UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

JUL 8 1993

Docket: 50-458
License: NPF-47

Gulf States Utilities
ATTN: P. D. Graham
Vice President (RBNG)
P. O. Box 220
St. Francisville, LA 70775

SUBJECT: GENERIC FUNDAMENTALS EXAMINATION RESULTS

This letter forwards the results of the Generic Fundamentals Examination Section (GFES) of the written operator licensing examination that was administered on June 9, 1993, to nominated employees of your facility. We are forwarding the following items:

- The examinations, including answer keys;
- The results for your nominated employees; and
- Copies of the individual answer sheets completed by your nominated employees.

We request that your training department forward the individual answer sheets and results to the appropriate individuals. It should be noted that the examination was administered in two forms, which were identical except for the sequence of questions.

In accordance with the Commission's regulations, 10 CFR 2.790, a copy of this letter and the examination and answer key will be placed in the NRC's Public Document Room (PDR). The individual results and answer sheets are exempt from public disclosure and therefore will not be placed in the PDR.

Questions concerning this examination should be directed to Dr. George Usova at (301) 504-1064.

Sincerely,

Samuel J. Collins, Director
Division of Reactor Safety

Enclosures: As stated

cc: (see next page)

cc:
Gulf States Utilities Company
ATTN: Ron Thurow, Nuclear
Training Director
P.O. Box 220
St. Francisville, LA 70775

bcc to DCB (IE42) 1\1

bcc distribution by RIV:
DRP Section Chief
Resident Inspector
E. Baker, NRR (MS: 13-H-15)
Leah Tremper, OC:LFDCB (4503 MNBB)
RIV file
L. Miller, TTC
J. L. Milhoan, RA
J. L. Pellet, Rdg file
L. A. Hurley

RIV:OS:LA	C:OS	DD:DRS	D:DRP	D:DRS
LAHurley	JLPellet	ATHowell	ABBeach	SJCollins
07/01/93	7/7/93	7/7/93	/93	7/8/93

130003

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LAHurley	JLPellet	ATHowell	ABBeach	SJCollins
7/ 7/93	7/ 7/93	7/ 7/93	7/ /93	7/ 8/93

June 26, 1993

JUNE 1993 GENERIC FUNDAMENTALS EXAM
BOILING WATER REACTOR - ANSWER KEY

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

NRC GENERIC FUNDAMENTALS EXAMINATION
CHECKLIST - BWR

_____1. Verify receipt of BWR examination, form A and B.

_____2. Verify each examination form has:

- Cover sheet (page 1)
- Rules and guidelines (page 2)
- Equations and conversions handout (page 3)

_____3. Verify each examination contains 100 questions.

- Form A (pages 4 through 59)
- Form B (pages 4 through 59)

UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
JUNE 1993 - FORM A

Please Print:

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO CANDIDATE

Use the answer sheet provided. Each question 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.

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.

_____
Candidate'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. Use only 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 EXAMINATIONS SECTION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

$SUR = 26.06/\tau$

$$SUR = \frac{26.06(\lambda_{eff}\rho)}{(\overline{\beta} - \rho)}$$

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

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

$\tau = (\ell^*/\rho) + [(\overline{\beta} - \rho)/\lambda_{eff}\rho]$

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

$\rho = \Delta K_{eff}/K_{eff}$

$$\text{Cycle Efficiency} = \frac{\text{Net Work (out)}}{\text{Energy (in)}}$$

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

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$$M = \frac{(1 - K_{eff})_0}{(1 - K_{eff})_1}$$

$SDM = (1 - K_{t:f})/K_{eff}$

$\tau = \ell^*/(\rho - \overline{\beta})$

$\ell^* = 1 \times 10^{-5}$ seconds

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

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

$$\upsilon(P_e - P_i) + \frac{(\bar{v}_e^2 - \bar{v}_i^2)}{2} + g(z_e - z_i) = 0$$

CONVERSIONS

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

QUESTION: 1

The difference between the setpoint pressure at which a safety/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

All of the following are acceptable methods for verifying the position of a shut manual gate valve, <u>except</u>:

A. attempting to turn the handwheel in the "open" direction.

B. attempting to turn the handwheel in the "close" direction.

C. observing the position of the valve stem using handwheel or position indicators.

D. observing indicators for plant parameters, such as temperature, pressure and level.

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. greater than

C. less than

D. increasing with

QUESTION: 4

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

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

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

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

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

QUESTION: 5

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: 6

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be:

A. 244.8 psid.

B. 171.4 psid.

C. 122.4 psid.

D. 85.7 psid.

QUESTION: 7

Flow rate (gpm) in a cooling water system is being measured using a flow nozzle and a differential pressure (D/P) detector. An instrument calibration has just been performed.

If air is introduced into the system such that air bubbles become entrained in the water, indicated flow rate will be:

A. stable because the air bubbles dampen system pressure surges.

B. fluctuating despite the air bubbles dampening system pressure surges.

C. stable despite the compression/expansion of the air bubbles in the nozzle.

D. fluctuating because of the compression/expansion of the air bubbles in the nozzle.

QUESTION: 8

Which one of the following will cause indicated volumetric flow rate to be lower than actual volumetric flow rate using a differential pressure (D/P) flow detector and a calibrated orifice?

A. System pressure decreases.

B. The orifice erodes over time.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

QUESTION: 9

Two differential pressure level transmitters are installed on a large water storage tank. Transmitter I is calibrated at 100°F and transmitter II is calibrated at 200°F water temperature.

Which transmitter will indicate a higher level?

A. Transmitter I below 150°F, transmitter II above 150°F

B. Transmitter II below 150°F, transmitter I above 150°F

C. Transmitter I at all water temperatures

D. Transmitter II at all water temperatures

QUESTION: 10

A correct statement regarding thermocouples is that they:

A. are more accurate than resistance temperature detectors.

B. will indicate low offscale with an open circuit at the sensing junction.

C. are made up of two similar metals in contact at one end, called the hot junction.

D. are based on the inherent characteristic of metals: a change in electrical resistance occurs when a change in temperature occurs.

QUESTION: 11

Refer to the drawing of a cooling water system that is cooling a lube oil heat exchanger (see figure below).

Surge tank level is being measured using a differential pressure (D/P) level detector that has been calibrated at the current water temperature in the tank. The lube oil-to-cooling water heat exchanger develops a tube leak resulting in lube oil accumulation in the surge tank.

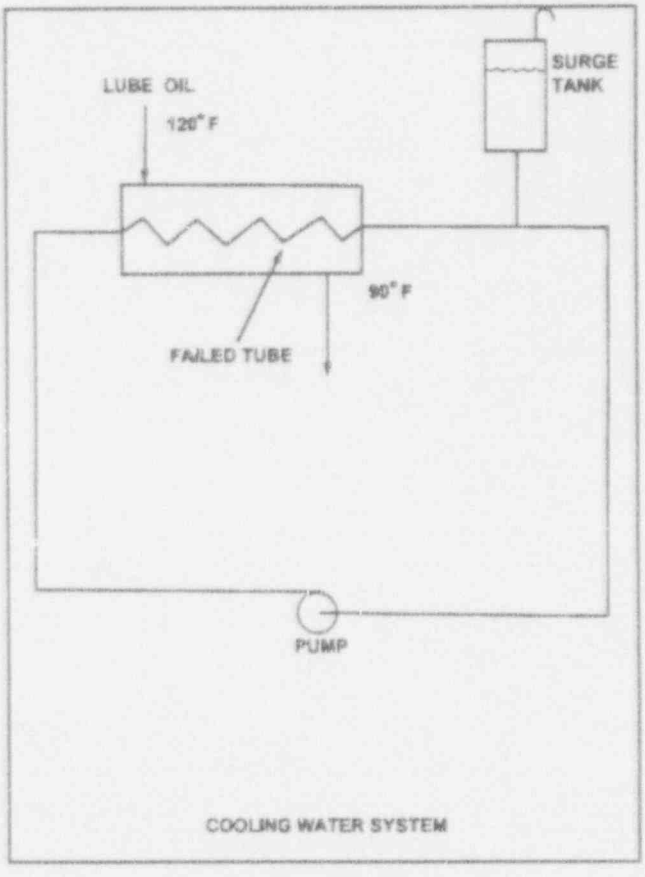
Assuming that the temperature of the contents in the surge tank does not change, indicated level will be _____ than actual tank level because lube oil is _____ than water.

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense



QUESTION: 12

Refer to the drawing of a reactor vessel differential pressure level detector (see figure below).

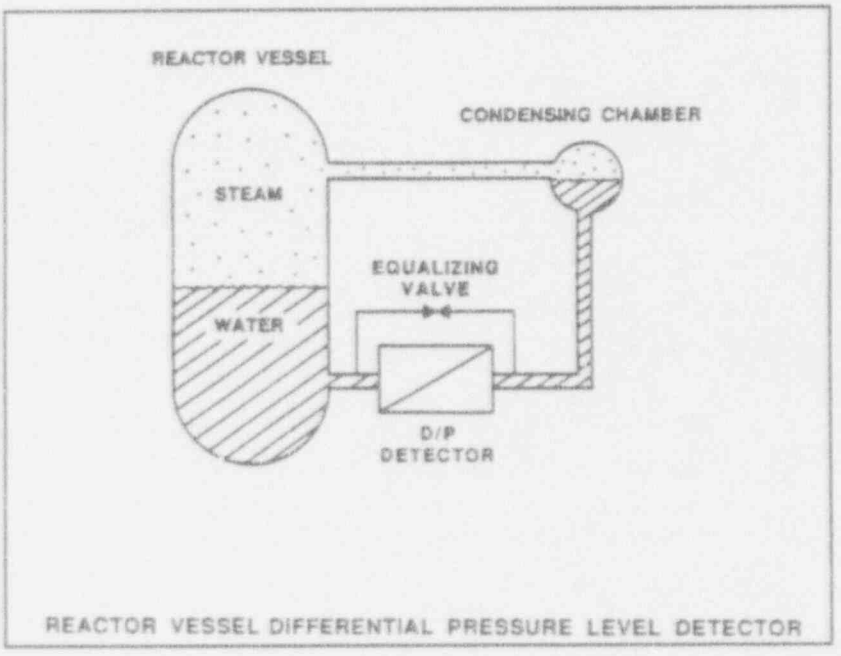
Which one of the following events will result in a reactor vessel level indication that is greater than actual level?

A. The reference leg water flashes to steam.

B. The reactor pressure increases by 50 psia.

C. The variable leg breaks and completely drains.

D. The temperature surrounding the reference leg decreases significantly.



REACTOR VESSEL DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 13

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

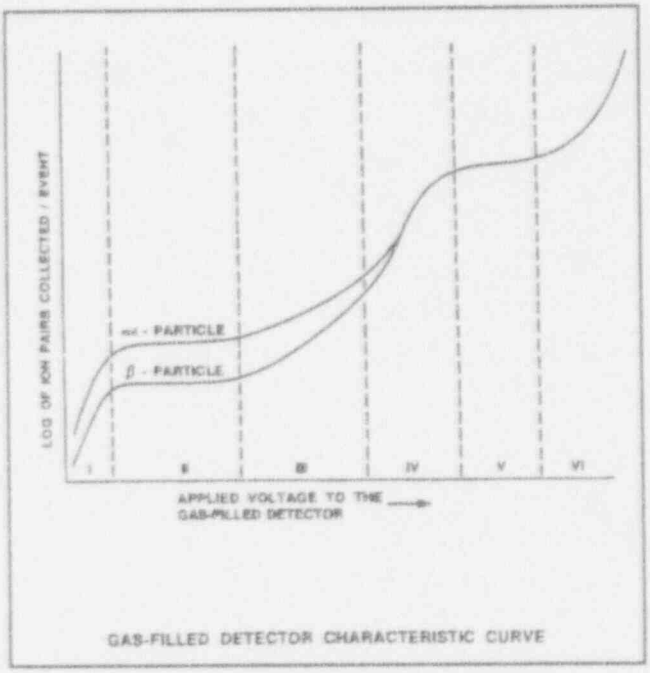
What is an advantage of operating a fission chamber neutron detector with a voltage at the high end (vice low end) of the proportional region?

A. Gas amplification will be minimized, which will prolong detector life.

B. A greater number of primary ionizations will occur from a given radiation field, which increases the sensitivity of the detector.

C. The difference between the magnitude of neutron and gamma pulse heights will be larger, which improves gamma compensation.

D. The space charge effect will be minimized, which ensures that detector output is directly proportional to the number of ionizing events.



GAS-FILLED DETECTOR CHARACTERISTIC CURVE

QUESTION: 14

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.

QUESTION: 15

Which one of the following describes the response of a direct acting proportional-integral controller, operating in automatic, to an increase in the controlled parameter above the controller setpoint?

A. The controller will develop an output signal that will remain directly proportional to the rate of change of the controlled parameter.

B. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes zero.

C. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes constant.

D. The controller will develop an output signal that will remain directly proportional to the difference between the controlled parameter and the controller setpoint.

QUESTION: 16

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

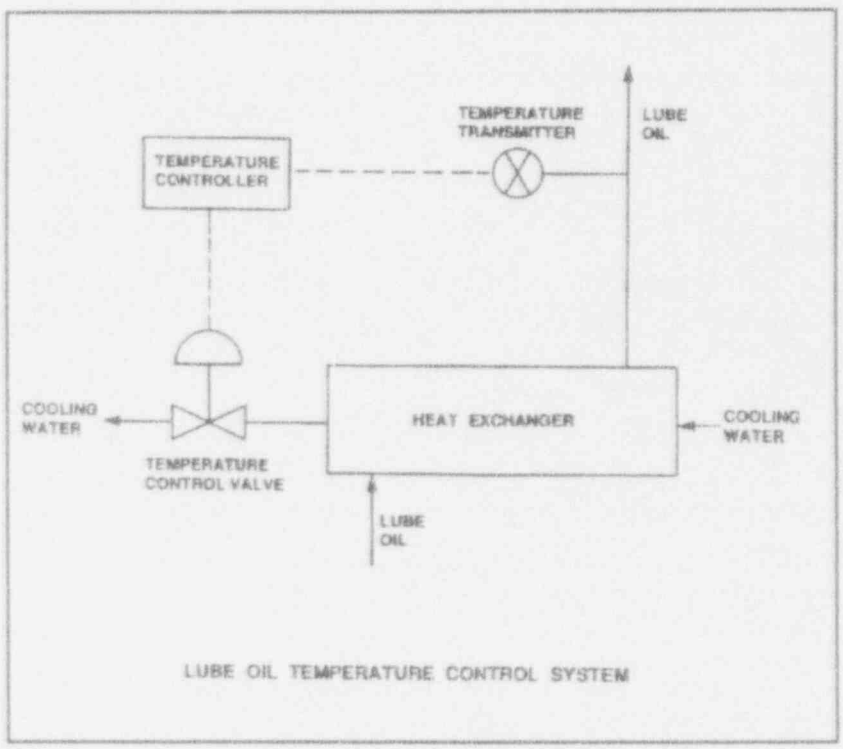
If the temperature transmitter fails high (high temperature output signal), the temperature controller will _____ the temperature control valve, causing the actual heat exchanger lube oil outlet temperature to _____.

A. close; increase

B. close; decrease

C. open; increase

D. open; decrease



LUBE OIL TEMPERATURE CONTROL SYSTEM

QUESTION: 17

If the turbine shaft speed signal received by a typical turbine governor control system fails low during turbine startup, the turbine governor will cause turbine speed to:

A. increase, until an upper limit is reached or the turbine trips on overspeed.

B. decrease, until the mismatch with demanded turbine speed is nulled.

C. increase, until the mismatch with demanded turbine speed is nulled.

D. decrease to a minimum speed setpoint.

QUESTION: 18

Select the statement that describes pump cavitation.

A. Vapor bubbles are formed when the enthalpy difference between pump discharge and pump suction exceeds the latent heat of vaporization.

B. Vapor bubbles are formed in the eye of the pump and collapse as they enter higher pressure regions of the pump.

C. Vapor bubbles are produced when the localized pressure exceeds the vapor pressure at the existing temperature.

D. Vapor bubbles are discharged from the pump where they impinge on downstream piping and cause a water hammer.

QUESTION: 19

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

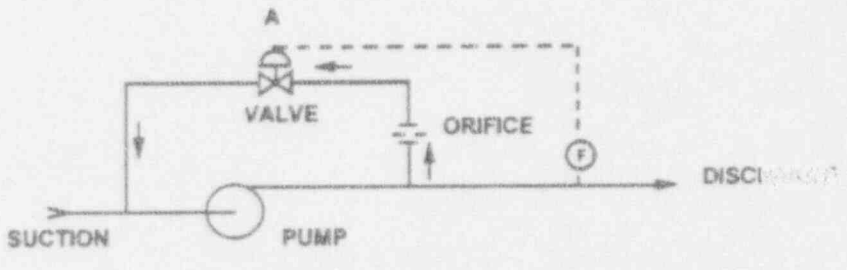
Valve "A" will open when:

A. pump discharge pressure reaches a high setpoint.

B. pump discharge pressure reaches a low setpoint.

C. pump flow rate reaches a high setpoint.

D. pump flow rate reaches a low setpoint.



PUMP WITH RECIRCULATION LINE

QUESTION: 20

In a centrifugal pump, gas binding is a term that refers to a condition in which the pump:

A. suction pressure drop is sufficient to cause the fluid to vaporize.

B. capacity is reduced due to the presence of steam or air in the pump volute.

C. capacity is increased due to the expansion of vapor bubbles in the pump casing.

D. motor current increases due to dissolved noncondensible gases adding to the volume of the fluid being pumped.

QUESTION: 21

A centrifugal pump is operating with the following parameters:

Pump head:	50 psid
Flow rate:	200 gpm
Power input:	3 Kw

Pump speed is increased and flow rate increases to 400 gpm. Which of the following is the value of the new power consumption?

A. 6 Kw

B. 9 Kw

C. 24 Kw

D. 27 Kw

QUESTION: 22

Which one of the following changes in plant status will bring the reactor recirculation system closer to the condition in which the recirculation pump will cavitate?

A. During a plant shutdown, reactor recirculation pump suction temperature decreases while reactor pressure remains constant.

B. Reactor recirculation pump speed is increased.

C. Reactor water level increases.

D. Extraction steam is isolated from one high pressure feedwater heater during power operations.

QUESTION: 23

A constant-speed centrifugal pump motor draws the least current when the pump is:

A. at shutoff head with no recirculation flow.

B. accelerating to normal speed during start.

C. operating on recirculation flow only.

D. at maximum rated flow conditions.

QUESTION: 24

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below) in which pumps A and B are identical single-speed centrifugal pumps and only pump A is operating.

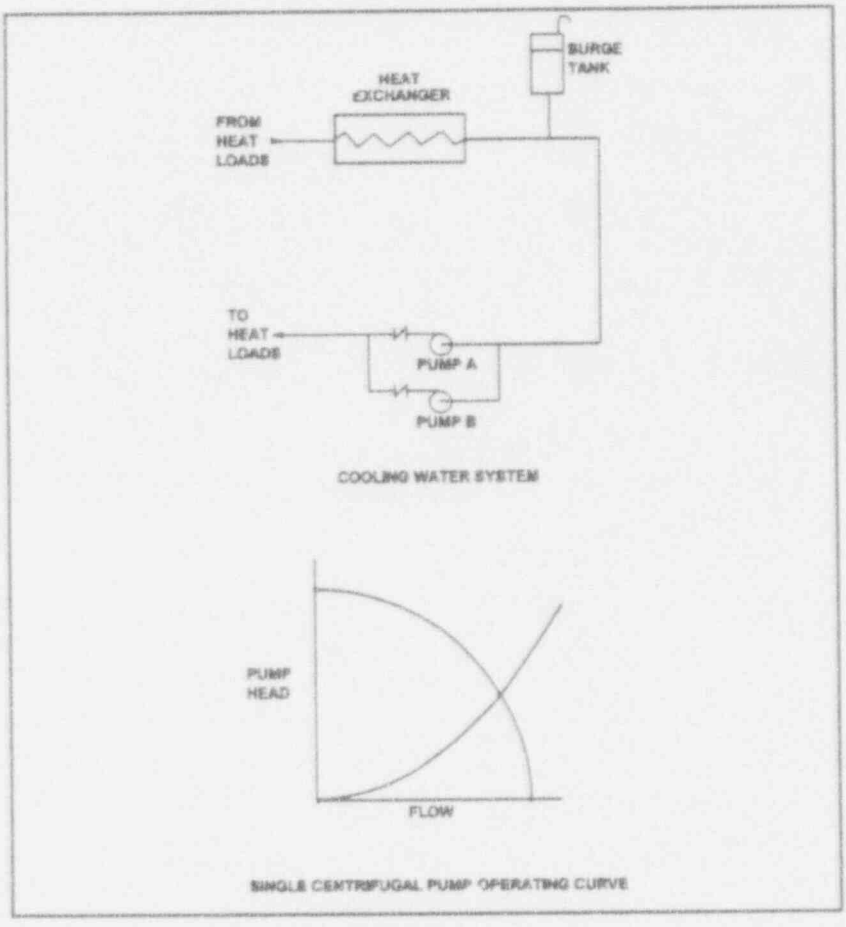
If pump B is started, system flow rate will be _____ and common pump discharge pressure will be _____.

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher



QUESTION: 25

Operating a motor-driven centrifugal pump under "pump runout" conditions causes:

A. pump overheating, cavitation, and ultimately pump failure.

B. excessive motor current to be drawn, damage to the motor windings, and ultimately motor failure.

C. excessive motor current to be drawn, overheating of pump and motor bearings, and ultimately pump failure.

D. no damage, because the pump and motor are designed to operate without failure under pump runout conditions.

QUESTION: 26

A positive displacement pump with a three-phase AC induction motor is operating to maintain 1600 psig in a hydraulic fluid system. If the voltage supplied to the pump motor is slowly reduced by 20%, the pump motor current will _____ and motor winding temperature will _____. (Assume the motor does not stall.)

A. increase; increase

B. decrease; increase

C. increase; decrease

D. decrease; decrease

QUESTION: 27

Which one of the following AC motor events is characterized by maximum rotor slip and a motor current 5 to 6 times full-load current?

A. Starting of the motor

B. Ground in motor windings

C. Motor overloaded by 50%

D. Motor operating at breakdown torque

QUESTION: 28

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

A. 93 psid

B. 172 psid

C. 320 psid

D. 2048 psid

QUESTION: 29

A generator is paralleled to the grid and is supplying 0 MVAR. If generator output voltage is increased, the generator will become _____ and will attain a _____ power factor.

A. overexcited; leading

B. underexcited; lagging

C. underexcited; leading

D. overexcited; lagging

QUESTION: 30

A 4160 volt diesel generator (D/G) is loaded to 2850 Kw with a 0.85 lagging power factor. What is the KVAR load on the D/G?

A. 503 KVAR

B. 1766 KVAR

C. 2850 KVAR

D. 3353 KVAR

QUESTION: 31

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

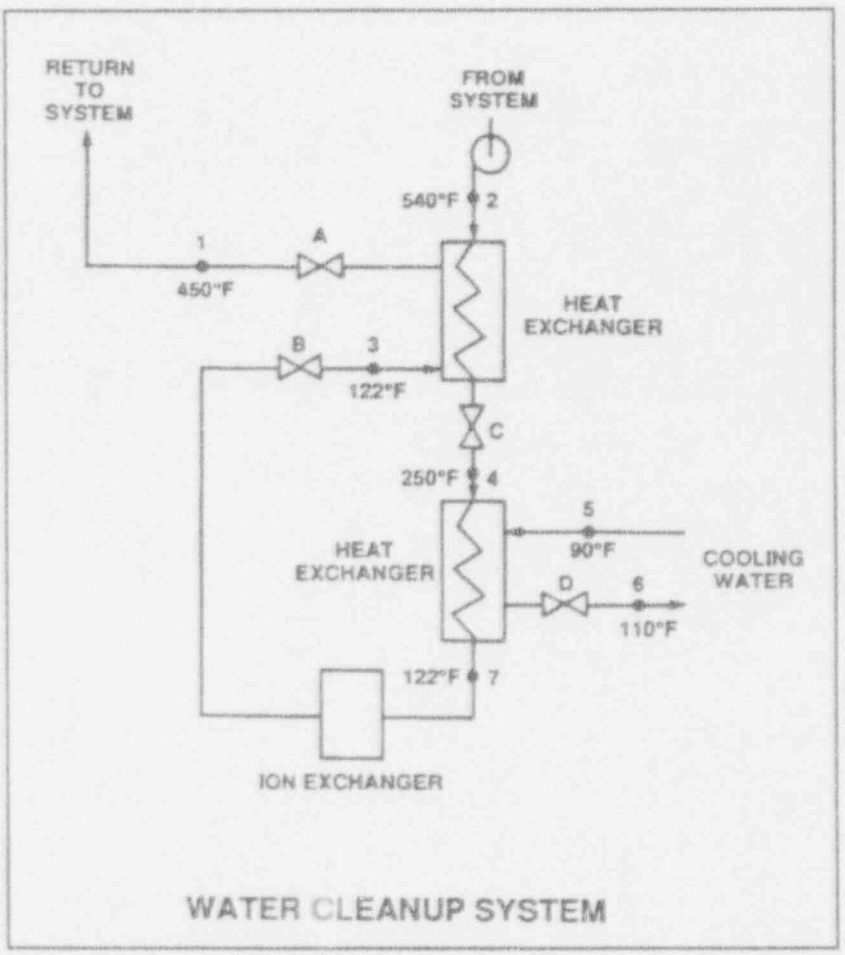
All valves are identical and are initially 50% open. To lower the temperature at point 4, the operator should adjust valve _____ in the _____ direction.

A. A; open

B. B; shut

C. C; open

D. D; shut



WATER CLEANUP SYSTEM

QUESTION: 32

Assuming that condenser cooling water temperature and flow do not change, if condenser vacuum improves (absolute pressure decreases), condensate temperature will:

A. increase because condenser saturation pressure has increased.

B. increase because condensate subcooling has decreased.

C. decrease because condenser saturation pressure has decreased.

D. decrease because condensate subcooling has increased.

QUESTION: 33

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

A. 538.4°F

B. 536.5°F

C. 533.9°F

D. 532.6°F

QUESTION: 34

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

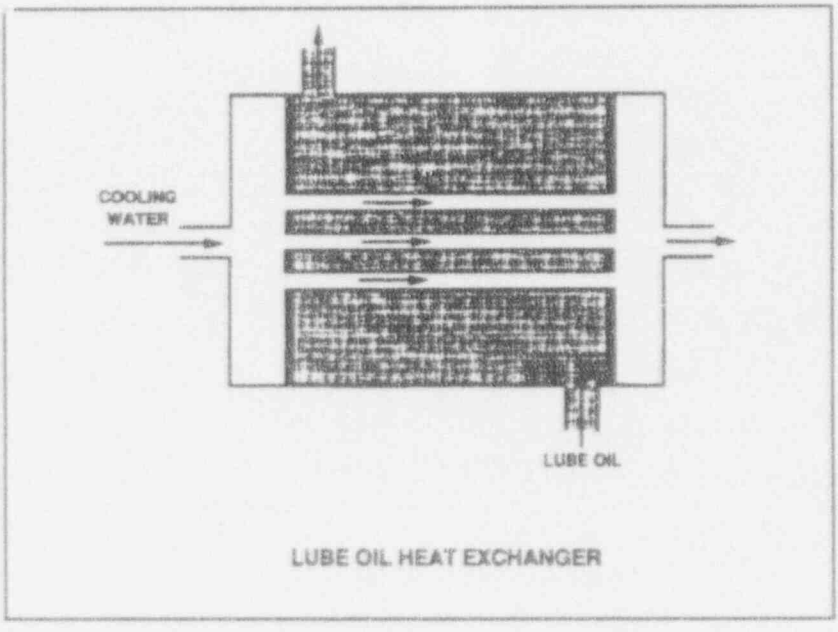
As tube fouling increases in the lube oil heat exchanger, cooling water outlet temperature will _____ and lube oil outlet temperature will _____. (Assume flow rates do not change.)

A. decrease; increase

B. increase; increase

C. decrease; decrease

D. increase; decrease



LUBE OIL HEAT EXCHANGER

QUESTION: 35

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

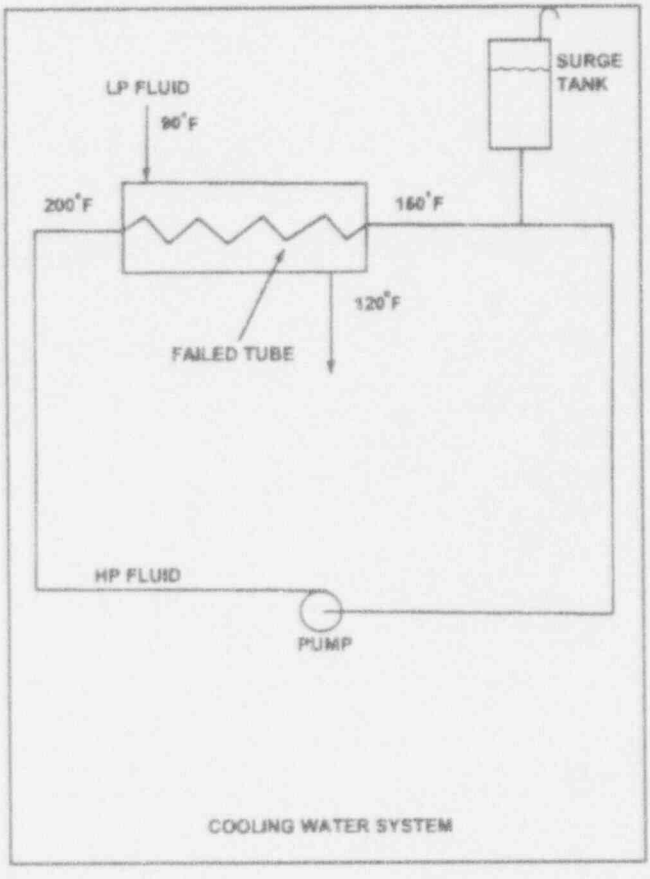
Which of the following effects initially would occur as a result of a tube failure in the heat exchanger?

A. Level in the tank increases.

B. High pressure fluid flow rate decreases.

C. Flow in the low pressure system reverses.

D. Temperature in the low pressure system increases.



QUESTION: 36

During power plant operation, the accumulation of air and non-condensable gases in the main condenser will:

A. not effect turbine work.

B. not effect turbine efficiency.

C. increase generator load.

D. increase turbine backpressure.

QUESTION: 37

Which 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 bed

B. A sudden large decrease in the temperature of the influent

C. Exhaustion of the bed due to high inlet conductivity

D. Operation of the bed at lower than design flow rates

QUESTION: 38

The ion exchange efficiency of a condensate demineralizer can be determined by:

A. performing a calculation based on the ratio between the inlet pH divided by the outlet pH.

B. performing a calculation based on the change in differential pressure across the demineralizer.

C. sampling the inlet and outlet of the demineralizer to determine the difference in activity.

D. sampling the inlet and outlet of the demineralizer to determine the change in conductivity.

QUESTION: 39

The temperature of the water passing through a demineralizer must be controlled because excessively hot water will:

A. reduce the affinity of the demineralizer resin for ion exchange.

B. degrade the corrosion inhibitor applied to the inner wall of the demineralizer.

C. increase the ion exchange rate for hydronium ions, thereby changing effluent pH.

D. result in excessive demineralizer retention element thermal expansion, thereby releasing resin.

QUESTION: 40

Two AC generators are considered to be in phase when:

A. the alternating sine wave voltage of one generator is in alignment with the other generator.

B. the frequency of one generator is equal to the frequency of the other generator.

C. the synchroscope is turning slowly in the clockwise direction.

D. the synchroscope is turning slowly in the counter clockwise direction.

QUESTION: 41

Which one of the following local breaker indications will provide the most reliable information for determining the position of a 4160 volt bus feeder breaker?

A. Open/closed mechanical flag and load-side current

B. Open/closed indicating lights and load-side current

C. Open/closed indicating lights and load-side voltage

D. Open/closed mechanical flag indication and load-side voltage

QUESTION: 42

Refer to the drawing of a typical valve control circuit (see figure below).

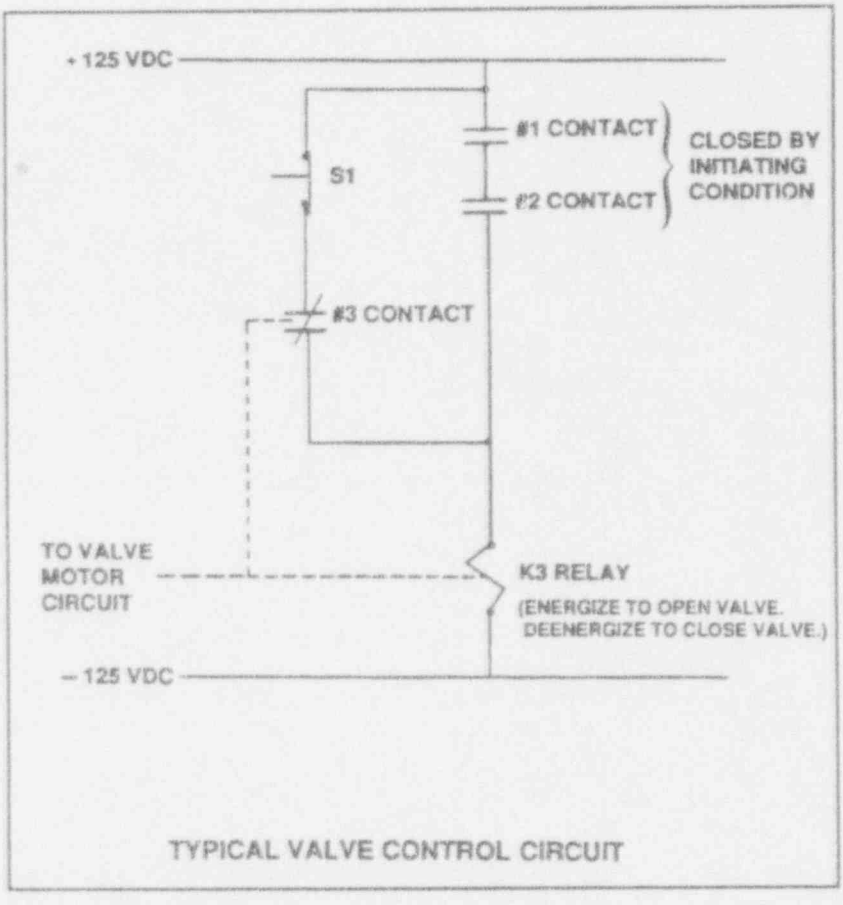
What is the purpose of depressing the S1 pushbutton?

A. To maintain the K3 relay energized after the initiating condition has cleared

B. To manually energize the K3 relay in the absence of the initiating condition

C. To prevent pickup of the K3 relay when the initiating condition occurs

D. To reset the K3 relay after the initiating condition has cleared



TYPICAL VALVE CONTROL CIRCUIT

QUESTION: 43

Which one of the following will cause a loss of indication from the remote breaker position indicating lights associated with a typical 480 VAC load supply breaker?

A. Locally opening the breaker

B. Loss of breaker line voltage

C. Removing the breaker control power fuses

D. Burnout of the local breaker position indicating lights

QUESTION: 44

High voltage electrical disconnects should <u>not</u> be used to:

A. tie buswork sections together.

B. interrupt circuits under load.

C. electrically ground buswork.

D. isolate equipment electrically.

QUESTION: 45

Which one of the following will increase the distance travelled 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: 46

A description of a good moderator is a moderator that is:

A. not dense and is composed of small atoms.

B. dense and is composed of small atoms.

C. not dense and is composed of large atoms.

D. dense and is composed of large atoms.

QUESTION: 47

Which one of the following combinations of core conditions at 35% power indicates the least amount of excess reactivity exists in the core?

	CONTROL ROD POSITION	REACTOR RECIRCULATION FLOW
A.	25% inserted	25%
B.	50% inserted	50%
C.	25% inserted	50%
D.	50% inserted	25%

QUESTION: 48

Which one of the following will increase the reactivity margin to criticality in a subcritical reactor at 250°F?

A. Decay of Sm-149

B. Increased core recirculation flow rate.

C. Reactor coolant heatup

D. Control rod withdrawal

QUESTION: 49

Which one of the following pairs of neutron reactions produces the largest contribution to the source neutron level after the first fuel cycle? (Neglect contribution from neutron source.)

A. Alpha-neutron reactions and spontaneous fission

B. Spontaneous fission and photo-neutron reactions

C. Photo-neutron reactions and beta-neutron reactions

D. Beta-neutron reactions and alpha-neutron reactions

QUESTION: 50

Two reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

QUESTION: 51

The effective delayed neutron fraction ($\overline{\beta}_{eff}$) takes into account two factors not considered in calculating the delayed neutron fraction ($\overline{\beta}$). These factors consider that:

1. Delayed neutrons are _____ likely to cause fast fission than prompt neutrons, and

2. Delayed neutrons are _____ likely to leak from the core than prompt neutrons.

A. more; more

B. more; less

C. less; more

D. less; less

QUESTION: 52

During a continuous rod withdrawal accident, reactor power has increased from 387 Mw to 553 Mw in 10 seconds. What was the reactor period for this power increase?

A. 3 seconds

B. 24 seconds

C. 28 seconds

D. 35 seconds

QUESTION: 53

The moderator temperature coefficient of reactivity is _____ negative at end of core life because, over core life the utilization of thermal neutrons _____.

A. more; decreases

B. less; decreases

C. more; increases

D. less; increases

QUESTION: 54

Factors that affect resonance absorption of a neutron into a nucleus include:

A. kinetic energy of the nucleus, kinetic energy of the neutron, and excitation energy of the nucleus.

B. excitation energy of the neutron, kinetic energy of the nucleus, and kinetic energy of the neutron.

C. kinetic energy of the neutron, excitation energy of the nucleus, and excitation energy of the neutron.

D. excitation energy of the nucleus, excitation energy of the neutron, and kinetic energy of the nucleus.

QUESTION: 55

A core consists of fuel bundles and control rods that are 12 feet in length. A new rod position is indicated for every 3 inches of rod motion.

If a control rod is inserted 75% into the core, it will be located at rod position:

A. 9.

B. 12.

C. 27.

D. 36.

QUESTION: 56

A control rod is inserted in the reactor with the following neutron flux parameters:

Core average thermal neutron flux = 10^{12} neutrons/cm^2-sec
Control rod tip neutron flux = 5×10^{12} neutrons/cm^2-sec

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

A. 4.0

B. 2.0

C. 1.4

D. 0.5

QUESTION: 57

If a control rod is fully rted (from the fully withdrawn position), the normalize al neutron flux shape in the core will undergo a:

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

B. minor distortion, because the fully inserted control rod appears to be invisible.

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

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

QUESTION: 58

If the void fraction surrounding centrally located fuel bundles increases, the worth of the associated control rod(s) will:

A. decrease, because more neutrons are able to travel from one fuel bundle to the next without being absorbed by the control rod.

B. increase, because thermal neutrons will travel farther resulting in a larger fraction of thermal neutrons being absorbed by the control rod.

C. increase, because control rods are epithermal neutron absorbers and neutrons remain at higher energies longer due to the longer slowing down length.

D. decrease, because more neutrons are resonantly absorbed in the fuel as they are being thermalized resulting in fewer thermal neutrons to be absorbed by the control rod.

QUESTION: 59

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Uranium-235

B. Uranium-238

C. Plutonium-239

D. Xenon-135

QUESTION: 60

Xenon-135 is produced in the reactor by two methods. One is directly from fission, the other is indirectly from the decay of:

A. Barium-135.

B. Cesium-135.

C. Iodine-135.

D. Xenon-136.

QUESTION: 61

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

A. xenon decay to cesium.

B. xenon absorption of neutrons.

C. xenon production from fission.

D. xenon production from iodine decay.

QUESTION: 62

The reactor has been operating at 100% power for 2 weeks when power is decreased to 10% in 1 hour. Immediately following the power decrease, xenon-135 concentration will _____ for a period of _____.

A. decrease; 4 to 6 hours

B. increase; 4 to 6 hours

C. decrease; 8 to 11 hours

D. increase; 8 to 11 hours

QUESTION: 63

What is the difference in peak xenon concentration following a reactor scram after 1 week at 100% power as compared to a scram after 1 week at 50% power?

A. The peaks are equal because the decay rate of iodine remains constant.

B. The peak from 50% is of a smaller magnitude due to the lower xenon burnout rate.

C. The peak from 100% power is of a larger magnitude, due to the larger initial iodine concentration.

D. The time to reach the peak is shorter after 100% power than after 50% power, due to the higher iodine decay rate.

QUESTION: 64

Four hours after a reactor trip from a long-term, steady-state, 100% power run, the reactor has been taken critical and is to be maintained at 1 to 2% power. Which of the following will describe the operator's action and what is happening?

A. Add negative reactivity because xenon is building in.

B. Add positive reactivity because xenon is building in.

C. Add negative reactivity because xenon is decaying away.

D. No actions required; xenon is at an equilibrium condition.

QUESTION: 65

Gadolinium (Gd-155 and -157) is used instead of boron (B-10) as the _____ material because 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: 66

During a reactor startup, source range monitors (SRMs) indicate 100 cps, and K_{eff} is 0.95. After a number of rods have been withdrawn, SRMs indicate 270 cps. Which one of the following is closest to the new K_{eff}? (Assume reactor period is infinity before and after the rod withdrawal.)

A. 0.990

B. 0.982

C. 0.971

D. 0.936

QUESTION: 67

The reactor is exactly critical during a reactor startup. Which one of the following must be closely monitored and controlled to ensure safe operation of the reactor as power is raised to the point of adding heat?

A. Reactor period

B. Reactor temperature

C. Source range count rate

D. Power peaking factors

QUESTION: 68

With K_{eff} = 0.985, how much reactivity must be added to make the reactor critical?

A. 0.0148 $\Delta k/k$

B. 0.0150 $\Delta k/k$

C. 0.0152 $\Delta k/k$

D. 0.0154 $\Delta k/k$

QUESTION: 69

A reactor is being started up with a stable 100-second period and power entering the intermediate range. Assuming no operator action, which of the following is true?

A. Reactor period will remain constant through all ranges of intermediate range indication.

B. As heat production in the reactor exceeds ambient losses, the temperature of the moderator increases, adding negative reactivity, and reactor period goes to infinity.

C. Prior to reaching the point of adding heat, fuel temperature increases, adding positive reactivity, which causes period to become shorter and shorter until a scram occurs on short period.

D. As heat production in the reactor exceeds ambient losses, the resulting fuel temperature increase adds positive reactivity to counteract the negative reactivity added by increased moderator temperature.

QUESTION: 70

Which one of the following will add the most positive reactivity during a power decrease from 100% to 25% over a 1 hour period? (Assume the power change is performed by changing core recirculation flow rate.)

A. Fuel temperature change

B. Moderator temperature change

C. Fission product poison change

D. Void content change

QUESTION: 71

In response to which one of the following events will the Doppler coefficient act first to change the reactivity addition to the core?

A. Tripping of the main turbine at 45% reactor power

B. A control-rod drop during reactor power operation

C. A safety relief valve opening during reactor power operation

D. The loss of one feedwater heater (extraction steam isolated) during reactor power operation

QUESTION: 72

A reactor is operating at 100% power and flow. Reactor power is reduced by driving control rods in. (Recirculating pump speed remains constant.) What is the effect on core flow?

A. Core flow will increase, due to the decrease in recirculation ratio.

B. Core flow will decrease, due to an increase in two-phase flow resistance.

C. Core flow will increase, due to the decrease in two-phase resistance.

D. Core flow remains constant, since reactor power does not affect core flow.

QUESTION: 73

If the pressure sensed by a bourdon tube increases, the curvature of the detector will _____ because of the greatest force being applied to the _____ curve of the detector.

A. decrease; outer

B. increase; outer

C. decrease; inner

D. increase; inner

QUESTION: 74

A saturated vapor exists at 800 psia. If 500 BTU/lbm is removed from this saturated vapor at a constant pressure:

A. the temperature will decrease.

B. the density will decrease.

C. the specific volume will decrease.

D. the enthalpy will increase.

QUESTION: 75

Cooling water exits a fuel channel with an enthalpy of 1195 BTU/lbm at a reactor pressure of 1050 psig. What is the state of the fluid at the exit of the fuel channel?

A. Subcooled

B. Saturated

C. Compressed

D. Superheated

QUESTION: 76

The steam inlet nozzles used in steam jet air ejectors convert the _____ of the steam into _____.

A. kinetic energy; pressure

B. enthalpy; kinetic energy

C. kinetic energy; velocity

D. enthalpy; pressure

QUESTION: 77

What effect will an increase of noncondensible gases in a main condenser have on condenser operations in a plant operating at full power?

A. Decreased condensate temperature

B. Increased amount of condensate depression

C. Decreased steam pressure in the condenser

D. Increased cooling water outlet temperature

QUESTION: 78

The reactor plant was initially operating normally at 90% power when heating steam (supplied by the turbine) was automatically isolated to several feedwater heaters. The plant stabilized and reactor power was returned to 90%.

As compared to the initial turbine load, the current turbine load is:

A. higher, because less steam is being extracted from the turbine.

B. higher, because the steam cycle is less efficient.

C. lower, because less steam is being extracted from the turbine.

D. lower, because the steam cycle is less efficient.

QUESTION: 79

Why are steamlines gradually warmed instead of admitting full steam flow?

A. Minimize condensation

B. Minimize thermal expansion

C. Minimize potential for water hammer

D. Minimize heat loss to ambient

QUESTION: 80

Which one of the following describes pump head?

A. The energy added by a pump to maintain or increase fluid pressure or velocity.

B. The energy added by a pump to maintain or increase fluid volume or velocity.

C. The fluid energy required to ensure the pump does not cavitate.

D. The fluid energy contained at the inlet of the pump.

QUESTION: 81

A boiling water reactor is operating at a pressure of 1025 psia. It has a temperature of 530°F in the suction of the recirculating pump and an elevation head of 25 psi.

Neglecting line losses, which one of the following values is the net positive suction head?

A. 177 psi

B. 165 psi

C. 154 psi

D. 143 psi

QUESTION: 82

The predominant mode of heat transfer from the fuel-clad surface to the coolant during full power operating conditions is:

A. radiation.

B. conduction.

C. forced convection.

D. natural convection.

QUESTION: 83

Which one of the following formulas includes the heat transfer coefficient of the tubes in a heat exchanger?

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

B. $\dot{Q} = \dot{m}\Delta T$

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

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

QUESTION: 84

Given the following data for a typical steam condenser (i.e., a cross-flow heat exchanger), what is the heat load in megawatts?

Total tube area	= 500,000 ft^2
Cooling water flow rate	= 200,000 gpm
Condenser pressure	= 1 psia
Specific heat of cooling water (Cp)	= 1.0 BTU/lbm-°F
Cooling water inlet temperature	= 60°F
Cooling water outlet temperature	= 85°F
Steam condensing rate	= 3 x 10^6 lbm/hr
1 gallon water	= 8.34 lbm

A. 833 Mw

B. 783 Mw

C. 733 Mw

D. 703 Mw

QUESTION: 85

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: 86

Core heat transfer is maximized by the presence of:

A. laminar flow with nucleate boiling.

B. turbulent flow with nucleate boiling.

C. laminar flow with no nucleate boiling.

D. turbulent flow with no nucleate boiling.

QUESTION: 87

Which one of the following is characterized by steam bubbles moving away from a heated surface and collapsing in the bulk fluid?

A. Subcooled nucleate boiling

B. Saturated convection

C. Subcooled convection

D. Saturated nucleate boiling

QUESTION: 88

Which one of the following is indicated by a rapid increase in the fuel clad-to-coolant ΔT and a decrease in heat flux from the fuel?

A. Bulk boiling is occurring.

B. Departure from nucleate boiling (DNB) has been reached.

C. Critical heat flux (CHF) is increasing.

D. Nucleate boiling is occurring.

QUESTION: 89

A reactor is operating at full power with a fuel coolant channel that is experiencing each of the following heat transfer mechanisms somewhere along the length of the coolant channel.

Which of the following causes the first reduction in the local cladding heat transfer coefficient as the coolant flows upward through the coolant channel?

A. Nucleate boiling

B. Stable film boiling

C. Partial film boiling

D. Single-phase convection

QUESTION: 90

A reactor is operating at 100% power. Recirculation flow is decreased from 100% to 80%.

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

A. It physically moves down the fuel rods, because more 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 fewer BTUs per pound mass of water are now being transferred.

D. It physically moves up the fuel rods, because fewer BTUs per pound mass of water are now being transferred.

QUESTION: 91

Which of the following statements most accurately describes the principle of jet pump operation?

A. Low static pressure created by the high-velocity jet draws downcomer fluid into the jet pump throat.

B. Low static pressure created by the increasing area in the diffuser draws downcomer fluid into the jet pump throat.

C. The high driving-to-driven flow ratio creates a low static pressure in the diffuser, which draws downcomer fluid into the jet pump throat.

D. High-velocity jet flow draws downcomer fluid into the jet pump throat as a result of friction between the driving flow and the driven flow.

QUESTION: 92

The linear heat generation rate (LHGR) is being maintained within the thermal limits of the reactor core if the ratio _____ is being maintained at _____.

A. LHGR-actual/LHGR-limit; 1.15

B. LHGR-limit/LHGR-actual; 1.10

C. LHGR-actual/LHGR-limit; 1.05

D. LHGR-limit/LHGR-actual; 0.95

QUESTION: 93

Which one of the following limits takes into consideration fuel pellet swell effects?

A. Rated thermal power (RTP)

B. Minimum critical power ratio (MCPR)

C. Average gain adjustment factor (AGAF)

D. Maximum linear heat generation rate (MLHGR)

QUESTION: 94

At low core exposures, the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limit increases with increasing exposure. What is the reason for this increase?

A. Fissionable elements in the fuel pellet are being depleted, thereby reducing the heat that is transferred to the fuel cladding.

B. Fuel pellet cracking brings the fuel pellets into contact with fuel cladding, thereby increasing the fuel-to-clad heat transfer coefficient.

C. Fission product gases that are building up in the fuel pin have lower specific volume than the helium fill gas, thereby resulting in lower cladding stresses.

D. Fission product gases that are building up in the fuel pin have a lower heat transfer coefficient than the helium fill gas, thereby decreasing the fuel cladding temperature.

QUESTION: 95

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

Given the following initial core parameters at the beginning of core life:

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

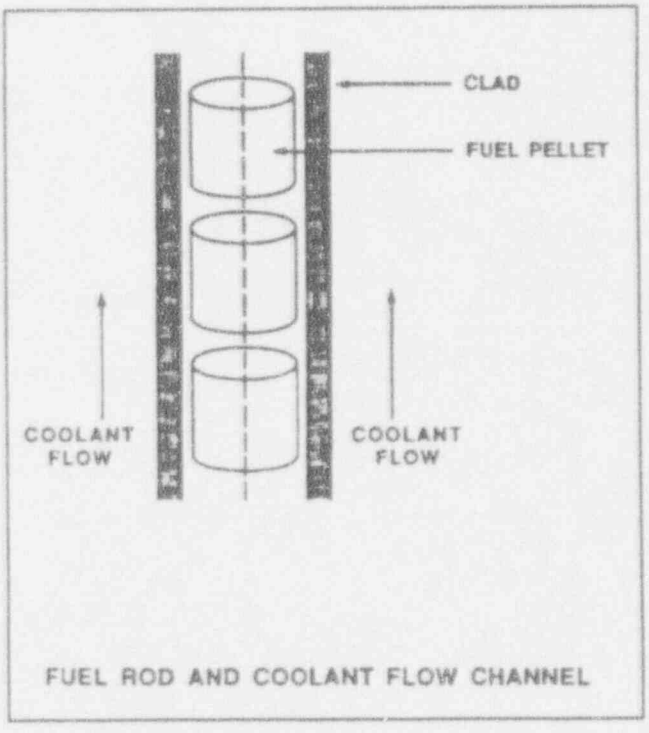
What would be the fuel centerline temperature at the end of core life if, over core life, the total fuel-to-coolant thermal conductivity doubled?

A. 1750°F

B. 1500°F

C. 1250°F

D. 1000°F



FUEL ROD AND COOLANT FLOW CHANNEL

QUESTION: 96

Which one of the following is limited during operation to prevent gross cladding failure?

A. Critical heat flux

B. Linear heat generation rate

C. Average planar linear heat generation rate

D. Minimum critical power ratio

QUESTION: 97

The plant is operating at 100% load when a turbine trip occurs with no bypass valve actuation. Assuming the reactor does not scram immediately, Critical Power Ratio (CPR) will initially:

A. increase due to an increased latent heat of vaporization.

B. decrease due to a decreased latent heat of vaporization.

C. increase due to an increased reactor power.

D. decrease due to a decreased reactor power.

QUESTION: 98

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: 99

Brittle fracture of the reactor vessel (RV) is most likely to occur during a _____ of the Reactor Coolant System (RCS) when RCS temperature is _____ the RV reference temperature for nil ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

QUESTION: 100

Prolonged exposure of the reactor vessel to a fast neutron flux will cause the reference temperature for nil-ductility transition (RT_{NDT}) to:

A. decrease due to the propagation of existing flaws.

B. increase due to the propagation of existing flaws.

C. decrease due to changes in the material properties of the vessel wall.

D. increase due to changes in the material properties of the vessel wall.

UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
JUNE 1993 - FORM B

Please Print:

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO CANDIDATE

Use the answer sheet provided. Each question 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.

SECTION	QUESTIONS	% OF TOTAL	SCORE
THERMODYNAMICS	1 - 28		
COMPONENTS	29 - 72		
REACTOR THEORY	73 - 100		
TOTALS	100		

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

_____
Candidate'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. Use only 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 EXAMINATIONS SECTION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

$SUR = 26.06/\tau$

$$SUR = \frac{26.06(\lambda_{eff}\rho)}{(\bar{\beta} - \rho)}$$

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

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

$\tau = (\ell^*/\rho) + [(\bar{\beta} - \rho)/\lambda_{eff}\rho]$

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

$\rho = \Delta K_{eff}/K_{eff}$

$$\text{Cycle Efficiency} = \frac{\text{Net Work (out)}}{\text{Energy (in)}}$$

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

$CR_1(1 - K_{eff})_1 = CR_2(1 - K_{eff})_2$

$M = 1/(1 - K_{eff}) = CR_1/CR_0$

$$M = \frac{(1 - K_{eff})_0}{(1 - K_{eff})_1}$$

$SDM = (1 - K_{eff})/K_{eff}$

$\tau = \ell^*/(\rho - \bar{\beta})$

$\ell^* = 1 \times 10^{-5}$ seconds

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

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

$$\upsilon(P_e - P_i) + \frac{(\bar{v}_e^2 - \bar{v}_i^2)}{2} + g(z_e - z_i) = 0$$

CONVERSIONS

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

QUESTION: 1

If the pressure sensed by a bourdon tube increases, the curvature of the detector will _____ because of the greatest force being applied to the _____ curve of the detector.

A. decrease; outer

B. increase; outer

C. decrease; inner

D. increase; inner

QUESTION: 2

A saturated vapor exists at 800 psia. If 500 BTU/lbm is removed from this saturated vapor at a constant pressure:

A. the temperature will decrease.

B. the density will decrease.

C. the specific volume will decrease.

D. the enthalpy will increase.

QUESTION: 3

Cooling water exits a fuel channel with an enthalpy of 1195 BTU/lbm at a reactor pressure of 1050 psig. What is the state of the fluid at the exit of the fuel channel?

A. Subcooled

B. Saturated

C. Compressed

D. Superheated

QUESTION: 4

The steam inlet nozzles used in steam jet air ejectors convert the _____ of the steam into _____.

A. kinetic energy; pressure

B. enthalpy; kinetic energy

C. kinetic energy; velocity

D. enthalpy; pressure

QUESTION: 5

What effect will an increase of noncondensible gases in a main condenser have on condenser operations in a plant operating at full power?

A. Decreased condensate temperature

B. Increased amount of condensate depression

C. Decreased steam pressure in the condenser

D. Increased cooling water outlet temperature

QUESTION: 6

The reactor plant was initially operating normally at 90% power when heating steam (supplied by the turbine) was automatically isolated to several feedwater heaters. The plant stabilized and reactor power was returned to 90%.

As compared to the initial turbine load, the current turbine load is:

A. higher, because less steam is being extracted from the turbine.

B. higher, because the steam cycle is less efficient.

C. lower, because less steam is being extracted from the turbine.

D. lower, because the steam cycle is less efficient.

QUESTION: 7

Why are steamlines gradually warmed instead of admitting full steam flow?

A. Minimize condensation

B. Minimize thermal expansion

C. Minimize potential for water hammer

D. Minimize heat loss to ambient

QUESTION: 8

Which one of the following describes pump head?

A. The energy added by a pump to maintain or increase fluid pressure or velocity.

B. The energy added by a pump to maintain or increase fluid volume or velocity.

C. The fluid energy required to ensure the pump does not cavitate.

D. The fluid energy contained at the inlet of the pump.

QUESTION: 9

A boiling water reactor is operating at a pressure of 1025 psia. It has a temperature of 530°F in the suction of the recirculating pump and an elevation head of 25 psi.

Neglecting line losses, which one of the following values is the net positive suction head?

A. 177 psi

B. 165 psi

C. 154 psi

D. 143 psi

QUESTION: 10

The predominant mode of heat transfer from the fuel-clad surface to the coolant during full power operating conditions is:

A. radiation.

B. conduction.

C. forced convection.

D. natural convection.

QUESTION: 11

Which one of the following formulas includes the heat transfer coefficient of the tubes in a heat exchanger?

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

B. $\dot{Q} = \dot{m}\Delta T$

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

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

QUESTION: 12

Given the following data for a typical steam condenser (i.e., a cross-flow heat exchanger), what is the heat load in megawatts?

Total tube area	= 500,000 ft^2
Cooling water flow rate	= 200,000 gpm
Condenser pressure	= 1 psia
Specific heat of cooling water (Cp)	= 1.0 BTU/lbm-°F
Cooling water inlet temperature	= 60°F
Cooling water outlet temperature	= 85°F
Steam condensing rate	= 3 x 10^6 lbm/hr
1 gallon water	= 8.34 lbm

A. 833 Mw

B. 783 Mw

C. 733 Mw

D. 703 Mw

QUESTION: 13

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: 14

Core heat transfer is maximized by the presence of:

A. laminar flow with nucleate boiling.

B. turbulent flow with nucleate boiling.

C. laminar flow with no nucleate boiling.

D. turbulent flow with no nucleate boiling.

QUESTION: 15

Which one of the following is characterized by steam bubbles moving away from a heated surface and collapsing in the bulk fluid?

A. Subcooled nucleate boiling

B. Saturated convection

C. Subcooled convection

D. Saturated nucleate boiling

QUESTION: 16

Which one of the following is indicated by a rapid increase in the fuel clad-to-coolant ΔT and a decrease in heat flux from the fuel?

A. Bulk boiling is occurring.

B. Departure from nucleate boiling (DNB) has been reached.

C. Critical heat flux (CHF) is increasing.

D. Nucleate boiling is occurring.

QUESTION: 17

A reactor is operating at full power with a fuel coolant channel that is experiencing each of the following heat transfer mechanisms somewhere along the length of the coolant channel.

Which of the following causes the first reduction in the local cladding heat transfer coefficient as the coolant flows upward through the coolant channel?

A. Nucleate boiling

B. Stable film boiling

C. Partial film boiling

D. Single-phase convection

QUESTION: 18

A reactor is operating at 100% power. Recirculation flow is decreased from 100% to 80%.

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

A. It physically moves down the fuel rods, because more 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 fewer BTUs per pound mass of water are now being transferred.

D. It physically moves up the fuel rods, because fewer BTUs per pound mass of water are now being transferred.

QUESTION: 19

Which of the following statements most accurately describes the principle of jet pump operation?

A. Low static pressure created by the high-velocity jet draws downcomer fluid into the jet pump throat.

B. Low static pressure created by the increasing area in the diffuser draws downcomer fluid into the jet pump throat.

C. The high driving-to-driven flow ratio creates a low static pressure in the diffuser, which draws downcomer fluid into the jet pump throat.

D. High-velocity jet flow draws downcomer fluid into the jet pump throat as a result of friction between the driving flow and the driven flow.

QUESTION: 20

The linear heat generation rate (LHGR) is being maintained within the thermal limits of the reactor core if the ratio _____ is being maintained at _____.

A. LHGR-actual/LHGR-limit; 1.15

B. LHGR-limit/LHGR-actual; 1.10

C. LHGR-actual/LHGR-limit; 1.05

D. LHGR-limit/LHGR-actual; 0.95

QUESTION: 21

Which one of the following limits takes into consideration fuel pellet swell effects?

A. Rated thermal power (RTP)

B. Minimum critical power ratio (MCPR)

C. Average gain adjustment factor (AGAF)

D. Maximum linear heat generation rate (MLHGR)

QUESTION: 22

At low core exposures, the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limit increases with increasing exposure. What is the reason for this increase?

A. Fissionable elements in the fuel pellet are being depleted, thereby reducing the heat that is transferred to the fuel cladding.

B. Fuel pellet cracking brings the fuel pellets into contact with fuel cladding, thereby increasing the fuel-to-clad heat transfer coefficient.

C. Fission product gases that are building up in the fuel pin have lower specific volume than the helium fill gas, thereby resulting in lower cladding stresses.

D. Fission product gases that are building up in the fuel pin have a lower heat transfer coefficient than the helium fill gas, thereby decreasing the fuel cladding temperature.

QUESTION: 23

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

Given the following initial core parameters at the beginning of core life:

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

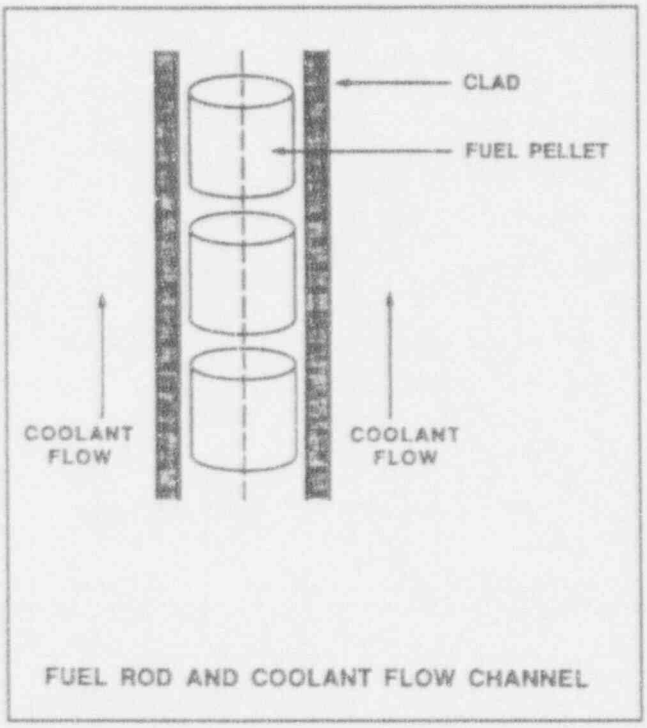
What would be the fuel centerline temperature at the end of core life if, over core life, the total fuel-to-coolant thermal conductivity doubled?

A. 1750°F

B. 1500°F

C. 1250°F

D. 1000°F



FUEL ROD AND COOLANT FLOW CHANNEL

QUESTION: 24

Which one of the following is limited during operation to prevent gross cladding failure?

A. Critical heat flux

B. Linear heat generation rate

C. Average planar linear heat generation rate

D. Minimum critical power ratio

QUESTION: 25

The plant is operating at 100% load when a turbine trip occurs with no bypass valve actuation. Assuming the reactor does not scram immediately, Critical Power Ratio (CPR) will initially:

A. increase due to an increased latent heat of vaporization.

B. decrease due to a decreased latent heat of vaporization.

C. increase due to an increased reactor power.

D. decrease due to a decreased reactor power.

QUESTION: 26

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: 27

Brittle fracture of the reactor vessel (RV) is most likely to occur during a _____ of the Reactor Coolant System (RCS) when RCS temperature is _____ the RV reference temperature for nil ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

QUESTION: 28

Prolonged exposure of the reactor vessel to a fast neutron flux will cause the reference temperature for nil-ductility transition (RT_{NDT}) to:

A. decrease due to the propagation of existing flaws.

B. increase due to the propagation of existing flaws.

C. decrease due to changes in the material properties of the vessel wall.

D. increase due to changes in the material properties of the vessel wall.

QUESTION: 29

The difference between the setpoint pressure at which a safety/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: 30

All of the following are acceptable methods for verifying the position of a shut manual gate valve, except:

A. attempting to turn the handwheel in the "open" direction.

B. attempting to turn the handwheel in the "close" direction.

C. observing the position of the valve stem using handwheel or position indicators.

D. observing indicators for plant parameters, such as temperature, pressure and level.

QUESTION: 31

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. greater than

C. less than

D. increasing with

QUESTION: 32

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

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

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

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

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

QUESTION: 33

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: 34

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be:

A. 244.8 psid.

B. 171.4 psid.

C. 122.4 psid.

D. 85.7 psid.

QUESTION: 35

Flow rate (gpm) in a cooling water system is being measured using a flow nozzle and a differential pressure (D/P) detector. An instrument calibration has just been performed.

If air is introduced into the system such that air bubbles become entrained in the water, indicated flow rate will be:

A. stable because the air bubbles dampen system pressure surges.

B. fluctuating despite the air bubbles dampening system pressure surges.

C. stable despite the compression/expansion of the air bubbles in the nozzle.

D. fluctuating because of the compression/expansion of the air bubbles in the nozzle.

QUESTION: 36

Which one of the following will cause indicated volumetric flow rate to be lower than actual volumetric flow rate using a differential pressure (D/P) flow detector and a calibrated orifice?

A. System pressure decreases.

B. The orifice erodes over time.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

QUESTION: 37

Two differential pressure level transmitters are installed on a large water storage tank. Transmitter I is calibrated at 100°F and transmitter II is calibrated at 200°F water temperature.

Which transmitter will indicate a higher level?

A. Transmitter I below 150°F, transmitter II above 150°F

B. Transmitter II below 150°F, transmitter I above 150°F

C. Transmitter I at all water temperatures

D. Transmitter II at all water temperatures

QUESTION: 38

A correct statement regarding thermocouples is that they:

A. are more accurate than resistance temperature detectors.

B. will indicate low offscale with an open circuit at the sensing junction.

C. are made up of two similar metals in contact at one end, called the hot junction.

D. are based on the inherent characteristic of metals: a change in electrical resistance occurs when a change in temperature occurs.

QUESTION: 39

Refer to the drawing of a cooling water system that is cooling a lube oil heat exchanger (see figure below).

Surge tank level is being measured using a differential pressure (D/P) level detector that has been calibrated at the current water temperature in the tank. The lube oil-to-cooling water heat exchanger develops a tube leak resulting in lube oil accumulation in the surge tank.

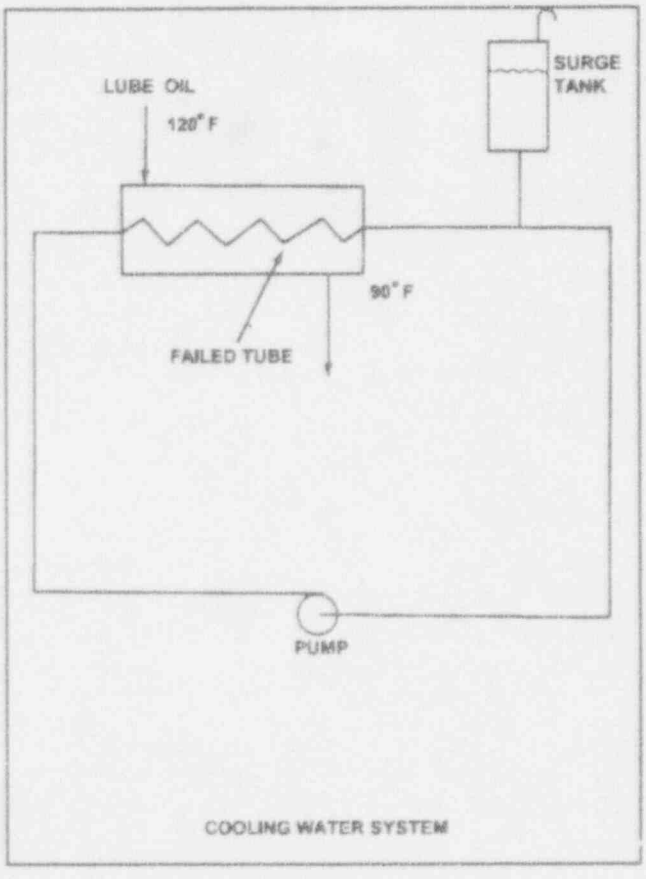
Assuming that the temperature of the contents in the surge tank does not change, indicated level will be _____ than actual tank level because lube oil is _____ than water.

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense



QUESTION: 40

Refer to the drawing of a reactor vessel differential pressure level detector (see figure below).

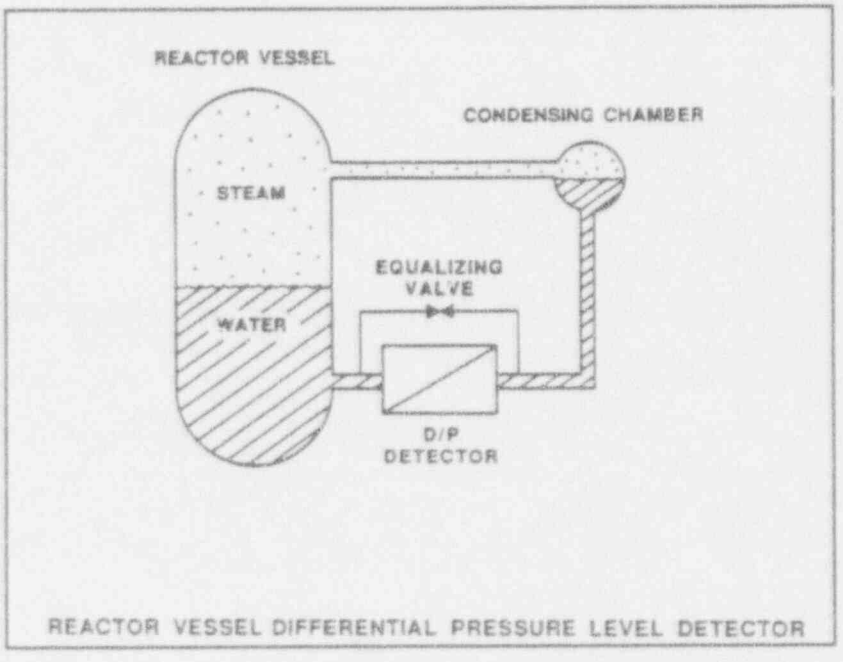
Which one of the following events will result in a reactor vessel level indication that is greater than actual level?

A. The reference leg water flashes to steam.

B. The reactor pressure increases by 50 psia.

C. The variable leg breaks and completely drains.

D. The temperature surrounding the reference leg decreases significantly.



REACTOR VESSEL DIFFERENTIAL PRESSURE LEVEL DETECTOR

QUESTION: 41

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

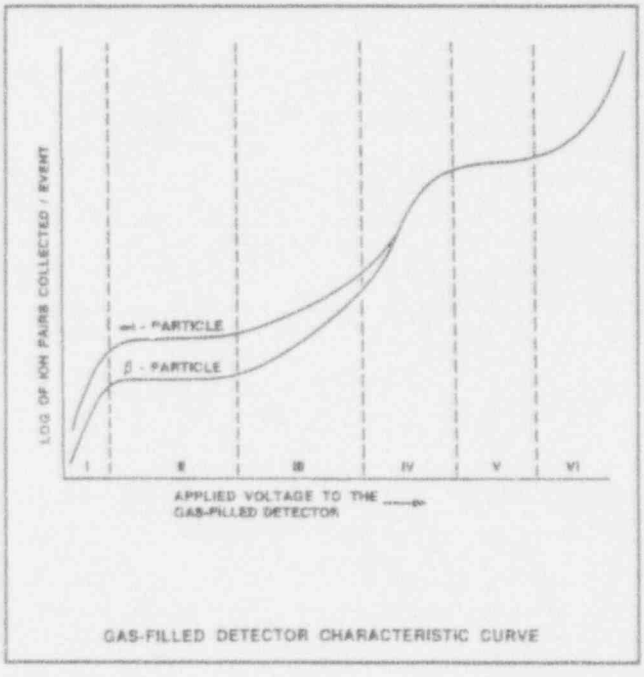
What is an advantage of operating a fission chamber neutron detector with a voltage at the high end (vice low end) of the proportional region?

A. Gas amplification will be minimized, which will prolong detector life.

B. A greater number of primary ionizations will occur from a given radiation field, which increases the sensitivity of the detector.

C. The difference between the magnitude of neutron and gamma pulse heights will be larger, which improves gamma compensation.

D. The space charge effect will be minimized, which ensures that detector output is directly proportional to the number of ionizing events.



GAS-FILLED DETECTOR CHARACTERISTIC CURVE

QUESTION: 42

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.

QUESTION: 43

Which one of the following describes the response of a direct acting proportional-integral controller, operating in automatic, to an increase in the controlled parameter above the controller setpoint?

A. The controller will develop an output signal that will remain directly proportional to the rate of change of the controlled parameter.

B. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes zero.

C. The controller will develop an output signal that continues to increase until the controlled parameter equals the controller setpoint, at which time the output signal becomes constant.

D. The controller will develop an output signal that will remain directly proportional to the difference between the controlled parameter and the controller setpoint.

QUESTION: 44

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

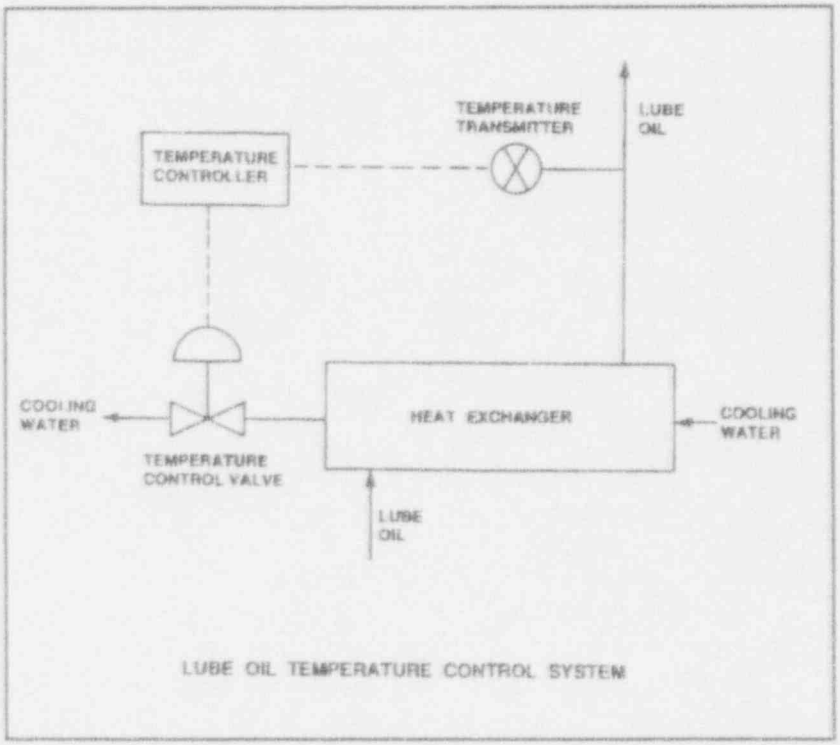
If the temperature transmitter fails high (high temperature output signal), the temperature controller will _____ the temperature control valve, causing the actual heat exchanger lube oil outlet temperature to _____.

A. close; increase

B. close; decrease

C. open; increase

D. open; decrease



LUBE OIL TEMPERATURE CONTROL SYSTEM

QUESTION: 45

If the turbine shaft speed signal received by a typical turbine governor control system fails low during turbine startup, the turbine governor will cause turbine speed to:

A. increase, until an upper limit is reached or the turbine trips on overspeed.

B. decrease, until the mismatch with demanded turbine speed is nulled.

C. increase, until the mismatch with demanded turbine speed is nulled.

D. decrease to a minimum speed setpoint.

QUESTION: 46

Select the statement that describes pump cavitation.

A. Vapor bubbles are formed when the enthalpy difference between pump discharge and pump suction exceeds the latent heat of vaporization.

B. Vapor bubbles are formed in the eye of the pump and collapse as they enter higher pressure regions of the pump.

C. Vapor bubbles are produced when the localized pressure exceeds the vapor pressure at the existing temperature.

D. Vapor bubbles are discharged from the pump where they impinge on downstream piping and cause a water hammer.

QUESTION: 47

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

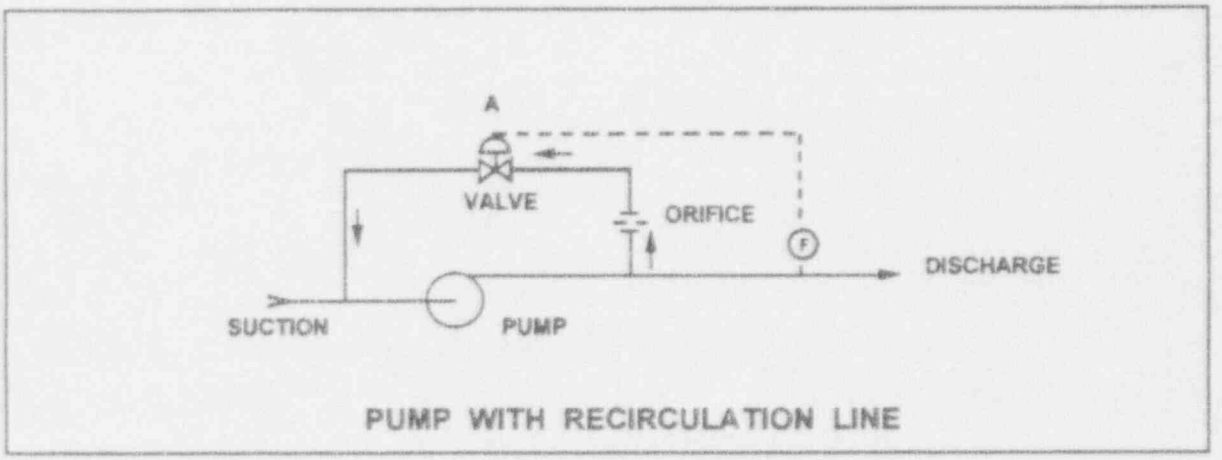
Valve "A" will open when:

A. pump discharge pressure reaches a high setpoint.

B. pump discharge pressure reaches a low setpoint.

C. pump flow rate reaches a high setpoint.

D. pump flow rate reaches a low setpoint.



PUMP WITH RECIRCULATION LINE

QUESTION: 48

In a centrifugal pump, gas binding is a term that refers to a condition in which the pump:

A. suction pressure drop is sufficient to cause the fluid to vaporize.

B. capacity is reduced due to the presence of steam or air in the pump volute.

C. capacity is increased due to the expansion of vapor bubbles in the pump casing.

D. motor current increases due to dissolved noncondensible gases adding to the volume of the fluid being pumped.

QUESTION: 49

A centrifugal pump is operating with the following parameters:

Pump head:	50 psid
Flow rate:	200 gpm
Power input:	3 Kw

Pump speed is increased and flow rate increases to 400 gpm.
Which of the following is the value of the new power consumption?

A. 6 Kw

B. 9 Kw

C. 24 Kw

D. 27 Kw

QUESTION: 50

Which one of the following changes in plant status will bring the reactor recirculation system closer to the condition in which the recirculation pump will cavitate?

A. During a plant shutdown, reactor recirculation pump suction temperature decreases while reactor pressure remains constant.

B. Reactor recirculation pump speed is increased.

C. Reactor water level increases.

D. Extraction steam is isolated from one high pressure feedwater heater during power operations.

QUESTION: 51

A constant-speed centrifugal pump motor draws the least current when the pump is:

A. at shutoff head with no recirculation flow.

B. accelerating to normal speed during start.

C. operating on recirculation flow only.

D. at maximum rated flow conditions.

QUESTION: 52

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve (see figure below) in which pumps A and B are identical single-speed centrifugal pumps and only pump A is operating.

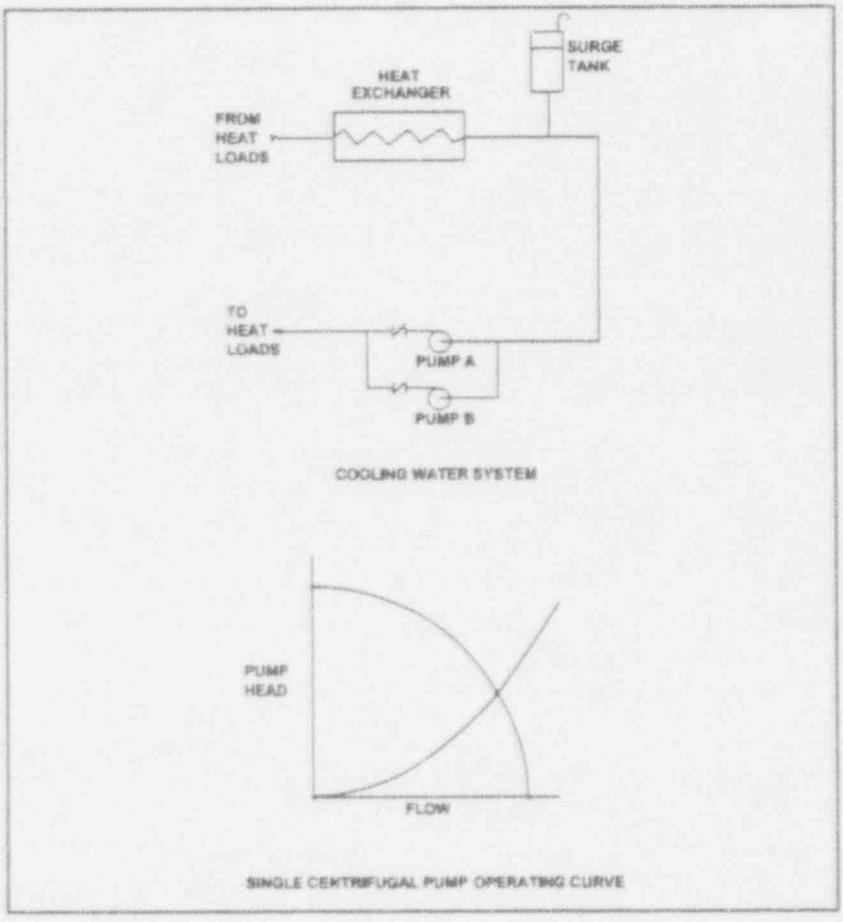
If pump B is started, system flow rate will be _____ and common pump discharge pressure will be _____.

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher



QUESTION: 53

Operating a motor-driven centrifugal pump under "pump runout" conditions causes:

A. pump overheating, cavitation, and ultimately pump failure.

B. excessive motor current to be drawn, damage to the motor windings, and ultimately motor failure.

C. excessive motor current to be drawn, overheating of pump and motor bearings, and ultimately pump failure.

D. no damage, because the pump and motor are designed to operate without failure under pump runout conditions.

QUESTION: 54

A positive displacement pump with a three-phase AC induction motor is operating to maintain 1600 psig in a hydraulic fluid system. If the voltage supplied to the pump motor is slowly reduced by 20%, the pump motor current will _____ and motor winding temperature will _____. (Assume the motor does not stall.)

A. increase; increase

B. decrease; increase

C. increase; decrease

D. decrease; decrease

QUESTION: 55

Which one of the following AC motor events is characterized by maximum rotor slip and a motor current 5 to 6 times full-load current?

A. Starting of the motor

B. Ground in motor windings

C. Motor overloaded by 50%

D. Motor operating at breakdown torque

QUESTION: 56

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

A. 93 psid

B. 172 psid

C. 320 psid

D. 2048 psid

QUESTION: 57

A generator is paralleled to the grid and is supplying 0 MVAR. If generator output voltage is increased, the generator will become _____ and will attain a _____ power factor.

A. overexcited; leading

B. underexcited; lagging

C. underexcited; leading

D. overexcited; lagging

QUESTION: 58

A 4160 volt diesel generator (D/G) is loaded to 2850 Kw with a 0.85 lagging power factor. What is the KVAR load on the D/G?

A. 503 KVAR

B. 1766 KVAR

C. 2850 KVAR

D. 3353 KVAR

QUESTION: 59

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

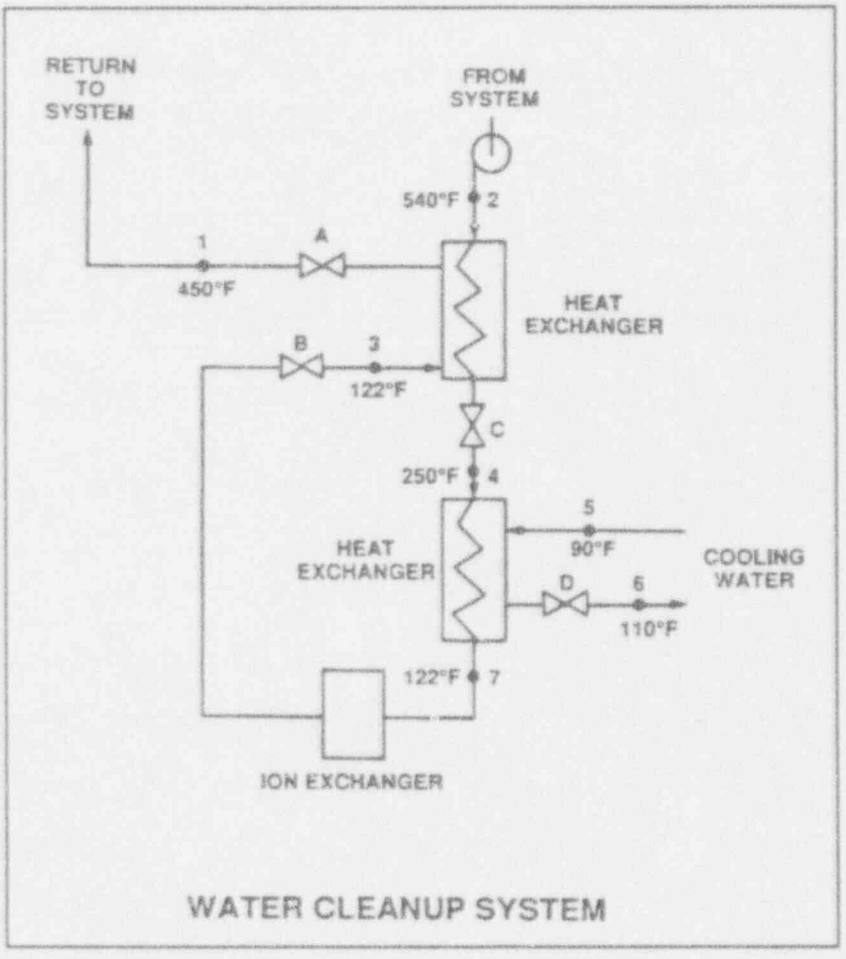
All valves are identical and are initially 50% open. To lower the temperature at point 4, the operator should adjust valve _____ in the _____ direction.

A. A; open

B. B; shut

C. C; open

D. D; shut



WATER CLEANUP SYSTEM

QUESTION: 60

Assuming that condenser cooling water temperature and flow do not change, if condenser vacuum improves (absolute pressure decreases), condensate temperature will:

A. increase because condenser saturation pressure has increased.

B. increase because condensate subcooling has decreased.

C. decrease because condenser saturation pressure has decreased.

D. decrease because condensate subcooling has increased.

QUESTION: 61

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

A. 538.4°F

B. 536.5°F

C. 533.9°F

D. 532.6°F

QUESTION: 62

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

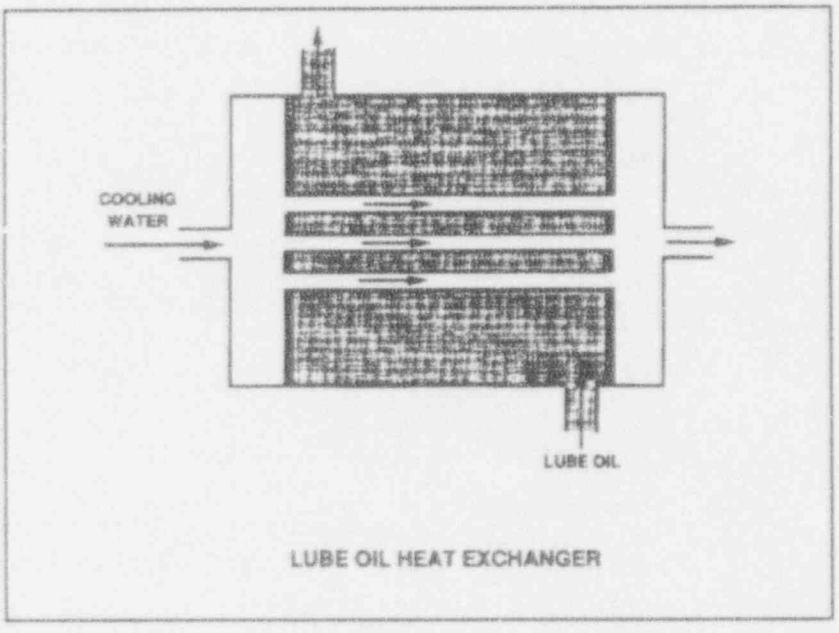
As tube fouling increases in the lube oil heat exchanger, cooling water outlet temperature will _____ and lube oil outlet temperature will _____. (Assume flow rates do not change.)

A. decrease; increase

B. increase; increase

C. decrease; decrease

D. increase; decrease



LUBE OIL HEAT EXCHANGER

QUESTION: 63

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

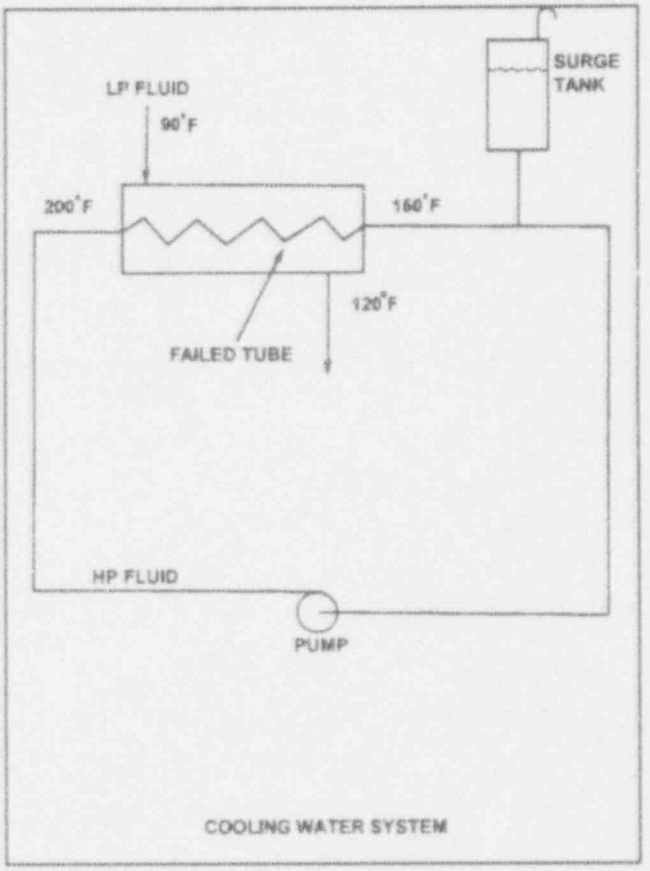
Which of the following effects initially would occur as a result of a tube failure in the heat exchanger?

A. Level in the tank increases.

B. High pressure fluid flow rate decreases.

C. Flow in the low pressure system reverses.

D. Temperature in the low pressure system increases.



QUESTION: 64

During power plant operation, the accumulation of air and non-condensable gases in the main condenser will:

A. not effect turbine work.

B. not effect turbine efficiency.

C. increase generator load.

D. increase turbine backpressure.

QUESTION: 65

Which 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 bed

B. A sudden large decrease in the temperature of the influent

C. Exhaustion of the bed due to high inlet conductivity

D. Operation of the bed at lower than design flow rates

QUESTION: 66

The ion exchange efficiency of a condensate demineralizer can be determined by:

A. performing a calculation based on the ratio between the inlet pH divided by the outlet pH.

B. performing a calculation based on the change in differential pressure across the demineralizer.

C. sampling the inlet and outlet of the demineralizer to determine the difference in activity.

D. sampling the inlet and outlet of the demineralizer to determine the change in conductivity.

QUESTION: 67

The temperature of the water passing through a demineralizer must be controlled because excessively hot water will:

A. reduce the affinity of the demineralizer resin for ion exchange.

B. degrade the corrosion inhibitor applied to the inner wall of the demineralizer.

C. increase the ion exchange rate for hydronium ions, thereby changing effluent pH.

D. result in excessive demineralizer retention element thermal expansion, thereby releasing resin.

QUESTION: 68

Two AC generators are considered to be in phase when:

A. the alternating sine wave voltage of one generator is in alignment with the other generator.

B. the frequency of one generator is equal to the frequency of the other generator.

C. the synchroscope is turning slowly in the clockwise direction.

D. the synchroscope is turning slowly in the counter clockwise direction.

QUESTION: 69

Which one of the following local breaker indications will provide the most reliable information for determining the position of a 4160 volt bus feeder breaker?

A. Open/closed mechanical flag and load-side current

B. Open/closed indicating lights and load-side current

C. Open/closed indicating lights and load-side voltage

D. Open/closed mechanical flag indication and load-side voltage

QUESTION: 70

Refer to the drawing of a typical valve control circuit (see figure below).

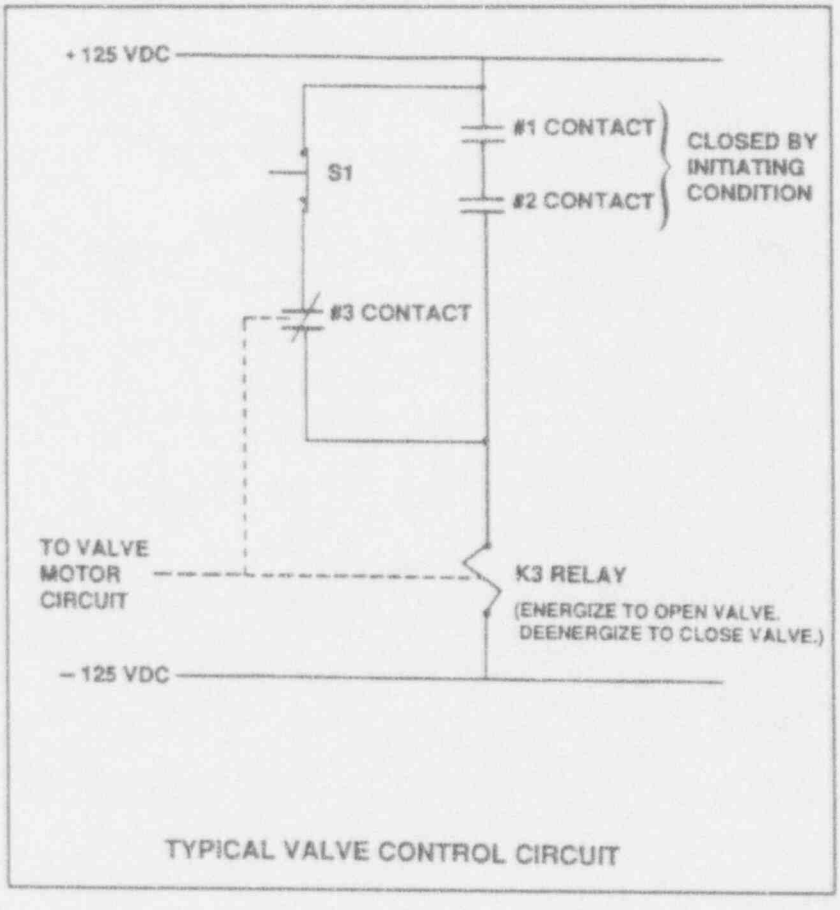
What is the purpose of depressing the S1 pushbutton?

A. To maintain the K3 relay energized after the initiating condition has cleared

B. To manually energize the K3 relay in the absence of the initiating condition

C. To prevent pickup of the K3 relay when the initiating condition occurs

D. To reset the K3 relay after the initiating condition has cleared



TYPICAL VALVE CONTROL CIRCUIT

QUESTION: 71

Which one of the following will cause a loss of indication from the remote breaker position indicating lights associated with a typical 480 VAC load supply breaker?

A. Locally opening the breaker

B. Loss of breaker line voltage

C. Removing the breaker control power fuses

D. Burnout of the local breaker position indicating lights

QUESTION: 72

High voltage electrical disconnects should <u>not</u> be used to:

A. tie buswork sections together.

B. interrupt circuits under load.

C. electrically ground buswork.

D. isolate equipment electrically.

QUESTION: 73

Which one of the following will increase the distance travelled 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: 74

A description of a good moderator is a moderator that is:

A. not dense and is composed of small atoms.

B. dense and is composed of small atoms.

C. not dense and is composed of large atoms.

D. dense and is composed of large atoms.

QUESTION: 75

Which one of the following combinations of core conditions at 35% power indicates the least amount of excess reactivity exists in the core?

	CONTROL ROD POSITION	REACTOR RECIRCULATION FLOW
A.	25% inserted	25%
B.	50% inserted	50%
C.	25% inserted	50%
D.	50% inserted	25%

QUESTION: 76

Which one of the following will increase the reactivity margin to criticality in a subcritical reactor at 250°F?

A. Decay of Sm-149

B. Increased core recirculation flow rate.

C. Reactor coolant heatup

D. Control rod withdrawal

QUESTION: 77

Which one of the following pairs of neutron reactions produces the largest contribution to the source neutron level after the first fuel cycle? (Neglect contribution from neutron source.)

A. Alpha-neutron reactions and spontaneous fission

B. Spontaneous fission and photo-neutron reactions

C. Photo-neutron reactions and beta-neutron reactions

D. Beta-neutron reactions and alpha-neutron reactions

QUESTION: 78

Two reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

QUESTION: 79

The effective delayed neutron fraction ($\overline{\beta}_{eff}$) takes into account two factors not considered in calculating the delayed neutron fraction ($\overline{\beta}$). These factors consider that:

1. Delayed neutrons are _____ likely to cause fast fission than prompt neutrons, and

2. Delayed neutrons are _____ likely to leak from the core than prompt neutrons.

A. more; more

B. more; less

C. less; more

D. less; less

QUESTION: 80

During a continuous rod withdrawal accident, reactor power has increased from 387 Mw to 553 Mw in 10 seconds. What was the reactor period for this power increase?

A. 3 seconds

B. 24 seconds

C. 28 seconds

D. 35 seconds

QUESTION: 81

The moderator temperature coefficient of reactivity is _____ negative at end of core life because, over core life, the utilization of thermal neutrons _____.

A. more; decreases

B. less; decreases

C. more; increases

D. less; increases

QUESTION: 82

Factors that affect resonance absorption of a neutron into a nucleus include:

A. kinetic energy of the nucleus, kinetic energy of the neutron, and excitation energy of the nucleus.

B. excitation energy of the neutron, kinetic energy of the nucleus, and kinetic energy of the neutron.

C. kinetic energy of the neutron, excitation energy of the nucleus, and excitation energy of the neutron.

D. excitation energy of the nucleus, excitation energy of the neutron, and kinetic energy of the nucleus.

QUESTION: 83

A core consists of fuel bundles and control rods that are 12 feet in length. A new rod position is indicated for every 3 inches of rod motion.

If a control rod is inserted 75% into the core, it will be located at rod position:

A. 9.

B. 12.

C. 27.

D. 36.

QUESTION: 84

A control rod is inserted in the reactor with the following neutron flux parameters:

Core average thermal neutron flux = 10^{12} neutrons/cm^2-sec
Control rod tip neutron flux = 5 x 10^{12} neutrons/cm^2-sec

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

A. 4.0

B. 2.0

C. 1.4

D. 0.5

QUESTION: 85

If a control rod is fully inserted (from the fully withdrawn position), the normalized axial neutron flux shape in the core will undergo a:

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

B. minor distortion, because the fully inserted control rod appears to be invisible.

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

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

QUESTION: 86

If the void fraction surrounding centrally located fuel bundles increases, the worth of the associated control rod(s) will:

A. decrease, because more neutrons are able to travel from one fuel bundle to the next without being absorbed by the control rod.

B. increase, because thermal neutrons will travel farther resulting in a larger fraction of thermal neutrons being absorbed by the control rod.

C. increase, because control rods are epithermal neutron absorbers and neutrons remain at higher energies longer due to the longer slowing down length.

D. decrease, because more neutrons are resonantly absorbed in the fuel as they are being thermalized resulting in fewer thermal neutrons to be absorbed by the control rod.

QUESTION: 87

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Uranium-235

B. Uranium-238

C. Plutonium-239

D. Xenon-135

QUESTION: 88

Xenon-135 is produced in the reactor by two methods. One is directly from fission, the other is indirectly from the decay of:

A. Barium-135.

B. Cesium-135.

C. Iodine-135.

D. Xenon-136.

QUESTION: 89

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

A. xenon decay to cesium.

B. xenon absorption of neutrons.

C. xenon production from fission.

D. xenon production from iodine decay.

QUESTION: 90

The reactor has been operating at 100% power for 2 weeks when power is decreased to 10% in 1 hour. Immediately following the power decrease, xenon-135 concentration will _____ for a period of _____.

A. decrease; 4 to 6 hours

B. increase; 4 to 6 hours

C. decrease; 8 to 11 hours

D. increase; 8 to 11 hours

QUESTION: 91

What is the difference in peak xenon concentration following a reactor scram after 1 week at 100% power as compared to a scram after 1 week at 50% power?

A. The peaks are equal because the decay rate of iodine remains constant.

B. The peak from 50% is of a smaller magnitude due to the lower xenon burnout rate.

C. The peak from 100% power is of a larger magnitude, due to the larger initial iodine concentration.

D. The time to reach the peak is shorter after 100% power than after 50% power, due to the higher iodine decay rate.

QUESTION: 92

Four hours after a reactor trip from a long-term, steady-state, 100% power run, the reactor has been taken critical and is to be maintained at 1 to 2% power. Which of the following will describe the operator's action and what is happening?

A. Add negative reactivity because xenon is building in.

B. Add positive reactivity because xenon is building in.

C. Add negative reactivity because xenon is decaying away.

D. No actions required; xenon is at an equilibrium condition.

QUESTION: 93

Gadolinium (Gd-155 and -157) is used instead of boron (B-10) as the _____ material because 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: 94

During a reactor startup, source range monitors (SRMs) indicate 100 cps, and K_{eff} is 0.95. After a number of rods have been withdrawn, SRMs indicate 270 cps. Which one of the following is closest to the new K_{eff}? (Assume reactor period is infinity before and after the rod withdrawal.)

A. 0.990

B. 0.982

C. 0.971

D. 0.936

QUESTION: 95

The reactor is exactly critical during a reactor startup. Which one of the following must be closely monitored and controlled to ensure safe operation of the reactor as power is raised to the point of adding heat?

A. Reactor period

B. Reactor temperature

C. Source range count rate

D. Power peaking factors

QUESTION: 96

With K_{eff} = 0.985, how much reactivity must be added to make the reactor critical?

A. 0.0148 $\Delta k/k$

B. 0.0150 $\Delta k/k$

C. 0.0152 $\Delta k/k$

D. 0.0154 $\Delta k/k$

QUESTION: 97

A reactor is being started up with a stable 100-second period and power entering the intermediate range. Assuming no operator action, which of the following is true?

A. Reactor period will remain constant through all ranges of intermediate range indication.

B. As heat production in the reactor exceeds ambient losses, the temperature of the moderator increases, adding negative reactivity, and reactor period goes to infinity.

C. Prior to reaching the point of adding heat, fuel temperature increases, adding positive reactivity, which causes period to become shorter and shorter until a scram occurs on short period.

D. As heat production in the reactor exceeds ambient losses, the resulting fuel temperature increase adds positive reactivity to counteract the negative reactivity added by increased moderator temperature.

QUESTION: 98

Which one of the following will add the most positive reactivity during a power decrease from 100% to 25% over a 1 hour period? (Assume the power change is performed by changing core recirculation flow rate.)

A. Fuel temperature change

B. Moderator temperature change

C. Fission product poison change

D. Void content change

QUESTION: 99

In response to which one of the following events will the Doppler coefficient act first to change the reactivity addition to the core?

A. Tripping of the main turbine at 45% reactor power

B. A control-rod drop during reactor power operation

C. A safety relief valve opening during reactor power operation

D. The loss of one feedwater heater (extraction steam isolated) during reactor power operation

QUESTION: 100

A reactor is operating at 100% power and flow. Reactor power is reduced by driving control rods in. (Recirculating pump speed remains constant.) What is the effect on core flow?

A. Core flow will increase, due to the decrease in recirculation ratio.

B. Core flow will decrease, due to an increase in two-phase flow resistance.

C. Core flow will increase, due to the decrease in two-phase resistance.

D. Core flow remains constant, since reactor power does not affect core flow.