttling a flow control valve?

A. Flow

B. Kinetic

C. Internal

D. Potential

QUESTION: 80

A plant is operating at full power when a 200 gpm reactor coolant leak occurs, which results in a reactor scram and initiation of emergency coolant injection. Reactor vessel pressure stabilizes at 900 psia and all centrifugal injection pumps are operating with all pump miniflow paths isolated. The shutoff heads for the pumps are as follows:

High pressure coolant injection (HPCI) pumps: 1200 psia
Low pressure coolant injection (LPCI) pumps: 200 psia

Which pumps are currently threatened for operability and why?

A. LPCI pumps due to pump overheating

B. LPCI pumps due to motor overheating

C. HPCI pumps due to pump overheating

D. HPCI pumps due to motor overheating

QUESTION: 81

A 100 gpm leak to atmosphere has developed from a cooling water system that is operating at 60 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 20 psig?

A. 33.3 gpm

B. 53.0 gpm

C. 57.7 gpm

D. 70.7 gpm

QUESTION: 82

Consider the temperature profile for a typical fuel rod. Which one of the following has the largest thermal conductivity?

A. Fuel pellet

B. Fuel clad

C. Fuel rod fill gas

D. Fission product gases

QUESTION: 83

A reactor plant was operating at a steady-state power level with the following main condenser parameters:

Main condenser pressure:	1.2 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	84°F

As a result of increased condenser air inleakage, the overall heat transfer coefficient of the main condenser decreases by 25%. Main condenser heat transfer rate and cooling water temperatures are unchanged. Which one of the following is the approximate resulting pressure in the main condenser?

A. 1.7 psia

B. 2.3 psia

C. 3.0 psia

D. 4.6 psia

QUESTION: 84

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 feed water temperature.

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

C. The feed flow rate used in the heat balance calculation was lower than actual feed flow rate.

D. The steam pressure used in the heat balance calculation was lower than actual steam pressure.

QUESTION: 85

The maximum convective heat transfer coefficient exists just prior to the beginning of:

A. bulk boiling.

B. saturated nucleate boiling.

C. subcooled nucleate boiling.

D. departure from nucleate boiling.

QUESTION: 86

Following a reactor accident, transition boiling is occurring near the top of one fuel assembly coolant channel. At the coolant channel elevation where the onset of transition boiling is occurring, coolant flow is changing from _____ flow to _____ flow.

A. annular; slug

B. annular; vapor

C. bubbly; slug

D. bubbly; vapor

QUESTION: 87

What is the approximate void fraction (in percent) for the following conditions:

10 lbm mixture of vapor and liquid
Steam quality = 20%
Pressure = 1,000 psia

A. 42%

B. 48%

C. 84%

D. 96%

QUESTION: 88

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: 89

Single-phase coolant flow resistance in a reactor core is proportional to coolant _____ and inversely proportional to _____.

A. velocity; orifice diameter

B. velocity; bundle length

C. temperature; orifice diameter

D. temperature; bundle length

QUESTION: 90

Core bypass flow is:

A. undesirable but cannot be prevented due to machined clearances within the reactor vessel.

B. desirable because it provides cooling for low-power areas of the core.

C. undesirable because it makes actual core flow hard to measure.

D. desirable because it provides cooling for incore instrumentation.

QUESTION: 91

While a reactor is shut down, what effect will decreasing reactor water level to just below the steam separators have on natural circulation flow rate?

A. Flow rate will significantly decrease due to the loss of communication between the annulus and the core.

B. Flow rate will decrease initially and then increase to a new thermal equilibrium value slightly less than the original flow rate.

C. Flow rate will increase to a new stable value as the temperature of the water in the core increases to a new stable value.

D. Flow rate will not be significantly affected because the thermal driving head is primarily dependent on the differential temperature between the core and the annulus.

QUESTION: 92

The ratio of the highest pin heat flux in a node to the average pin heat flux in the same node is called the _____ peaking factor.

A. local

B. radial

C. axial

D. total

QUESTION: 93

Linear heat generation rate is the:

A. ratio of the average power per fuel rod divided by the associated fuel bundle power.

B. ratio of the power produced in a given fuel bundle divided by total core thermal power.

C. sum of the power produced by all fuel rods in a given fuel bundle at a specific planar cross section.

D. sum of the power per unit area for each unit area of the fuel cladding for a unit length of a fuel rod.

QUESTION: 94

Maintaining the linear heat generation rate below the thermal limit ensures that:

A. plastic strain (deformation) of the cladding will not exceed 1%.

B. peaking factors will not exceed those assumed in the safety analysis.

C. during transients, more than 99.97% of the fuel rods will avoid transition boiling.

D. peak cladding temperature after the design basis loss of coolant accident will not exceed 2200°F.

QUESTION: 95

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

A. 2200°F is approximately 500°F below the fuel cladding melting temperature.

B. the rate of the zircaloy-steam reaction increases significantly at temperatures above 2200°F.

C. any cladding temperature higher than 2200°F correlates to a fuel centerline temperature above the fuel melting point.

D. the thermal conductivity of zircaloy decreases rapidly at temperatures above 2200°F causing an unacceptably sharp rise in the fuel centerline temperature.

QUESTION: 96

Which one of the following expressions describes the critical power ratio?

A. Critical power/actual bundle power

B. Actual bundle power/critical power

C. Average bundle power/critical power

D. Critical power/average bundle power

QUESTION: 97

If a reactor is being operated with minimum critical power ratio (MCPR) at its transient limit, which one of the following is indicated?

A. None of the fuel rods are experiencing critical heat flux.

B. A small fraction of the fuel rods may be experiencing critical heat flux.

C. All radioactive fission products are being contained within the reactor fuel.

D. All radioactive fission products are being contained within either the reactor fuel or the reactor vessel.

QUESTION: 98

Select the cause for the reduction in the size of the gap between the fuel pellet and the clad over core life.

A. Contraction of the clad due to zirconium hydriding

B. Expansion of the fuel pellets due to densification

C. Contraction of the clad due to fuel rod internal vacuum

D. Expansion of the fuel pellets due to fission product buildup

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. Maintaining reactor vessel pressure below the maximum design limit

C. Operating above the reference temperature for nil-ductility transition (RT_{NDT})

D. Maintaining the number of reactor vessel heatup/cooldown cycles within limits

QUESTION: 100

Two identical reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 60% and has been operating for 15 years. Reactor B has an average lifetime power capacity of 75% and has been operating for 12 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

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

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

C. Both reactors will have approximately the same nil ductility transition temperature because each core has produced approximately the same number of fissions.

D. Both reactors will have approximately the same nil ductility transition temperature because fast neutron irradiation in a shut down core is not significant.

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

FEBRUARY 2002 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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