UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2004--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 3.0 hours after the examination starts. This examination applies to a typical boiling water reactor (BWR) nuclear power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 22		
REACTOR THEORY	23 - 36		
THERMODYNAMICS	37 - 50		
TOTALS	50		

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

_____
Applicant's Signature

RULES AND GUIDELINES FOR THE NRC
GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

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

1. Print your name in the blank provided on the cover sheet of the examination.

2. Fill in 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 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 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

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

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

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

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

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

$1/M = CR_1/CR_X$

$A = \pi r^2$

$F = PA$

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

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

$E = IR$

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

The difference between the setpoint pressure at which a relief valve begins to open and the pressure at which it is fully open is called...

A. setpoint deviation.

B. setpoint tolerance.

C. accumulation.

D. blowdown.

QUESTION: 2

Refer to the drawing of a cooling water system in which both centrifugal pumps A and B are operating (see figure below).

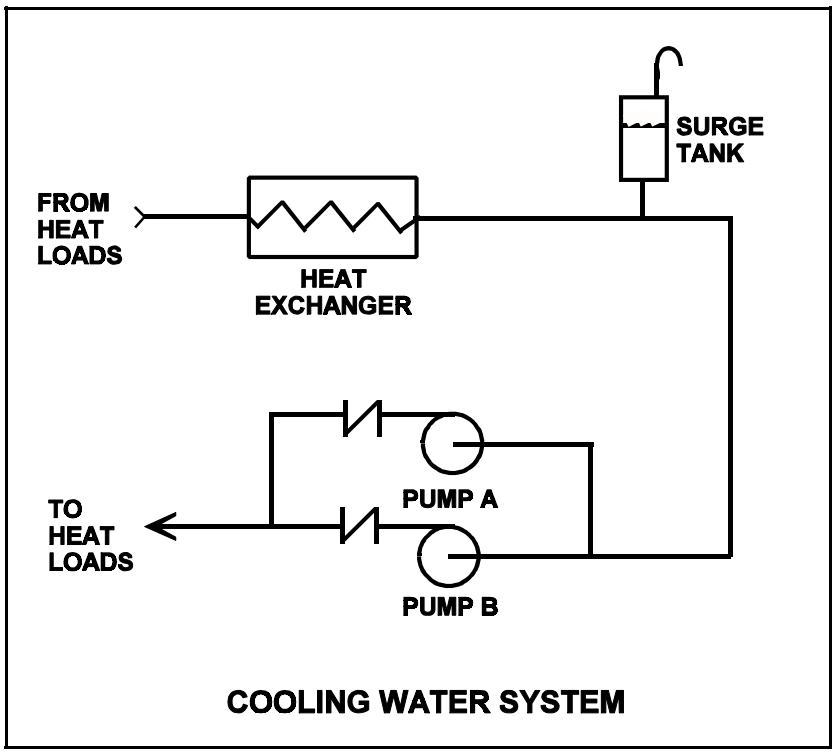
An operator stops pump B, but the pump B check valve fails to close. In comparison to normal operation with only pump A running, operation with the failed pump B check valve will result in pump A flow rate being _____ than normal; and heat exchanger flow rate being _____ than normal.

A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower



QUESTION: 3

The purpose of backseating a manual valve in an operating system is to...

A. isolate system pressure from the stem packing to minimize leakage past the valve stem.

B. fully remove the valve disk from the flow stream to minimize system headloss.

C. ensure the valve is fully open by verifying that the valve disk is attached to the valve stem.

D. reduce valve disk wear by completely removing it from the flow stream.

QUESTION: 4

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure:	125 psig	Actual Flow Rate:	100 gpm
Downstream Pressure:	116 psig	Indicated Flow Rate:	100 gpm

Significant erosion of the orifice hole has occurred since the calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 110 psig and 106 psig respectively.

What is the approximate flow rate that is currently indicated?

A. 44 gpm

B. 67 gpm

C. 81 gpm

D. 120 gpm

QUESTION: 5

A cooling water system bourdon tube pressure detector is located inside a sealed building and system pressure currently indicates 50 psig. A building ambient temperature increase of 100°F will cause a _____ change in indicated system pressure, and a building pressure increase of 20 psig will cause a _____ change in indicated system pressure.

A. significant; significant

B. negligible; significant

C. significant; negligible

D. negligible; negligible

QUESTION: 6

In contrast to a thermocouple, a resistance temperature detector...

A. is used in high temperature applications.

B. does not require an external power supply for temperature indication.

C. uses a single type of metal or alloy in the sensing element.

D. is commonly placed in direct contact with the monitored substance.

QUESTION: 7

A beta particle and an alpha particle enter and cause ionization in a gas-filled radiation detector operating in the Geiger-Mueller region. Which one of the following accurately compares the amplitude of the detector pulses caused by each type of radiation?

A. The beta particle pulse will be larger in amplitude.

B. The alpha particle pulse will be larger in amplitude.

C. The pulses will be identical for both types of radiation.

D. Cannot be determined without particle kinetic energy information.

QUESTION: 8

The level in a tank is controlled by an automatic level controller. Level is initially at 50% when the tank develops a leak. When level decreases to 45% the level controller opens a makeup supply valve. After a few minutes level is 55% and the makeup valve closes. With the leak still in progress, level continuously oscillates between 45% and 55% as the makeup valve opens and closes.

The controller in this system uses primarily _____ control.

A. bistable

B. proportional

C. integral

D. derivative

QUESTION: 9

Refer to the drawing of a pressure bistable in an alarm circuit (see figure below).

The orientation of the bistable symbol indicates the characteristics of the bistable, as is normal for a control circuit diagram. The bistable turns on to actuate an alarm at a system pressure of 100 psig. The bistable has a 5 psig dead band, or neutral zone.

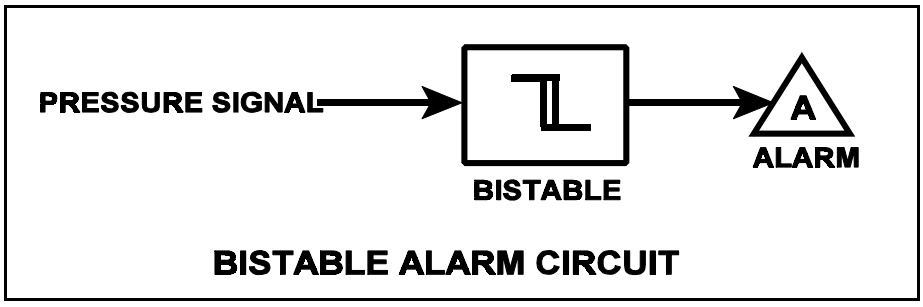
If system pressure is currently 110 psig, which one of the following describes the alarm circuit response as system pressure slowly decreases to 90 psig?

A. The alarm will actuate at 100 psig and will <u>not</u> turn off.

B. The alarm will actuate at 100 psig and will turn off at 95 psig.

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

D. The alarm is currently actuated and will turn off at 95 psig.



BISTABLE ALARM CIRCUIT

QUESTION: 10

Refer to the drawing of a cooling water system in which only centrifugal pump A is operating and the common pump discharge valve is currently 90% open (see figure below).

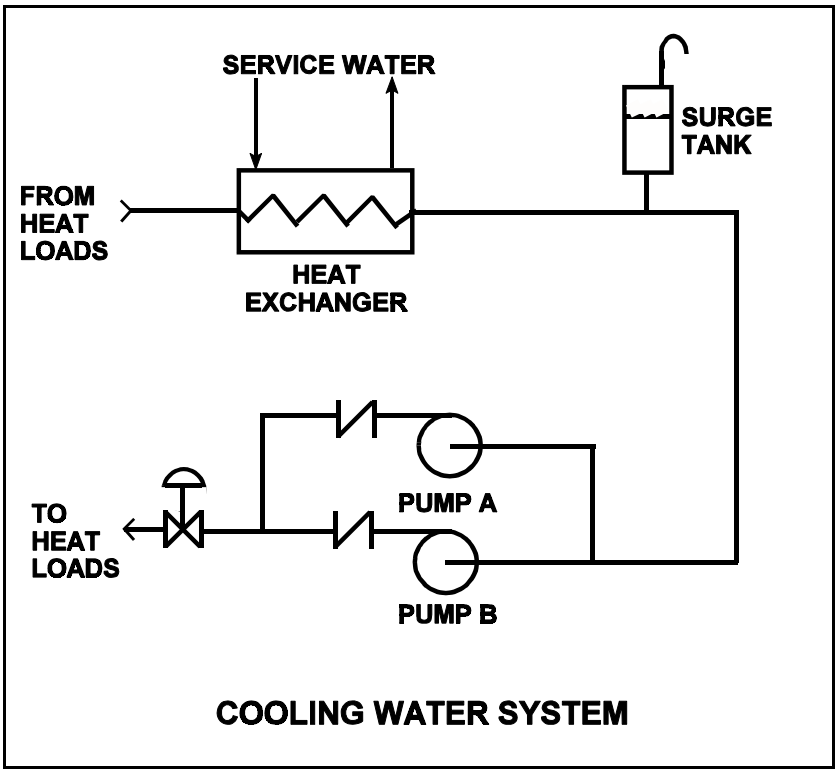
An abnormal total heat load on the cooling water system is causing pump A to approach operation at runout conditions. Which one of the following will cause pump A to operate farther away from runout conditions? (Assume that satisfactory available net positive suction head is maintained at all times.)

A. Starting pump B.

B. Positioning the discharge valve to 100% open.

C. Raising the water level in the surge tank by 2 feet.

D. Decreasing heat exchanger service water flow rate by 10%.



QUESTION: 11

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

Given:

- The pump eye is located 5 feet above the reservoir water level.
- The pump has a shutoff head of 120 feet.
- The required net positive suction head (NPSH) for the pump is 15 feet.
- The reservoir water temperature is 60°F.

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

A. 111 feet

B. 116 feet

C. 121 feet

D. 126 feet

QUESTION: 12

Which one of the following will occur as a direct result of operating a positive displacement pump with insufficient net positive suction head?

A. Increased slip

B. Decreased pump speed

C. Increased flow rate

D. Vapor binding

QUESTION: 13

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

A. throttled; throttled

B. throttled; fully open

C. fully open; throttled

D. fully open; fully open

QUESTION: 14

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

Current = 100 amperes
Pump head = 50 psid
Pump flow rate = 880 gpm

What will be the approximate value of pump head if pump speed is increased such that the pump now draws 640 amperes?

A. 93 psid

B. 126 psid

C. 173 psid

D. 320 psid

QUESTION: 15

A main turbine-generator is operating in parallel with an infinite power grid. If the turbine control valves (or throttle valves) slowly fail open, the generator will experience high current primarily due to... (Assume no generator protective actuations occur.)

A. excessive generator MWe.

B. excessive generator KVAR (VARs out).

C. excessive generator KVAR (VARs in).

D. generator reverse power.

QUESTION: 16

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

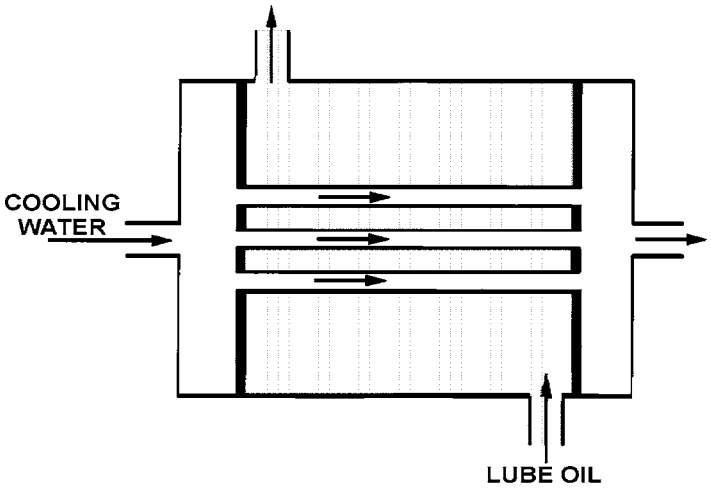
Assume that the inlet lube oil and inlet cooling water temperatures are constant and cooling water flow rate remains the same. Decreasing the oil flow rate through the heat exchanger will cause the oil outlet temperature to _____ and the cooling water outlet temperature to _____.

A. increase, increase

B. increase, decrease

C. decrease, increase

D. decrease, decrease



LUBE OIL HEAT EXCHANGER

QUESTION: 17

A pressure gauge on a condenser reads 27 inches of mercury (Hg) vacuum. What is the absolute pressure corresponding to this vacuum? (Assume that standard atmospheric pressure equals 15 psia.)

A. 1.0 psia

B. 1.5 psia

C. 13.5 psia

D. 14.0 psia

QUESTION: 18

A nuclear power plant is operating at 100% power when air inleakage results in the buildup of noncondensible gases in the main condenser. Which one of the following will decrease as a result of this air inleakage?

A. Condensate temperature

B. Pressure in the main condenser

C. Suction pressure at the condensate pumps

D. Condenser cooling water outlet temperature

QUESTION: 19

Channeling in a demineralizer is undesirable because the...

A. resulting high velocity fluid flow can cause significant damage to resin retention elements.

B. resulting high velocity fluid flow will cause agitation of the resin beads and the release of unwanted ions.

C. ability of the resin bed to remove suspended solids will decrease and cause outlet pH to increase.

D. ability of the resin bed to remove undesirable ions will decrease and cause outlet conductivity to increase.

QUESTION: 20

Which one of the following describes the process of backwashing a mixed-resin deep bed demineralizer?

A. Alternating the flow of dilute acidic and caustic solutions through the demineralizer to remove suspended solids and colloidal matter

B. Alternating the flow of dilute acidic and caustic solutions through the demineralizer to remove ionic impurities

C. Reversing flow of pure water through the demineralizer to remove suspended solids and colloidal matter

D. Reversing flow of pure water through the demineralizer to remove ionic impurities

QUESTION: 21

Refer to the drawing of a valve motor control circuit (see figure below) for a valve that is currently fully closed and has a 10-second stroke time. (Note: Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts follow the standard convention for control circuit drawings.)

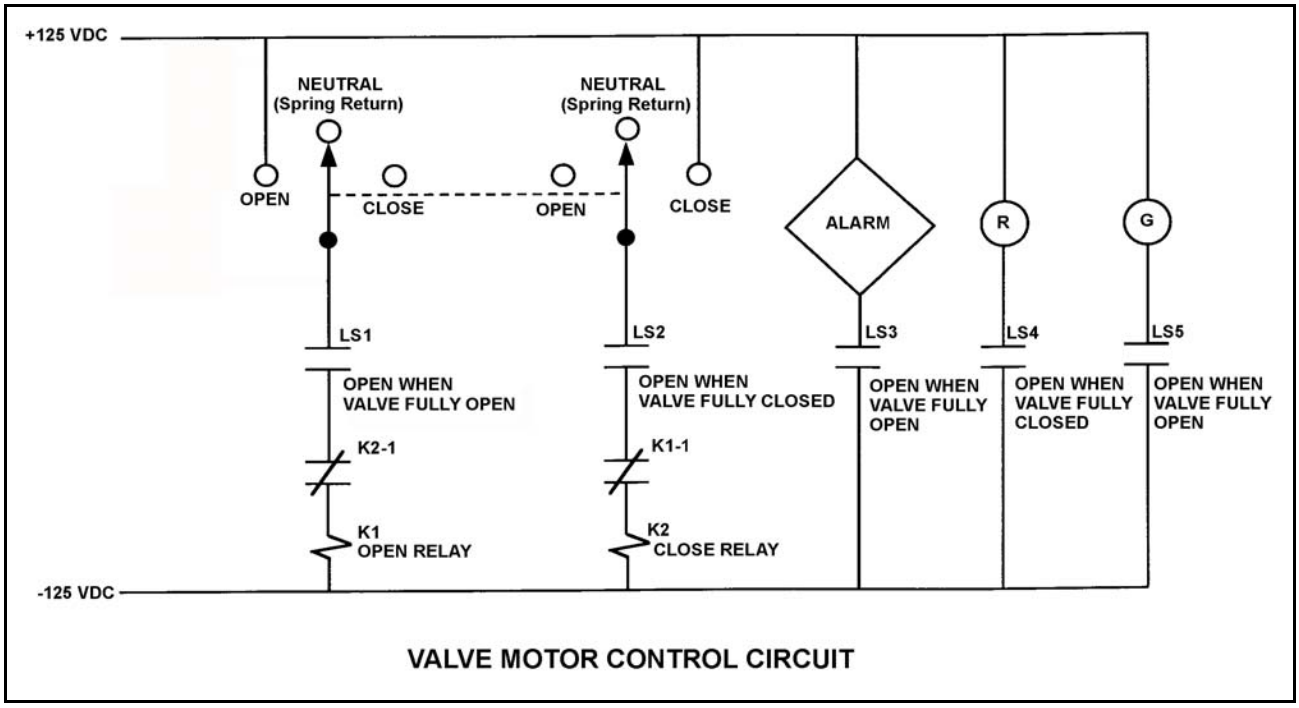
The operator takes the control switch to "Open" for 5 seconds and then releases the switch. After one minute the operator takes the control switch to "Close" for 5 seconds and then releases the switch. Which one of the following describes the valve position immediately after the control switch is released the second time?

A. Approximately fully open.

B. Approximately fully closed.

C. Approximately 50% open.

D. Cannot be determined without additional information.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 22

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

The generator breaker must be closed just as the synchroscope pointer reaches the 12 o'clock position to prevent...

A. motoring of the generator due to unequal frequencies.

B. excessive MWe load transfer to the generator due to unequal frequencies.

C. excessive MWe load transfer to the generator due to out-of-phase voltages.

D. excessive arcing within the generator output breaker due to out-of-phase voltages.

QUESTION: 23

Which one of the following types of neutrons in a reactor is more likely to cause fission of a U-238 nucleus in the reactor fuel? (Assume that each type of neutron remains in the reactor core until it interacts with a U-238 nucleus.)

A. Thermal neutron

B. Prompt fission neutron from birth

C. Delayed fission neutron from birth

D. Neutron at a U-238 resonance energy

QUESTION: 24

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 coefficient during a power increase.

D. To compensate for the conversion of U-238 to Pu-239 over core life.

QUESTION: 25

A reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

QUESTION: 26

Refer to the drawing of a curve showing the neutron absorption characteristics of a typical U-238 nucleus at a resonance neutron energy (see figure below). The associated reactor is currently operating at steady-state 80% power.

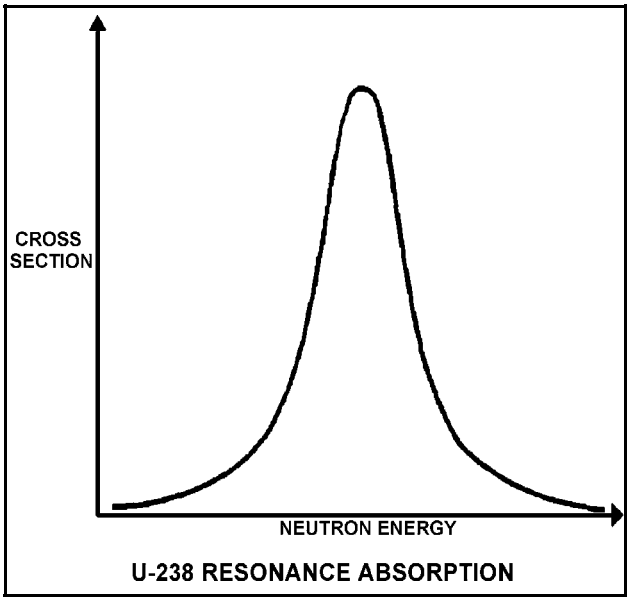
During a subsequent reactor power decrease to 70%, the curve will become _____; and the percentage of the core neutron population lost to resonance capture by U-238 will _____.

A. taller and more narrow; decrease

B. taller and more narrow; increase

C. shorter and broader; decrease

D. shorter and broader; increase



QUESTION: 27

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

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

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

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

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

QUESTION: 28

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

A. the same; the same

B. the same; higher

C. higher; the same

D. higher; higher

QUESTION: 29

A reactor is operating at 85% power with control rod X-Y inserted 20%. Which one of the following will cause the differential control rod worth of control rod X-Y to become more negative? (Assume that control rod X-Y remains 20% inserted for each case.)

A. Core Xe-135 builds up in the lower half of the core.

B. An adjacent control rod is fully withdrawn from the core.

C. Reactor vessel pressure drifts from 900 psig to 880 psig.

D. Fuel temperature increases as fission product gases accumulate in nearby fuel rods.

QUESTION: 30

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

A. 100%

B. 30%

C. 3%

D. 0.3%

QUESTION: 31

A reactor is initially shut down with no xenon in the core. Over the next four hours, the reactor is made critical and power level is increased to the point of adding heat. The shift supervisor has directed that power be maintained constant at this level for 12 hours for testing.

To accomplish this objective, control rods will have to be...

A. inserted periodically for the duration of the 12 hours.

B. withdrawn periodically for the duration of the 12 hours.

C. inserted periodically for 4 to 6 hours, then withdrawn periodically.

D. withdrawn periodically for 4 to 6 hours, then inserted periodically.

QUESTION: 32

Gadolinium (Gd-155 and -157) is used instead of boron (B-10) as the _____ material; when 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: 33

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

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

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

A. positive; at

B. positive; above

C. negative, but soon turn; at

D. negative, but soon turn; above

QUESTION: 34

After taking critical data during a reactor startup, the operator establishes a stable 50-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff} = 0.006$.)

A. -0.01 %ΔK/K

B. -0.06 %ΔK/K

C. -0.10 %ΔK/K

D. -0.60 %ΔK/K

QUESTION: 35

A nuclear power 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: 36

Reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

After five minutes, when compared to reactor B, the core fission rate in reactor A will be _____, and the reactor period in reactor A will be _____.

A. lower; shorter

B. lower; the same

C. the same; shorter

D. the same; the same

QUESTION: 37

Refer to the drawing of a tank with a differential pressure (D/P) level detector (see figure below).

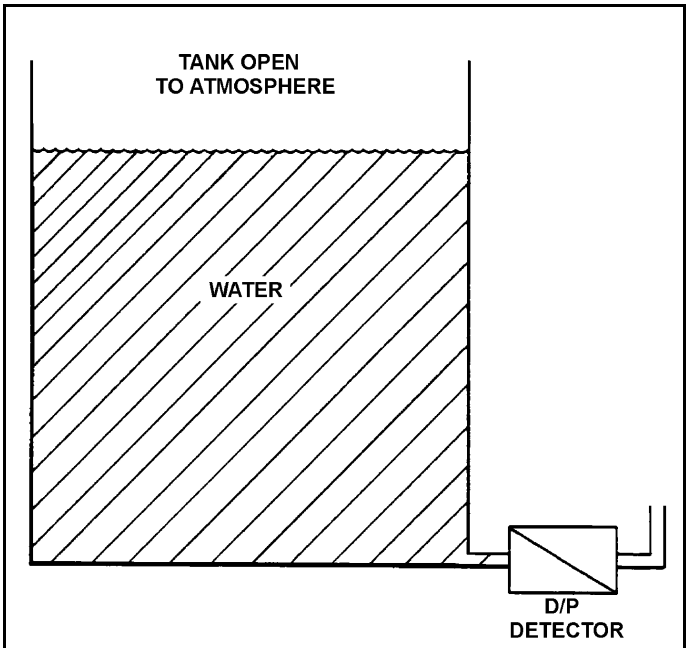
If the tank contains 30 feet of water at 60°F, what is the approximate D/P sensed by the detector?

A. 2 psid

B. 13 psid

C. 20 psid

D. 28 psid



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 38

Main steam is being used to reheat high-pressure (HP) turbine exhaust in a moisture separator reheater (MSR).

Given:

- The HP turbine exhaust enters the MSR reheater section as saturated steam (100% quality).
- The exhaust enters and exits the reheater section at 280 psia and a flow rate of 1.0E6 lbm/hr.
- The main steam heat transfer rate in the reheater section is 42.1E6 Btu/hr.

Which one of the following is the approximate temperature of the HP turbine exhaust leaving the reheater section of the MSR?

A. 450°F

B. 475°F

C. 500°F

D. 525°F

QUESTION: 39

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

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

QUESTION: 40

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

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

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

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

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

QUESTION: 41

Which one of the following statements describes the head loss in a section of horizontal pipe of uniform diameter containing flowing water?

A. A constant multiplied by the volumetric flow rate

B. A constant multiplied by the velocity of the fluid

C. The difference between the hydrostatic head at the beginning of the pipe section and the hydrostatic head at the end of the pipe section

D. The difference between the pressure head at the beginning of the pipe section and the pressure head at the end of the pipe section

QUESTION: 42

Refer to the drawing of four centrifugal pump operating curves (see figure below).

A centrifugal pump is initially operating normally in a cooling water system. Then debris becomes lodged in the screen in the pump suction line.

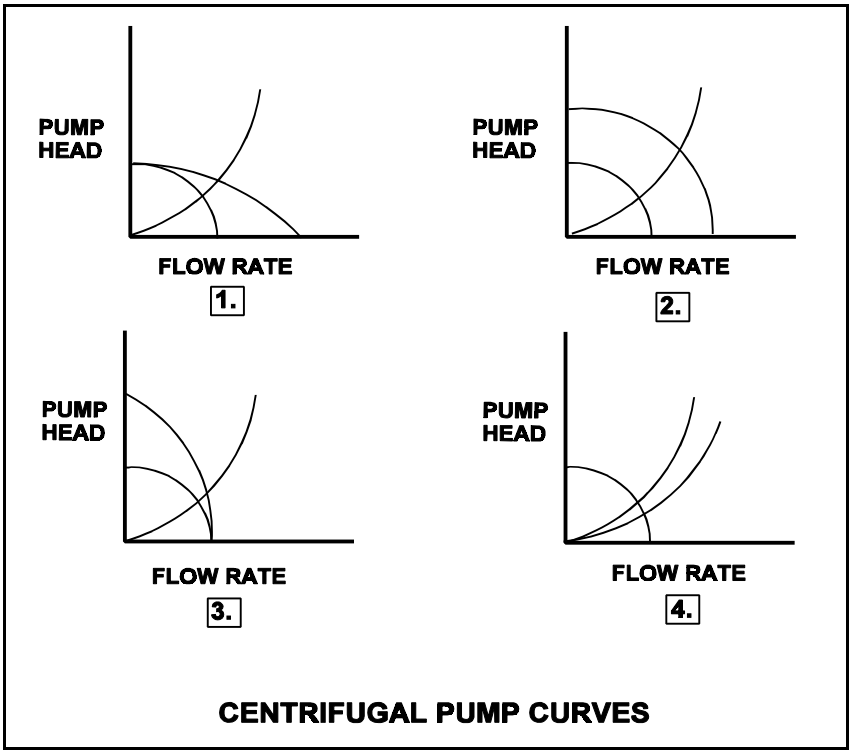
Which set of operating curves depicts the "before" and "after" conditions described above?

A. 1.

B. 2.

C. 3.

D. 4.



QUESTION: 43

Which one of the following is the most accurate indication of mass flow rate through the reactor for calculating core thermal power during reactor power operation?

A. Core flow rate

B. Steam flow rate

C. The sum of feed water and control rod drive flow rates

D. The sum of both reactor recirculation loop flow rates

QUESTION: 44

Which one of the following conditions must occur to sustain natural convection in a fluid system?

A. Subcooling of the fluid

B. A phase change in the fluid

C. An enthalpy change in the fluid

D. Radiative heat transfer to the fluid

QUESTION: 45

If the fission rate in a reactor core steadily increases, the mode of heat transfer that occurs immediately after the critical heat flux is reached is called...

A. transition boiling.

B. subcooled nucleate boiling.

C. saturated nucleate boiling.

D. stable film boiling.

QUESTION: 46

Which one of the following values represents the quality of the saturated steam/water mixture leaving a cyclone separator at 985 psig and 1177 Btu/lbm? (Answer should be rounded to the nearest whole number.)

A. 96%

B. 97%

C. 98%

D. 99%

QUESTION: 47

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

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

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

QUESTION: 48

If a reactor is being operated with the 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: 49

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

A. 25% power increase using only control rods

B. 25% power decrease using only control rods

C. 25% power increase using only recirculation flow

D. 25% power decrease using only recirculation flow

QUESTION: 50

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 *****

MARCH 2004 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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