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See Rpt.

SUBJECT: Forwards generic fundamental exam administered on 900207 including answer keys & grading result for distribution.

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

March 1, 1990

Docket No. 50-528/529/530

Arizona Public Service Company
Palo Verde Nuclear Facility
Mail Station 6994
P. O. Box 52034
Phoenix, Arizona 85072-2034

Attention: Ed Firth, Training Manager

Dear Mr. Firth:

On February 7, 1990, the NRC administered a Generic Fundamentals Examination Section (GFES) of the written operator licensing examination to employees of your facility. Enclosed with this letter are copies of both forms of the examination including answer keys, the grading results for your facility and copies of the individual answer sheets for each of the examinees taking the examination from your facility. Please forward the results to the examinees along with the copies of their answer sheets. A "P" in the column labeled RESULTS indicates a passing grade for this examination. Passing Grade for the GFES is 80%.

In accordance with 10 CFR 2.790 of the Commission's Regulations, a copy of this letter and enclosures (1) and (2) will be placed in the Public Documents Room. The results for individual examinees are exempt from disclosure, therefore enclosures (3) and (4) will not be placed in NRC's Public Document Room.

Should you have any questions concerning this examination, please contact Mr. Paul Doyle at telephone number (301) 492-1047.

Sincerely,

D F Kirsch

Dennis F. Kirsch, Chief
Reactor Safety Branch

Enclosures:
1. Examination Form "A" with answers and references
2. Examination Form "B" with answers and references
3. Examination Results Summary for facility.
4. Copies of Candidate's individual answer sheets.

IE22
1/1

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ENCLOSURE 1

GENERIC FUNDAMENTALS EXAMINATION SECTION (GFES)

PRESSURIZED WATER REACTOR

FORM A

FEBRUARY 1990 PWR GFE - FORM A ANSWER KEY

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

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 the ID-Number you were given at registration.

(4) Fill in your start and stop times at the appropriate time.

(5) Three handouts are provided for your use during the examination, an Equations and Conversions sheet, instructions for filling out the answer sheet, and Steam Table booklets.

(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) Any questions about an item on the examination should be directed to the examiner only.

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

(10) 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.

(11) 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.

(12) Turn in your examination materials, answer sheet on top, followed by the exam booklet, then examination aids - steam table booklets, handouts and scrap paper used during the examination.

(13) After turning in your examination materials, leave the examination area, as defined by the examiner. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

EQUATION SHEET

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

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

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

$Pwr = W_f\, \dot{m}$

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

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

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

---

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

1 kg $= 2.21$ lbm

1 hp $= 2.54 \times 10^3$ BTU/hr

1 Mw $= 3.41 \times 10^6$ BTU/hr

1 BTU $= 778$ ft-lbf

°F $= 9/5$ °C + 32

°C $= 5/9$ (°F - 32)

QUESTION: 1

Operators should use BOTH hands on valve handwheels when positioning manual valves to:

A. overcome the resistance of installed locking devices.

B. control the rate of valve motion to prevent water hammer.

C. ensure system pressure, temperature, and flow are controlled during valve motion.

D. control lateral force to prevent bending the valve stem.

QUESTION: 2

The DIFFERENCE between the pressure at which a safety/relief valve begins to open and the pressure at which it is fully open is called:

A. accumulation.

B. blowdown.

C. setpoint tolerance.

D. setpoint deviation.

QUESTION: 3

Refer to the figure below for the following question.

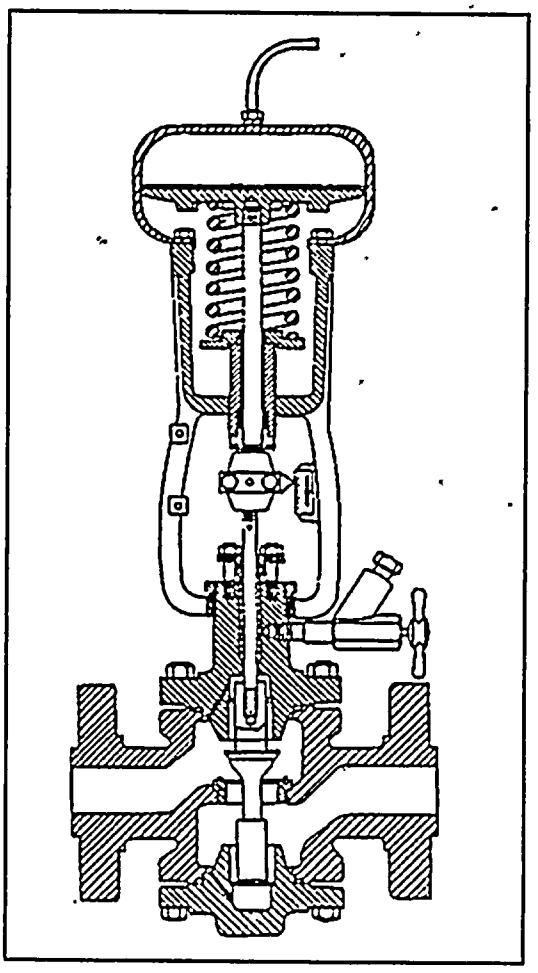
Following a loss of controlling air pressure, the spring-loaded valve will fail:

A. open.

B. as is.

C. closed.

D. to mid-position.



QUESTION: 4

The manual declutch lever of a motor-operated valve _____ the motor and _____ the handwheel.

A. disengages; engages

B. deenergizes; engages

C. engages; disengages

D. reenergizes; disengages

QUESTION: 5

To verify the position of a FULLY-OPEN manual valve, the operator should:

A. fully close the valve, then reopen it to the fully open position.

B. open the valve until it touches the backseat, then close it to the desired position.

C. operate the valve in the open direction until the valve is backseated one-half turn.

D. operate the valve in the closed direction, then reopen the valve to its previous open position.

QUESTION: 6

The most probable cause for fluctuating indication from a liquid flow rate differential pressure detector is:

A. gas or steam being trapped in the liquid.

B. the valve on the equalizing line being open.

C. the valve on the low pressure sensing line being closed.

D. the valve on the high pressure sensing line being closed.

QUESTION: 7

A differential pressure (D/P) cell is being used to measure flow rate in a cooling water system. Flow rate is indicating 75 percent of scale. If the D/P cell diaphram ruptures, INDICATED flow rate will:

A. go to 0 percent.

B. go to 100 percent (full-scale).

C. remain the same.

D. move slowly to 50 percent (mid-scale).

QUESTION: 8

A differential pressure level transmitter, with its reference leg vented to atmosphere, was calibrated for use on an open tank at 100 degrees F. If mass in the tank remains constant and the temperature is raised to 200 degrees F, the INDICATED level will:

A. remain the same although actual level increases.

B. increase but remain less than actual level.

C. decrease but remain greater than actual level.

D. increase in direct proportion to the temperature rise.

QUESTION: 9

Which one of the following failures of a wet reference leg differential pressure (D/P) level transmitter will cause its level indicator to indicate the LOWEST level?

A. The D/P cell diaphragm ruptures.

B. The reference leg ruptures.

C. The variable leg ruptures.

D. The equalizing line ruptures.

QUESTION: 10

A simple bellows pressure detector is located in the reactor containment with its low pressure side vented to the containment. If a main steam break raises containment pressure by 40 psig, the associated pressure indication (disregarding any temperature effect on the bellows) will:

A. increase by the square root of 40 psig.

B. increase by 40 psig.

C. decrease by 40 psig.

D. stay constant.

QUESTION: 11

A bourdon-tube pressure detector that is indicating 50 percent of scale is suddenly exposed to a pressure transient that extends the detector 75 percent beyond its upper-range value. Actual pressure returns to its original value. Assuming the detector remains intact, the affected pressure indication will initially go off-scale high, and then:

A. become unpredictable until the instrument is calibrated.

B. return to a pressure less than original pressure.

C. return to original pressure.

D. return to a pressure greater than original pressure.

QUESTION: 12

A resistance temperature detector (RTD) operates on the principle that a change in metal resistance is _____ proportional to the change in _____.

A. directly; metal temperature

B. directly; metal temperature squared

C. inversely; metal temperature

D. inversely; metal temperature squared

QUESTION: 13

An open circuit in a thermocouple causes the affected temperature indication to fail:

A. high.

B. low.

C. to reference junction temperature.

D. as is.

QUESTION: 14

Most of the electrons collected in a fission chamber are released as a result of ionizations caused DIRECTLY by:

A. fission fragments.

B. fission gammas.

C. fission betas.

D. fissionable materials.

QUESTION: 15

Which of the following describes the reason for the HIGH SENSITIVITY of a Geiger-Mueller tube radiation detector?

A. Changes in applied detector voltage have little effect on detector output.

B. Geiger-Mueller tubes are longer than other radiation detector types.

C. Any incident radiation event causing primary ionization results in ionization of the entire detector.

D. Geiger-Mueller tubes are capable of operating at relatively high detector voltages, allowing detection of low energy radiation.

QUESTION: 16

Which of the following statements describes the use of a self-reading pocket dosimeter (SRPD)?

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

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

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

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

QUESTION: 17

The range of values around the setpoint of a measured variable where NO ACTION occurs in an automatic flow controller is called:

A. deviation.

B. error.

C. deadband.

D. bias.

QUESTION: 18

The governor of an emergency diesel generator (D/G) DIRECTLY senses D/G _____ and adjusts D/G _____ flow to maintain a relatively constant D/G frequency.

A. load, air

B. speed, fuel

C. load, fuel

D. speed, air

QUESTION: 19

The output pressure of a pneumatic controller is typically insufficient to drive a valve actuator accurately. To overcome this problem, a control loop would NORMALLY employ a:

A. valve actuating lead/lag unit.

B. pressure regulator.

C. valve positioner.

D. filter drive unit.

QUESTION: 20

When shifting from automatic to manual valve control, the manual and automatic controller output signals should be MATCHED to:

A. prevent a sudden valve repositioning upon the transfer.

B. satisfy the control transfer interlocks.

C. move the valve to the new position prior to the transfer.

D. prevent the controller from locking up due to a large deviation.

QUESTION: 21

Which of the following changes in pump operating parameters will DIRECTLY lead to pump cavitation in a centrifugal pump that is operating in a closed-loop system?

A. Steadily increasing pump inlet temperature.

B. Steadily decreasing pump flow rate (by reducing pump speed).

C. Steadily increasing pump suction pressure.

D. Steadily increasing pump discharge pressure.

QUESTION: 22

The presence of air in a pump casing may result in _____ when the pump is started.

A. vortexing

B. pump runout

C. head loss

D. gas binding

QUESTION: 23

Failure to provide adequate minimum flow for a centrifugal pump can <u>DIRECTLY</u> result in:

A. discharge piping overpressurization.

B. suction piping overpressurization.

C. excessive pump leakoff.

D. pump overheating.

QUESTION: 24

A constant-speed centrifugal pump motor draws the <u>LEAST</u> current when the pump is:

A. at runout conditions.

B. at operating conditions.

C. accelerating to normal speed during start.

D. at shutoff head.

QUESTION: 25

Many larger centrifugal pumps are started with their discharge valves CLOSED in order to prevent:

A. loss of recirculation (miniflow).

B. overloading the pump motor.

C. cavitation in the pump.

D. lifting the discharge relief valve.

QUESTION: 26

An increase in positive displacement pump speed will cause the available net positive suction head for the pump to:

A. decrease due to the increase in fluid flow.

B. decrease due to the increase in fluid discharge pressure.

C. increase due to the increase in fluid discharge pressure.

D. increase due to the increase in fluid flow.

QUESTION: 27

The following are indications of a locked reactor (primary) coolant pump rotor EXCEPT:

A. reactor (primary) coolant system pressure transient.

B. peak reactor (primary) coolant pump amps with possible breaker trip.

C. decreased flow rate in unaffected loop(s).

D. low reactor (primary) coolant system flow trip.

QUESTION: 28

A centrifugal pump has a flow rate of 3,000 gpm and a current requirement of 200 amps. If the speed is reduced such that the flow rate is 2,000 gpm, what is the final CURRENT requirement at the new lower speed? (Assume a constant motor voltage.)

A. 59 amps

B. 89 amps

C. 133 amps

D. 150 amps

QUESTION: 29

Excessive AC motor current can be caused DIRECTLY by operating the motor:

A. completely unloaded.

B. at full load.

C. with open-circuited windings.

D. with short-circuited windings.

QUESTION: 30

Which of the following describes the motor current indications that would be observed during the start of a large AC motor at FULL load?

A. Amps slowly increase to the full-load value.

B. Amps increase immediately to the full-load value.

C. Amps increase immediately to approximately twice the full-load value and then decrease to the normal full-load value.

D. Amps increase immediately to more than three times the full-load value and then decrease to the normal full-load value.

QUESTION: 31

Which of the following is the reason for LIMITING the number of motor starts in a given time period?

A. Minimizes pitting of starter contacts

B. Prevents excessive torsional stresses on motor shaft

C. Prevents overheating of motor windings

D. Minimizes axial stresses on motor bearings

QUESTION: 32

Refer to the figure below for the following question. All valves are identical and are initially 50 percent open.

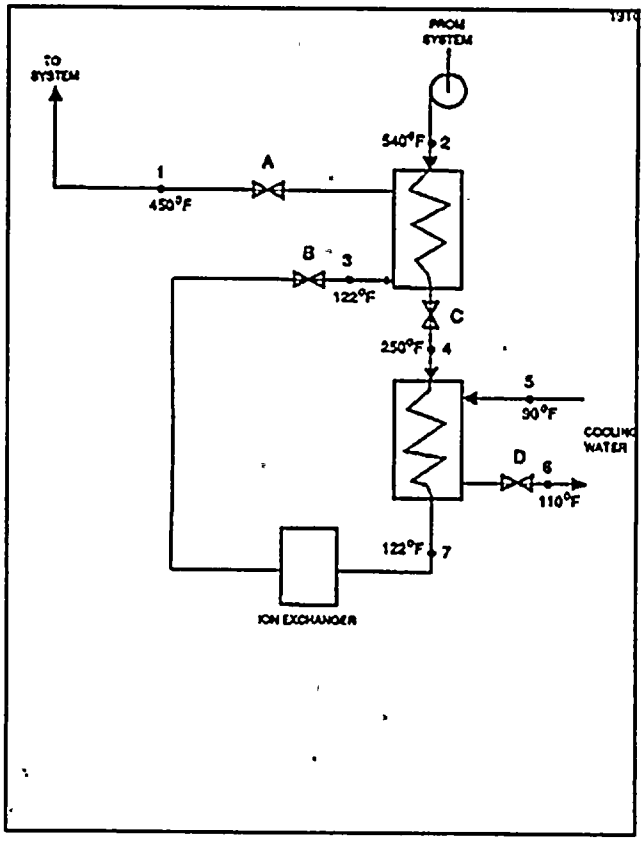
To LOWER the temperature at point 7, the operator should adjust valve _____ in the OPEN direction.

A. A

B. B

C. C

D. D



QUESTION: 33

The MAJOR thermodynamic concern resulting from RAPIDLY cooling a pressure vessel is:

A. loss of subcooling margin.

B. thermal shock.

C. loss of shutdown margin.

D. condensation.

QUESTION: 34

Refer to the figure below for the following question.

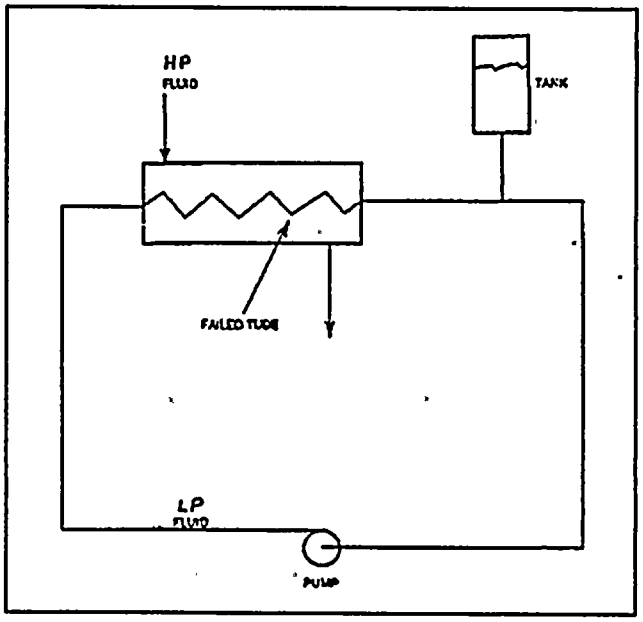
Which of the following effects would occur as a result of a tube FAILURE in the heat exchanger?

A. High pressure fluid inventory increases.

B. Flow in the low pressure system reverses.

C. Temperature in the low pressure system increases.

D. Level in the tank increases.



QUESTION: 35

When a mixed-bed demineralizer resin is exhausted, the resin should be replaced or regenerated because:

A. the resin will physically bond together, thereby causing a flow blockage.

B. ions previously removed by the resin will be released to solution.

C. the resin will fracture and possibly escape through the retention screens.

D. particles previously filtered out of solution will be released.

QUESTION: 36

A demineralizer that has been exposed to _____ should be bypassed because the resin beads may decompose.

A. high temperature

B. low flow

C. low temperature

D. high flow

QUESTION: 37

A demineralizer is <u>BORON SATURATED</u> when:

A. the demineralizer discharges large amounts of boron into the reactor coolant.

B. the demineralizer absorbs greater than 200 ppm boron per hour.

C. the demineralizer boron removal rate decreases rapidly.

D. outlet temperature of the demineralizer begins to increase rapidly.

QUESTION: 38

During maintenance activities, breakers in the open position are TAGGED and RACKED OUT to:

A. deenergize components and associated control and indication circuits.

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

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

D. permit immediate availability of the breaker if required for emergency use.

QUESTION: 39

While locally investigating the condition of a large circuit breaker, the operator observes the following indications:

- OPEN/CLOSED mechanical flag indication indicates open.
- OPEN/CLOSED indicating lights indicate open.
- Overcurrent trip flags are actuated on all phases.
- Load-side voltmeter indicates zero volts.
- Load-side ammeter indicates zero amperes.

Based on these indications, the operator should report that the circuit breaker is open, racked _____, with _____ condition indicated.

A. in, overload

B. in, no overload

C. out, overload

D. out, no overload

QUESTION: 40

Which of the following would cause a loss of ability to remotely trip a circuit breaker AND a loss of position indication?

A. Loss of breaker control power

B. Failure of breaker control switch

C. Mechanical binding of breaker

D. Breaker in "test" position

QUESTION: 41

Closing the output breaker of the main generator with the frequency of the generator HIGHER than grid frequency will result in the generator:

A. behaving as a real load to the grid.

B. behaving as a reactive load to the grid.

C. picking up a portion of the grid real load (MWe).

D. picking up a portion of the grid reactive load (MVAR).

QUESTION: 42

Which of the following generator conditions is MOST LIKELY to cause generator damage because of high current?

A. Tripping the output breaker under full-load conditions

B. Tripping the generator prime mover under full-load conditions

C. Closing the output breaker on a bus that has an open-circuit fault

D. Closing the output breaker on a bus that has a short-circuit fault

QUESTION: 43

The function of high voltage electrical disconnects is to:

A. isolate equipment electrically during no-load conditions.

B. isolate equipment electrically during overload conditions.

C. protect circuits during overcurrent conditions.

D. protect circuits during undervoltage conditions.

QUESTION: 44

The following indications are observed for a breaker in the control room.

- Red (energized) (closed) indicating light "off"
- Green (de-energized) (open) indicating light "off"
- Load amps indicate normal load current

Assuming one of the indicating lights is burnt out, what is the condition of the breaker?

A. Open and racked in

B. Shut and racked in

C. Open and racked to "test" position

D. Shut and racked to "test" position

QUESTION: 45

When determining shutdown margin for an operating reactor, how many control rods (CEAs) are assumed to remain <u>FULLY</u> withdrawn?

A. A single control rod (CEA) of the highest reactivity worth

B. A symmetrical pair of control rods (CEAs) of the highest reactivity worth

C. A single control rod (CEA) of average reactivity worth

D. A symmetrical pair of control rods (CEAs) of average reactivity worth

QUESTION: 46

A reactor at end of life has been shutdown from 100 percent power and cooled down to 140 degrees F over three days. During the cooldown, Boron concentration was increased by 100 ppm. Given the following absolute values of reactivities added during the cooldown, assign a (+) or (-) as appropriate and choose the current value of SHUTDOWN MARGIN.

Xenon - (+) 2.675% delta-K/K

Temperature - (+) 0.500% delta-K/K

Power Defect - (+) 1.575% delta-K/K

Rods - (-) 6.918% delta-K/K

Boron - (-) 1.040% delta-K/K

A. -3.208% delta-K/K

B. -8.558% delta-K/K

C. -1.128% delta-K/K

D. -6.358% delta-K/K

QUESTION: 47

Which one of the following plant parameter changes will result in an INCREASE in shutdown margin for a shutdown reactor at end of core life?

A. RCS boron concentration is increased by 100 ppm.

B. One control rod (CEA) is fully withdrawn for a test.

C. Xenon has decayed for 72 hours following shutdown.

D. RCS is cooled down by 300 degrees F.

QUESTION: 48

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical reactor is dependent on the _____ and _____.

A. prompt neutron lifetime; axial flux distribution

B. prompt neutron lifetime; control rod (CEA) position

C. average effective decay constant; average delayed neutron fraction

D. average effective decay constant; axial flux distribution

QUESTION: 49

Delayed neutrons contribute more to reactor stability than prompt neutrons because they _____ the average neutron generation time and are born at a _____ kinetic energy.

A. increase; lower

B. decrease; higher

C. increase; higher

D. decrease; lower

QUESTION: 50

During core physics testing, reactor coolant temperature should be held as stable as possible. This will MINIMIZE the effects of _____ on reactivity measurements.

A. xenon concentration

B. control rod (CEA) worth

C. reactor coolant inventory

D. moderator temperature coefficient

QUESTION: 51

Under which of the following conditions is a reactor core most likely to have a POSITIVE moderator temperature coefficient?

A. High coolant temperature at end-of-life

B. High coolant temperature at beginning-of-life

C. Low coolant temperature at end-of-life

D. Low coolant temperature at beginning-of-life

QUESTION: 52

During a plant heatup (with an initial negative moderator temperature coefficient), the moderator temperature coefficient becomes increasingly more NEGATIVE. This is because:

A. as moderator density decreases, more thermal neutrons are absorbed by the moderator than by the fuel.

B. the change in the thermal utilization factor dominates the change in the resonance escape probability.

C. a greater density change per degree F occurs at higher reactor coolant temperatures.

D. the core transitions from an under-moderated condition to an over-moderated condition.

QUESTION: 53

Which one of the following groups contain parameters that, if varied, will each have a DIRECT effect on the power coefficient?

A. Control rod (CEA) position, reactor power, moderator voids

B. Moderator temperature, RCS pressure, Xenon level

C. Fuel temperature, xenon level, control rod (CEA) position

D. Moderator voids, fuel temperature, moderator temperature

QUESTION: 54

The reactor is exactly critical below the point of adding heat. Control rods (CEAs) are withdrawn to establish a 0.5 dpm startup rate. Reactor power will increase:

A. and stabilize at a value above the point of adding heat.

B. temporarily, then stabilize at the original value.

C. and stabilize at a value below the point of adding heat.

D. continuously until control rods (CEAs) are reinserted.

QUESTION: 55

A comparison of the heat flux in the hottest coolant channel to the average heat flux in the core describes:

A. a core correction calibration factor.

B. a hot channel/peaking factor.

C. a heat flux normalizing factor.

D. an axial/radial flux deviation factor.

QUESTION: 56

The plant is operating at equilibrium 100 percent power level at BOL with all control rods (CEAs) fully withdrawn. If control rods (CEAs) are partially INSERTED, the axial neutron flux will shift toward _____ of the reactor.

A. the top

B. the middle

C. the bottom

D. both the top and the bottom

QUESTION: 57

Which of the following is NOT a consideration in establishing control rod (CEA) insertion limits?

A. Maximize control rod (CEA) maneuvering capability.

B. Ensure minimum shutdown margin available.

C. Minimize the worth of an ejected control rod.

D. Maintain allowable power distribution.

QUESTION: 58

The TWO characteristics of Xe-135 that result in it being a MAJOR reactor poison is its relatively _____ half-life and relatively _____ absorption cross section.

A. short; large

B. short; small

C. long; large

D. long; small

QUESTION: 59

A reactor has been operating at 50 percent power for a week when power is quickly ramped (over 4 hours) to 100 percent. How will the xenon concentration in the core respond?

A. Decreases initially, then builds to a new equilibrium concentration in 8 to 10 hours.

B. Increases steadily to a new equilibrium concentration in 20 to 30 hours.

C. Decreases initially, then builds to a new equilibrium concentration in 40 to 50 hours.

D. Increases steadily to a new equilibrium concentration in 60 to 70 hours.

QUESTION: 60

Two identical reactors are operating at power. Reactor "A" is at 50 percent power and reactor "B" is at 100 percent power. Both reactors trip/scram at the same time. Which statement describes post-trip/scram Xenon behavior?

A. Xenon will peak first in reactor "A".

B. Xenon will peak first in reactor "B".

C. Xenon will peak in both reactors at the same time.

D. Xenon will not peak in either reactor; it will simply decay away.

QUESTION: 61

Xenon oscillations that tend to DAMPEN themselves toward equilibrium over time are _____ oscillations.

A. converging

B. diverging

C. diffusing

D. transitioning

QUESTION: 62

Four hours after a reactor trip from equilibrium full power operation, the reactor is taken critical and power is immediately stabilized for critical data. In order to maintain a CONSTANT reactor power, the operator must add _____ reactivity because xenon concentration is _____.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

QUESTION: 63

A reactor that has been operating at rated power for about two weeks is reduced in power to 50 percent. What happens to the Xe-135 concentration in the core?

A. There will be no change because iodine concentration is constant.

B. Xenon will initially build up, then decrease to a new equilibrium value.

C. Xenon will initially decrease, then build up to a new equilibrium value.

D. Xenon will steadily decrease to a new equilibrium value.

QUESTION: 64

The plant is operating at EOL with a full-power boron concentration of 15 ppm. After the refueling, the full-power boron concentration is approximately 1,200 ppm. Which of the following is the reason for the necessary INCREASE in boron concentration?

A. Xenon concentration in the core at EOL is much greater than at BOL.

B. Differential boron worth at EOL is much greater than at BOL. [IBW at EOL is significantly smaller than at BOL.]

C. The excess reactivity in the core at BOL is much greater than at EOL.

D. The integral control rod (CEA) worth at EOL is much greater than at BOL.

QUESTION: 65

The reactor is subcritical with a reactor startup in progress. Assuming the reactor remains subcritical, a short control rod WITHDRAWAL will cause the reactor startup rate indication to increase rapidly in the positive direction, and then:

A. gradually decrease and stabilize at zero.

B. rapidly decrease and stabilize at a negative 1/3 dpm.

C. stabilize until the POAH is reached; then decrease to zero.

D. continue a rapid increase until the POAH is reached; then decrease to zero.

QUESTION: 66

During a reactor startup, the operator adds 1,000 pcm (1.0% delta-K/K) of positive reactivity by withdrawing control rods (CEAs), thereby increasing equilibrium source range neutron level from 220 cps to 440 cps. In order to raise equilibrium source range neutron level to 880 cps, an additional _____ of positive reactivity must be added.

A. 500 pcm (0.5% delta-K/K)

B. 1000 pcm (1.0% delta-K/K)

C. 2000 pcm (2.0% delta-K\K)

D. 4000 pcm (4.0% delta-K/K)

QUESTION: 67

As criticality is approached during a reactor startup, equal insertions of positive reactivity result in a _____ absolute change in equilibrium count rate and a _____ time to reach each new equilibrium.

A. smaller; shorter

B. smaller; longer

C. greater; shorter

D. greater; longer

QUESTION: 68

In order to predict criticality, the operator must predict the amount of positive reactivity that must be added to OVERCOME the effects of:

A. Boron, moderator voids, and burnable poisons.

B. control rods (CEAs), Xenon, and moderator temperature.

C. power defect, burnable poisons, and control rods (CEAs).

D. moderator temperature, moderator voids, and Xenon.

QUESTION: 69

Which two parameters have the MOST SIGNIFICANT effect on reactivity upon reaching criticality during a reactor startup, and prior to reaching the point of adding heat?

A. Coolant temperature and rod (CEA) position

B. Coolant temperature and coolant pressure

C. Rod (CEA) position and reactor power

D. Coolant pressure and reactor power

QUESTION: 70

The plant is operating at equilibrium 50 percent power level. Control rods (CEAs) are manually withdrawn for 5 seconds. When plant parameters have stabilized:

A. coolant temperature will be higher.

B. reactor (primary) coolant system pressure will be lower.

C. reactor power will be higher.

D. pressurizer level will be lower.

QUESTION: 71

The reactor is operating at equilibrium 20 percent power. The operator withdraws rods (CEAs) as necessary to immediately establish and maintain a 0.10 DPM startup rate. How long will it take for the reactor to reach 70 percent power?

A. 2.5 minutes

B. 5.5 minutes

C. 7.5 minutes

D. 10.5 minutes

QUESTION: 72

The reactor has been operating at 75 percent power for several weeks. A partial steam line break occurs and 3 percent total steam flow is escaping. Assuming no operator or automatic actions, stable reactor power will _____ and stable reactor coolant temperature will _____.

A. increase; increase

B. not change; increase

C. increase; decrease

D. not change; decrease

QUESTION: 73

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

A. 1.0 psia

B. 1.5 psia

C. 3.0 psia

D. 15.0 psia

QUESTION: 74

Excessive heat removal from the LP turbine exhaust steam in the main condenser will result in:

A. thermal shock.

B. loss of condenser vacuum.

C. condensate depression.

D. fluid compression.

QUESTION: 75

The saturation pressure for water at 328 degrees F is:

A. 85 psig.

B. 100 psig.

C. 115 psig.

D. 130 psig.

QUESTION: 76

The reactor coolant system is being maintained at 1000 psia. A pressurizer safety/relief valve is slowly discharging to a collection tank, which is maintained at 5 psig. What is the ENTHALPY of the fluid entering the tank?

A. 1,156 BTU/lbm

B. 1,178 BTU/lbm

C. 1,193 BTU/lbm

D. 1,210 BTU/lbm

QUESTION: 77

Which of the following will cause overall plant efficiency to INCREASE?

A. Increasing total steam generator blowdown from 30 gpm to 40 gpm.

B. Changing steam quality from 99.7 percent to 99.9 percent.

C. Bypassing a feedwater heater during normal plant operations.

D. Increasing condenser pressure from 1 psia to 2 psia.

QUESTION: 78

Which of the following methods would INCREASE the possibility and/or severity of water hammer?

A. Venting fluid systems prior to starting a pump.

B. Starting a pump with the discharge valve fully open.

C. Starting a pump with the discharge valve fully closed.

D. Opening and closing system valves slowly.

QUESTION: 79

A centrifugal pump is being returned to service after maintenance. The operator FAILS to vent the pump properly. When the pump is started the operator should see _____ capacity and _____ discharge head.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

QUESTION: 80

The MAJOR effect of operating centrifugal pumps in PARALLEL is:

A. increased system pressure.

B. increased system flow rate.

C. decreased system pressure.

D. decreased system flow rate.

QUESTION: 81

Flow instruments used to measure the mass flow rate of saturated steam are density compensated because, for a steam pressure increase at a constant volumetric flow rate, steam density will _____ and the actual mass flow rate will _____.

A. decrease; increase

B. increase; decrease

C. increase; increase

D. decrease; decrease

QUESTION: 82

During operation of a positive displacement pump, the MOST DESIRABLE method of decreasing system flow rate is to:

A. throttle the pump discharge valve.

B. throttle the pump suction valve.

C. decrease the pump NPSH.

D. decrease the pump speed.

QUESTION: 83

The transfer of heat from the reactor fuel to the fuel cladding during normal operations is an example of _____ heat transfer.

A. conduction

B. convection

C. radiant

D. two-phase

QUESTION: 84

As fluid flow rate INCREASES through the tubes of a shell-and-tube heat exchanger, the laminar film thickness _____, which causes heat transfer rate to _____.

A. increases; increase

B. increases; decrease

C. decreases; increase

D. decreases; decrease

QUESTION: 85

The reactor coolant enters the core at 545 degrees F and leaves at 595 degrees F. If the reactor coolant flow rate is 6.6×10^7 lbm/hr and the specific heat capacity of the coolant is 1.3 BTU/lbm-degree F, what is the core thermal power? (1 watt = 3.4127 BTU/hr)

A. 967 MWt

B. 1,160 MWt

C. 1,257 MWt

D. 1,508 MWt

QUESTION: 86

Which characteristic will ENHANCE steam bubble formation as heat is transferred to a liquid adjacent to a heating surface.

A. Surface scratches or cavities in the heating surface

B. Material dissolved in the bulk of the liquid

C. The absence of dissolved gases in the liquid

D. A tightly adherent and smooth oxide layer on the heating surface

QUESTION: 87

Which of the following describes departure from nucleate boiling?

A. Steam bubbles begin to blanket the fuel rod, causing a rapid increase in the delta-T between the fuel rod and the coolant.

B. Steam bubbles completely blanket the fuel rod, causing an increase in the heat flux from the fuel rod.

C. Steam bubbles begin to blanket the fuel rod, causing a rapid decrease in the delta-T between the fuel rod and the coolant.

D. Steam bubbles begin to form on the surface of the fuel rod, causing an increase in the heat flux from the fuel rod.

QUESTION: 88

Which parameter change will reduce the departure from nucleate boiling ratio (DNBR)?

A. Decrease reactor power.

B. Increase pressurizer pressure.

C. Increase reactor coolant flow.

D. Increase reactor coolant temperature.

QUESTION: 89

In the definition of the departure from nucleate boiling ratio (DNBR), the term ACTUAL HEAT FLUX refers to the:

A. heat transfer rate per unit area at any point along the fuel rod.

B. heat transfer rate along the entire fuel rod.

C. average heat transfer rate per unit area across the core.

D. total heat transferred along the fuel rod.

QUESTION: 90

The difference between the actual temperature and the saturation temperature of a liquid is the:

A. critical heat flux.

B. subcooling margin.

C. departure from nucleate boiling.

D. saturation margin.

QUESTION: 91

Assuming that reactor power remains constant at 30 percent, if reactor coolant flow decreases by 10 percent, FUEL temperature will:

A. increase, then stabilize at a higher value.

B. decrease, then stabilize at a lower value.

C. increase, then return to the original steady-state value.

D. decrease, then return to the original steady-state value.

QUESTION: 92

Which of the following must exist for natural circulation flow to occur?

A. The heat source must be located higher than the heat sink.

B. The heat source must be larger than the heat sink.

C. The heat sink must be located higher than the heat source.

D. The heat sink must be larger than the heat source.

QUESTION: 93

Natural circulation flow rate will be GREATER when:

A. all reactor coolant pumps run for an hour after a reactor trip, and then stop.

B. two reactor coolant pumps run for an hour after a reactor trip, and then stop.

C. one reactor coolant pump runs for an hour after a reactor trip, and then stops.

D. reactor coolant pumps stop at the same time the reactor trips.

QUESTION: 94

If the reactor is operated within core thermal limits, then:

A. plant thermal efficiency is optimized.

B. fuel cladding integrity is ensured.

C. pressurized thermal shock will be prevented.

D. reactor vessel thermal stresses will be minimized.

QUESTION: 95

During full power operation, critical heat flux (CHF) is MOST LIKELY to occur in a:

A. centrally located fuel assembly with flow restrictions.

B. centrally located fuel assembly without flow restrictions.

C. peripherally located fuel assembly with flow restrictions.

D. peripherally located fuel assembly without flow restrictions.

QUESTION: 96

Brittle fracture is the fragmentation of metal resulting from the application of _____ stress at relatively _____ temperatures.

A. compressive; high

B. compressive; low

C. tensile; high

D. tensile; low

QUESTION: 97

Reactor cooldown rate limitations are procedurally established to prevent:

A. excessive reactivity additions.

B. brittle fracture of the reactor vessel.

C. impurities from precipitating out of solution in the reactor vessel.

D. excessive reactor coolant system subcooling.

QUESTION: 98

Prolonged exposure of the reactor vessel to a fast neutron flux will cause the reference temperature for nil ductility transition (RTNDT) to:

A. increase due to the creation of flaws.

B. decrease due to the creation of flaws.

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

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

QUESTION: 99

Pressurized thermal shock is a condition that can occur following a _____ of the reactor coolant system (RCS) if RCS pressure is rapidly _____.

A. cooldown; decreased

B. cooldown; increased

C. heatup; decreased

D. heatup; increased

QUESTION: 100

A heatup stress applied to the reactor vessel is:

A. compressive at the inner wall, tensile at the outer wall.

B. tensile at the inner wall, compressive at the outer wall.

C. tensile across the entire wall.

D. compressive across the entire wall.

ENCLOSURE 2

GENERIC FUNDAMENTALS EXAMINATION SECTION (GFES)

PRESSURIZED WATER REACTOR

FORM B

ENCLOSURE 2

FEBRUARY 1990 PWR GFE - FORM B ANSWER KEY

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

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 the ID-Number you were given at registration.

(4) Fill in your start and stop times at the appropriate time.

(5) Three handouts are provided for your use during the examination, an Equations and Conversions sheet, instructions for filling out the answer sheet, and Steam Table booklets.

(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) Any questions about an item on the examination should be directed to the examiner only.

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

(10) 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.

(11) 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.

(12) Turn in your examination materials, answer sheet on top, followed by the exam booklet, then examination aids - steam table booklets, handouts and scrap paper used during the examination.

(13) After turning in your examination materials, leave the examination area, as defined by the examiner. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

EQUATION SHEET

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

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

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

$Pwr = W_f \dot{m}$

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

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

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

---

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

1 hp $= 2.54 \times 10^3$ BTU/hr

1 BTU $= 778$ ft-lbf

°C $= 5/9$ (°F - 32)

1 kg $= 2.21$ lbm

1 Mw $= 3.41 \times 10^6$ BTU/hr

°F $= 9/5$ °C + 32

QUESTION: 1

When determining shutdown margin for an operating reactor, how many control rods (CEAs) are assumed to remain FULLY withdrawn?

A. A single control rod (CEA) of the highest reactivity worth

B. A symmetrical pair of control rods (CEAs) of the highest reactivity worth

C. A single control rod (CEA) of average reactivity worth

D. A symmetrical pair of control rods (CEAs) of average reactivity worth

QUESTION: 2

A reactor at end of life has been shutdown from 100 percent power and cooled down to 140 degrees F over three days. During the cooldown, Boron concentration was increased by 100 ppm. Given the following absolute values of reactivities added during the cooldown, assign a (+) or (-) as appropriate and choose the current value of SHUTDOWN MARGIN.

Xenon = (-) 2.675% delta-K/K

Temperature = (+) 0.500% delta-K/K

Power Defect = (-) 1.575% delta-K/K

Rods = (-) 6.918% delta-K/K

Boron = (-) 1.040% delta-K/K

A. -3.208% delta-K/K

B. -8.558% delta-K/K

C. -1.128% delta-K/K

D. -6.358% delta-K/K

QUESTION: 3

Which one of the following plant parameter changes will result in an INCREASE in shutdown margin for a shutdown reactor at end of core life?

A. RCS boron concentration is increased by 100 ppm.

B. One control rod (CEA) is fully withdrawn for a test.

C. Xenon has decayed for 72 hours following shutdown.

D. RCS is cooled down by 300 degrees F.

QUESTION: 4

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical reactor is dependent on the _____ and _____.

A. prompt neutron lifetime; axial flux distribution

B. prompt neutron lifetime; control rod (CEA) position

C. average effective decay constant; average delayed neutron fraction

D. average effective decay constant; axial flux distribution

QUESTION: 5

Delayed neutrons contribute more to reactor stability than prompt neutrons because they _____ the average neutron generation time and are born at a _____ kinetic energy.

A. increase; lower

B. decrease; higher

C. increase; higher

D. decrease; lower

QUESTION: 6

During core physics testing, reactor coolant temperature should be held as stable as possible. This will MINIMIE the effects of _____ on reactivity measurements.

A. xenon concentration

B. control rod (CEA) worth

C. reactor coolant inventory

D. moderator temperature coefficient

QUESTION: 7

Under which of the following conditions is a reactor core most likely to have a POSITIVE moderator temperature coefficient?

A. High coolant temperature at end-of-life

B. High coolant temperature at beginning-of-life

C. Low coolant temperature at end-of-life

D. Low coolant temperature at beginning-of-life

QUESTION: 8

During a plant heatup (with an initial negative moderator temperature coefficient), the moderator temperature coefficient becomes increasingly more NEGATIVE. This is because:

A. as moderator density decreases, more thermal neutrons are absorbed by the moderator than by the fuel.

B. the change in the thermal utilization factor dominates the change in the resonance escape probability.

C. a greater density change per degree F occurs at higher reactor coolant temperatures.

D. the core transitions from an under-moderated condition to an over-moderated condition.

QUESTION: 9

Which one of the following groups contain parameters that, if varied, will each have a DIRECT effect on the power coefficient?

A. Control rod (CEA) position, reactor power, moderator voids

B. Moderator temperature, RCS pressure, Xenon level.

C. Fuel temperature, xenon level, control rod (CEA) position

D. Moderator voids, fuel temperature, moderator temperature

QUESTION: 10

The reactor is exactly critical below the point of adding heat. Control rods (CEAs) are withdrawn to establish a 0.5 dpm startup rate. Reactor power will increase:

A. and stabilize at a value above the point of adding heat.

B. temporarily, then stabilize at the original value.

C. and stabilize at a value below the point of adding heat.

D. continuously until control rods (CEAs) are reinserted.

QUESTION: 11

A comparison of the heat flux in the hottest coolant channel to the average heat flux in the core describes:

A. a core correction calibration factor.

B. a hot channel/peaking factor.

C. a heat flux normalizing factor.

D. an axial/radial flux deviation factor.

QUESTION: 12

The plant is operating at equilibrium 100 percent power level at BOL with all control rods (CEAs) fully withdrawn. If control rods (CEAs) are partially INSERTED, the axial neutron flux will shift toward _____ of the reactor.

A. the top

B. the middle

C. the bottom

D. both the top and the bottom

QUESTION: 13

Which of the following is NOT a consideration in establishing control rod (CEA) insertion limits?

A. Maximize control rod (CEA) maneuvering capability.

B. Ensure minimum shutdown margin available. ✓

C. Minimize the worth of an ejected control rod. ✓

D. Maintain allowable power distribution. ✓

QUESTION: 14

The TWO characteristics of Xe-135 that result in it being a MAJOR reactor poison is its relatively _____ half-life and relatively _____ absorption cross section.

A. short; large

B. short; small

C. long; large

D. long; small

QUESTION: 15

A reactor has been operating at 50 percent power for a week when power is quickly ramped (over 4 hours) to 100 percent. How will the xenon concentration in the core respond?

A. Decreases initially, then builds to a new equilibrium concentration in 8 to 10 hours.

B. Increases steadily to a new equilibrium concentration in 20 to 30 hours.

C. Decreases initially, then builds to a new equilibrium concentration in 40 to 50 hours.

D. Increases steadily to a new equilibrium concentration in 60 to 70 hours.

QUESTION: 16

Two identical reactors are operating at power. Reactor "A" is at 50 percent power and reactor "B" is at 100 percent power. Both reactors trip/scram at the same time. Which statement describes post-trip/scram Xenon behavior?

A. Xenon will peak first in reactor "A".

B. Xenon will peak first in reactor "B".

C. Xenon will peak in both reactors at the same time.

D. Xenon will not peak in either reactor; it will simply decay away.

QUESTION: 17

Xenon oscillations that tend to <u>DAMPEN</u> themselves toward equilibrium over time are _____ oscillations.

A. converging

B. diverging

C. diffusing

D. transitioning

QUESTION: 18

Four hours after a reactor trip from equilibrium full power operation, the reactor is taken critical and power is immediately stabilized for critical data. In order to maintain a CONSTANT reactor power, the operator must add _____ reactivity because xenon concentration is _____.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

QUESTION: 19

A reactor that has been operating at rated power for about two weeks is reduced in power to 50 percent. What happens to the Xe-135 concentration in the core?

A. There will be no change because iodine concentration is constant.

B. Xenon will initially build up, then decrease to a new equilibrium value.

C. Xenon will initially decrease, then build up to a new equilibrium value.

D. Xenon will steadily decrease to a new equilibrium value.

QUESTION: 20

The plant is operating at EOL with a full-power boron concentration of 15 ppm. After the refueling, the full-power boron concentration is approximately 1,200 ppm. Which of the following is the reason for the necessary INCREASE in boron concentration?

A. Xenon concentration in the core at EOL is much greater than at BOL.

B. Differential boron worth at EOL is much greater than at BOL. [IBW at EOL is significantly smaller than at BOL.]

C. The excess reactivity in the core at BOL is much greater than at EOL.

D. The integral control rod (CEA) worth at EOL is much greater than at BOL.

QUESTION: 21

The reactor is subcritical with a reactor startup in progress. Assuming the reactor remains subcritical, a short control rod WITHDRAWAL will cause the reactor startup rate indication to increase rapidly in the positive direction, and then:

A. gradually decrease and stabilize at zero.

B. rapidly decrease and stabilize at a negative 1/3 dpm.

C. stabilize until the POAH is reached; then decrease to zero.

D. continue a rapid increase until the POAH is reached; then decrease to zero.

QUESTION: 22

During a reactor startup, the operator adds 1,000 pcm (1.0% delta-K/K) of positive reactivity by withdrawing control rods (CEAs), thereby increasing equilibrium source range neutron level from 220 cps to 440 cps. In order to raise equilibrium source range neutron level to 880 cps, an additional _____ of positive reactivity must be added.

A. 500 pcm (0.5% delta-K/K)

B. 1000 pcm (1.0% delta-K/K)

C. 2000 pcm (2.0% delta-K\K)

D. 4000 pcm (4.0% delta-K/K)

QUESTION: 23

As criticality is approached during a reactor startup, equal insertions of positive reactivity result in a _____ absolute change in equilibrium count rate and a _____ time to reach each new equilibrium.

A. smaller; shorter

B. smaller; longer

C. greater; shorter

D. greater; longer

QUESTION: 24

In order to predict criticality, the operator must predict the amount of positive reactivity that must be added to OVERCOME the effects of:

A. Boron, moderator voids, and burnable poisons.

B. control rods (CEAs), Xenon, and moderator temperature.

C. power defect, burnable poisons, and control rods (CEAs).

D. moderator temperature, moderator voids, and Xenon.

QUESTION: 25

Which two parameters have the MOST SIGNIFICANT effect on reactivity upon reaching criticality during a reactor startup, and prior to reaching the point of adding heat?

A. Coolant temperature and rod (CEA) position

B. Coolant temperature and coolant pressure

C. Rod (CEA) position and reactor power

D. Coolant pressure and reactor power

QUESTION: 26

The plant is operating at equilibrium 50 percent power level. Control rods (CEAs) are manually withdrawn for 5 seconds. When plant parameters have stabilized:

A. coolant temperature will be higher.

B. reactor (primary) coolant system pressure will be lower.

C. reactor power will be higher.

D. pressurizer level will be lower.

QUESTION: 27

The reactor is operating at equilibrium 20 percent power. The operator withdraws rods (CEAs) as necessary to immediately establish and maintain a 0.10 DPM startup rate. How long will it take for the reactor to reach 70 percent power?

A. 2.5 minutes

B. 5.5 minutes

C. 7.5 minutes

D. 10.5 minutes

QUESTION: 28

The reactor has been operating at 75 percent power for several weeks. A partial steam line break occurs and 3 percent total steam flow is escaping. Assuming no operator or automatic actions, stable reactor power will _____ and stable reactor coolant temperature will _____.

A. increase; increase

B. not change; increase

C. increase; decrease

D. not change; decrease

QUESTION: 29

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

A. 1.0 psia

B. 1.5 psia

C. 3.0 psia

D. 15.0 psia

QUESTION: 30

Excessive heat removal from the LP turbine exhaust steam in the main condenser will result in:

A. thermal shock.

B. loss of condenser vacuum.

C. condensate depression.

D. fluid compression.

QUESTION: 31

The saturation pressure for water at 328 degrees F is:

A. 85 psig.

B. 100 psig.

C. 115 psig.

D. 130 psig.

QUESTION: 32

The reactor coolant system is being maintained at 1000 psia. A pressurizer safety/relief valve is slowly discharging to a collection tank, which is maintained at 5 psig. What is the ENTHALPY of the fluid entering the tank?

A. 1,156 BTU/lbm

B. 1,178 BTU/lbm

C. 1,193 BTU/lbm

D. 1,210 BTU/lbm

QUESTION: 33

Which of the following will cause overall plant efficiency to INCREASE?

A. Increasing total steam generator blowdown from 30 gpm to 40 gpm.

B. Changing steam quality from 99.7 percent to 99.9 percent.

C. Bypassing a feedwater heater during normal plant operations.

D. Increasing condenser pressure from 1 psia to 2 psia.

QUESTION: 34

Which of the following methods would INCREASE the possibility and/or severity of water hammer?

A. Venting fluid systems prior to starting a pump.

B. Starting a pump with the discharge valve fully open.

C. Starting a pump with the discharge valve fully closed.

D. Opening and closing system valves slowly.

QUESTION: 35

A centrifugal pump is being returned to service after maintenance. The operator FAILS to vent the pump properly. When the pump is started the operator should see _____ capacity and _____ discharge head.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

QUESTION: 36

The MAJOR effect of operating centrifugal pumps in PARALLEL is:

A. increased system pressure.

B. increased system flow rate.

C. decreased system pressure.

D. decreased system flow rate.

QUESTION: 37

Flow instruments used to measure the mass flow rate of saturated steam are density compensated because, for a steam pressure increase at a constant volumetric flow rate, steam density will _____ and the actual mass flow rate will_____.

A. decrease; increase

B. increase; decrease

C. increase; increase

D. decrease; decrease

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

QUESTION: 38

During operation of a positive displacement pump, the MOST DESIRABLE method of decreasing system flow rate is to:

A. throttle the pump discharge valve.

B. throttle the pump suction valve.

C. decrease the pump NPSH.

D. decrease the pump speed.

QUESTION: 39

The transfer of heat from the reactor fuel to the fuel cladding during normal operations is an example of __________ heat transfer.

A. conduction

B. convection

C. radiant

D. two-phase

QUESTION: 40

As fluid flow rate <u>INCREASES</u> through the tubes of a shell-and-tube heat exchanger, the laminar film thickness ____________, which causes heat transfer rate to ____________.

A. increases; increase

B. increases; decrease

C. decreases; increase

D. decreases; decrease

QUESTION: 41

The reactor coolant enters the core at 545 degrees F and leaves at 595 degrees F. If the reactor coolant flow rate is 6.6 x 10 lbm/hr and the specific heat capacity of the coolant is 1.3 BTU/lbm-degree F, what is the core thermal power? (1 watt = 3.4127 BTU/hr)

A. 967 MWt

B. 1,160 MWt

C. 1,257 MWt

D. 1,508 MWt

QUESTION: 42

Which characteristic will ENHANCE steam bubble formation as heat is transferred to a liquid adjacent to a heating surface.

A. Surface scratches or cavities in the heating surface

B. Material dissolved in the bulk of the liquid

C. The absence of dissolved gases in the liquid

D. A tightly adherent and smooth oxide layer on the heating surface

QUESTION: 43

Which of the following describes departure from nucleate boiling?

A. Steam bubbles begin to blanket the fuel rod, causing a rapid increase in the delta-T between the fuel rod and the coolant.

B. Steam bubbles completely blanket the fuel rod, causing an increase in the heat flux from the fuel rod.

C. Steam bubbles begin to blanket the fuel rod, causing a rapid decrease in the delta-T between the fuel rod and the coolant.

D. Steam bubbles begin to form on the surface of the fuel rod, causing an increase in the heat flux from the fuel rod.

QUESTION: 44

Which parameter change will reduce the departure from nucleate boiling ratio (DNBR)?

A. Decrease reactor power.

B. Increase pressurizer pressure.

C. Increase reactor coolant flow.

D. Increase reactor coolant temperature.

QUESTION: 45

In the definition of the departure from nucleate boiling ratio (DNBR), the term ACTUAL HEAT FLUX refers to the:

A. heat transfer rate per unit area at any point along the fuel rod.

B. heat transfer rate along the entire fuel rod.

C. average heat transfer rate per unit area across the core.

D. total heat transferred along the fuel rod.

QUESTION: 46

The difference between the actual temperature and the saturation temperature of a liquid is the:

A. critical heat flux.

B. subcooling margin.

C. departure from nucleate boiling.

D. saturation margin.

QUESTION: 47

Assuming that reactor power remains constant at 30 percent, if reactor coolant flow decreases by 10 percent, FUEL temperature will:

A. increase, then stabilize at a higher value.

B. decrease, then stabilize at a lower value.

C. increase, then return to the original steady-state value.

D. decrease, then return to the original steady-state value.

QUESTION: 48

Which of the following must exist for natural circulation flow to occur?

A. The heat source must be located higher than the heat sink.

B. The heat source must be larger than the heat sink.

C. The heat sink must be located higher than the heat source.

D. The heat sink must be larger than the heat source.

QUESTION: 49

Natural circulation flow rate will be GREATER when:

A. all reactor coolant pumps run for an hour after a reactor trip, and then stop.

B. two reactor coolant pumps run for an hour after a reactor trip, and then stop.

C. one reactor coolant pump runs for an hour after a reactor trip, and then stops.

D. reactor coolant pumps stop at the same time the reactor trips.

QUESTION: 50

If the reactor is operated within core thermal limits, then:

A. plant thermal efficiency is optimized.

B. fuel cladding integrity is ensured.

C. pressurized thermal shock will be prevented.

D. reactor vessel thermal stresses will be minimized.

QUESTION: 51

During full power operation, critical heat flux (CHF) is MOST LIKELY to occur in a:

A. centrally located fuel assembly with flow restrictions.

B. centrally located fuel assembly without flow restrictions.

C. peripherally located fuel assembly with flow restrictions.

D. peripherally located fuel assembly without flow restrictions.

QUESTION: 52

Brittle fracture is the fragmentation of metal resulting from the application of _____ stress at relatively _____ temperatures.

A. compressive; high

B. compressive; low

C. tensile; high

D. tensile; low

QUESTION: 53

Reactor cooldown rate limitations are procedurally established to prevent:

A. excessive reactivity additions.

B. brittle fracture of the reactor vessel.

C. impurities from precipitating out of solution in the reactor vessel.

D. excessive reactor coolant system subcooling.

QUESTION: 54

Prolonged exposure of the reactor vessel to a fast neutron flux will cause the reference temperature for nil ductility transition (RTNDT) to:

A. increase due to the creation of flaws.

B. decrease due to the creation of flaws..

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

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

QUESTION: 55

Pressurized thermal shock is a condition that can occur following a _____ of the reactor coolant system (RCS) if RCS pressure is rapidly _____.

A. cooldown; decreased

B. cooldown; increased

C. heatup; decreased

D. heatup; increased

QUESTION: 56

A heatup stress applied to the reactor vessel is:

A. compressive at the inner wall, tensile at the outer wall.

B. tensile at the inner wall, compressive at the outer wall.

C. tensile across the entire wall.

D. compressive across the entire wall.

QUESTION: 57

Operators should use BOTH hands on valve handwheels when positioning manual valves to:

A. overcome the resistance of installed locking devices.

B. control the rate of valve motion to prevent water hammer.

C. ensure system pressure, temperature, and flow are controlled during valve motion.

D. control lateral force to prevent bending the valve stem.

QUESTION: 58

The DIFFERENCE between the pressure at which a safety/relief valve begins to open and the pressure at which it is fully open is called:

A. accumulation.

B. blowdown.

C. setpoint tolerance.

D. setpoint deviation.

QUESTION: 59

Refer to the figure below for the following question.

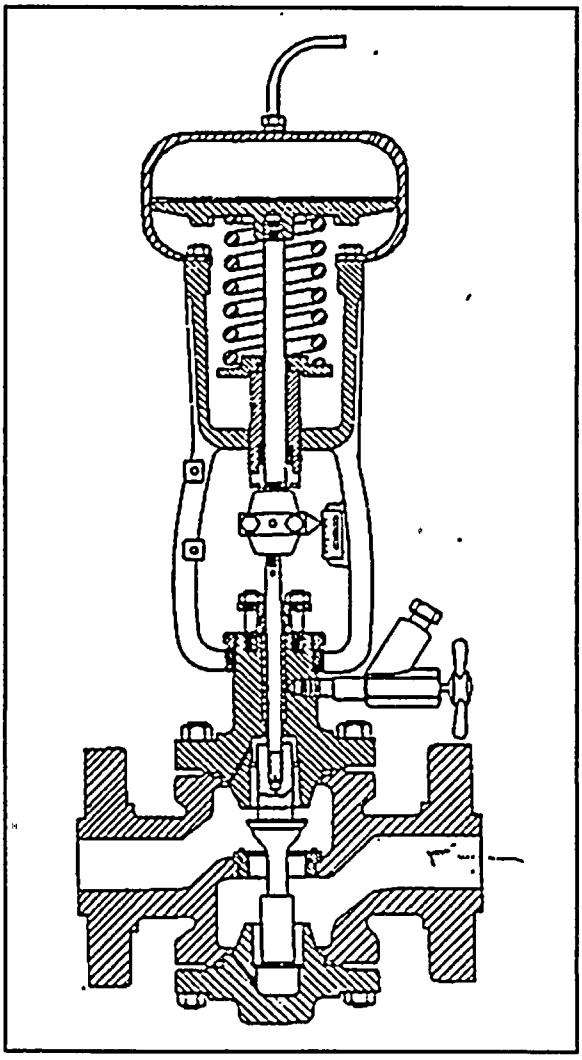
Following a loss of controlling air pressure, the spring-loaded valve will fail:

A. open.

B. as is.

C. closed.

D. to mid-position.



QUESTION: 60

The manual declutch lever of a motor-operated valve _____ the motor and _____ the handwheel.

A. disengages; engages

B. deenergizes; engages

C. engages; disengages

D. reenergizes; disengages

QUESTION: 61

To verify the position of a FULLY-OPEN manual valve, the operator should:

A. fully close the valve, then reopen it to the fully open position.

B. open the valve until it touches the backseat, then close it to the desired position.

C. operate the valve in the open direction until the valve is backseated one-half turn.

D. operate the valve in the closed direction, then reopen the valve to its previous open position.

QUESTION: 62

The most probable cause for fluctuating indication from a liquid flow rate differential pressure detector is:

A. gas or steam being trapped in the liquid.

B. the valve on the equalizing line being open.

C. the valve on the low pressure sensing line being closed.

D. the valve on the high pressure sensing line being closed.

QUESTION: 63

A differential pressure (D/P) cell is being used to measure flow rate in a cooling water system. Flow rate is indicating 75 percent of scale. If the D/P cell diaphram ruptures, INDICATED flow rate will:

A. go to 0 percent.

B. go to 100 percent (full-scale).

C. remain the same.

D. move slowly to 50 percent (mid-scale).

QUESTION: 64

A differential pressure level transmitter, with its reference leg vented to atmosphere, was calibrated for use on an open tank at 100 degrees F. If mass in the tank remains constant and the temperature is raised to 200 degrees F, the INDICATED level will:

A. remain the same although actual level increases.

B. increase but remain less than actual level.

C. decrease but remain greater than actual level.

D. increase in direct proportion to the temperature rise.

QUESTION: 65

Which one of the following failures of a wet reference leg differential pressure (D/P) level transmitter will cause its level indicator to indicate the LOWEST level?

A. The D/P cell diaphragm ruptures.

B. The reference leg ruptures.

C. The variable leg ruptures.

D. The equalizing line ruptures.

QUESTION: 66

A simple bellows pressure detector is located in the reactor containment with its low pressure side vented to the containment. If a main steam break raises containment pressure by 40 psig, the associated pressure indication (disregarding any temperature effect on the bellows) will:

A. increase by the square root of 40 psig.

B. increase by 40 psig.

C. decrease by 40 psig.

D. stay constant.

QUESTION: 67

A bourdon-tube pressure detector that is indicating 50 percent of scale is suddenly exposed to a pressure transient that extends the detector 75 percent beyond its upper-range value. Actual pressure returns to its original value. Assuming the detector remains intact, the affected pressure indication will initially go off-scale high, and then:

A. become unpredictable until the instrument is calibrated.

B. return to a pressure less than original pressure.

C. return to original pressure.

D. return to a pressure greater than original pressure.

QUESTION: 68

A resistance temperature detector (RTD) operates on the principle that a change in metal resistance is _____proportional to the change in _____.

A. directly; metal temperature

B. directly; metal temperature squared

C. inversely; metal temperature

D. inversely; metal temperature squared

QUESTION: 69

An open circuit in a thermocouple causes the affected temperature indication to fail:

A. high.

B. low.

C. to reference junction temperature.

D. as is.

QUESTION: 70

Most of the electrons collected in a fission chamber are released as a result of ionizations caused DIRECTLY by:

A. fission fragments.

B. fission gammas.

C. fission betas.

D. fissionable materials.

QUESTION: 71

Which of the following describes the reason for the HIGH SENSITIVITY of a Geiger-Mueller tube radiation detector?

A. Changes in applied detector voltage have little effect on detector output.

B. Geiger-Mueller tubes are longer than other radiation detector types.

C. Any incident radiation event causing primary ionization results in ionization of the entire detector.

D. Geiger-Mueller tubes are capable of operating at relatively high detector voltages, allowing detection of low energy radiation.

QUESTION: 72

Which of the following statements describes the use of a self-reading pocket dosimeter (SRPD)?

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

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

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

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

QUESTION: 73

The range of values around the setpoint of a measured variable where NO ACTION occurs in an automatic flow controller is called:

A. deviation.

B. error.

C. deadband.

D. bias.

QUESTION: 74

The governor of an emergency diesel generator (D/G) DIRECTLY senses D/G _____ and adjusts D/G _____ flow to maintain a relatively constant D/G frequency.

A. load, air

B. speed, fuel

C. load, fuel

D. speed, air

QUESTION: 75

The output pressure of a pneumatic controller is typically insufficient to drive a valve actuator accurately. To overcome this problem, a control loop would NORMALLY employ a:

A. valve actuating lead/lag unit.

B. pressure regulator.

C. valve positioner.

D. filter drive unit.

QUESTION: 76

When shifting from automatic to manual valve control, the manual and automatic controller output signals should be MATCHED to:

A. prevent a sudden valve repositioning upon the transfer.

B. satisfy the control transfer interlocks.

C. move the valve to the new position prior to the transfer.

D. prevent the controller from locking up due to a large deviation.

QUESTION: 77

Which of the following changes in pump operating parameters will <u>DIRECTLY</u> lead to pump cavitation in a centrifugal pump that is operating in a closed-loop system?

A. Steadily increasing pump inlet temperature.

B. Steadily decreasing pump flow rate (by reducing pump speed).

C. Steadily increasing pump suction pressure.

D. Steadily increasing pump discharge pressure.

QUESTION: 78

The presence of air in a pump casing may result in _____ when the pump is started.

A. vortexing

B. pump runout

C. head loss

D. gas binding

QUESTION: 79

Failure to provide adequate minimum flow for a centrifugal pump can DIRECTLY result in:

A. discharge piping overpressurization.

B. suction piping overpressurization.

C. excessive pump leakoff.

D. pump overheating.

QUESTION: 80

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

A. at runout conditions.

B. at operating conditions.

C. accelerating to normal speed during start.

D. at shutoff head.

QUESTION: 81

Many larger centrifugal pumps are started with their discharge valves CLOSED in order to prevent:

A. loss of recirculation (miniflow).

B. overloading the pump motor.

C. cavitation in the pump.

D. lifting the discharge relief valve.

QUESTION: 82

An increase in positive displacement pump speed will cause the available net positive suction head for the pump to:

A. decrease due to the increase in fluid flow.

B. decrease due to the increase in fluid discharge pressure.

C. increase due to the increase in fluid discharge pressure.

D. increase due to the increase in fluid flow.

QUESTION: 83

The following are indications of a locked reactor (primary) coolant pump rotor <u>EXCEPT</u>:

A. reactor (primary) coolant system pressure transient.

B. peak reactor (primary) coolant pump amps with possible breaker trip.

C. decreased flow rate in unaffected loop(s).

D. low reactor (primary) coolant system flow trip.

QUESTION: 84

A centrifugal pump has a flow rate of 3,000 gpm and a current requirement of 200 amps. If the speed is reduced such that the flow rate is 2,000 gpm, what is the final CURRENT requirement at the new lower speed? (Assume a constant motor voltage.)

A. 59 amps

B. 89 amps

C. 133 amps

D. 150 amps

QUESTION: 85

Excessive AC motor current can be caused DIRECTLY by operating the motor:

A. completely unloaded.

B. at full load.

C. with open-circuited windings.

D. with short-circuited windings.

QUESTION: 86

Which of the following describes the motor current indications that would be observed during the start of a large AC motor at FULL load?

A. Amps slowly increase to the full-load value.

B. Amps increase immediately to the full-load value.

C. Amps increase immediately to approximately twice the full-load value and then decrease to the normal full-load value.

D. Amps increase immediately to more than three times the full-load value and then decrease to the normal full-load value.

QUESTION: 87

Which of the following is the reason for LIMITING the number of motor starts in a given time period?

A. Minimizes pitting of starter contacts

B. Prevents excessive torsional stresses on motor shaft

C. Prevents overheating of motor windings

D. Minimizes axial stresses on motor bearings

QUESTION: 88

Refer to the figure below for the following question. All valves are identical and are initially 50 percent open.

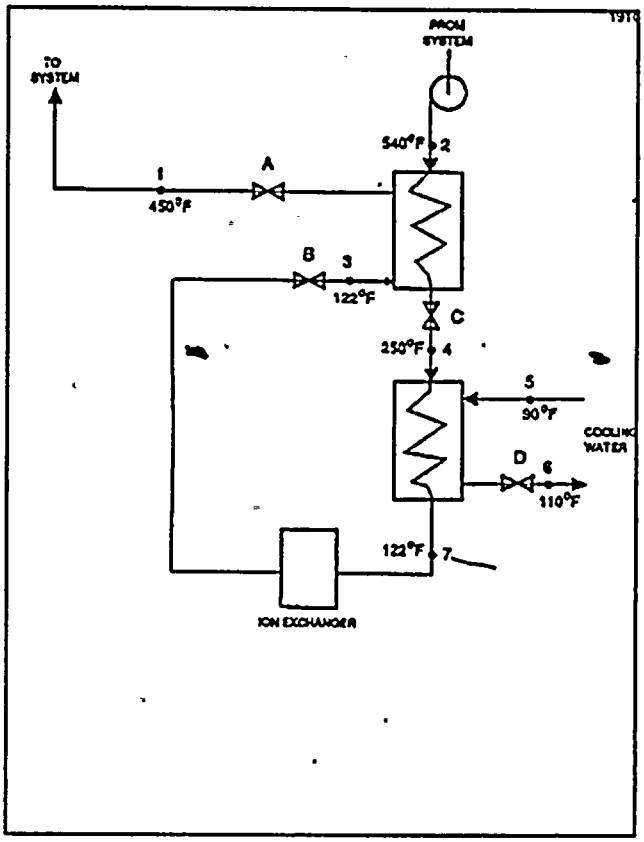
To LOWER the temperature at point 7, the operator should adjust valve _____ in the OPEN direction.

A. A

B. B

C. C

D. D



QUESTION: 89

The MAJOR thermodynamic concern resulting from RAPIDLY cooling a pressure vessel is:

A. loss of subcooling margin.

B. thermal shock.

C. loss of shutdown margin.

D. condensation.

QUESTION: 90

Refer to the figure below for the following question.

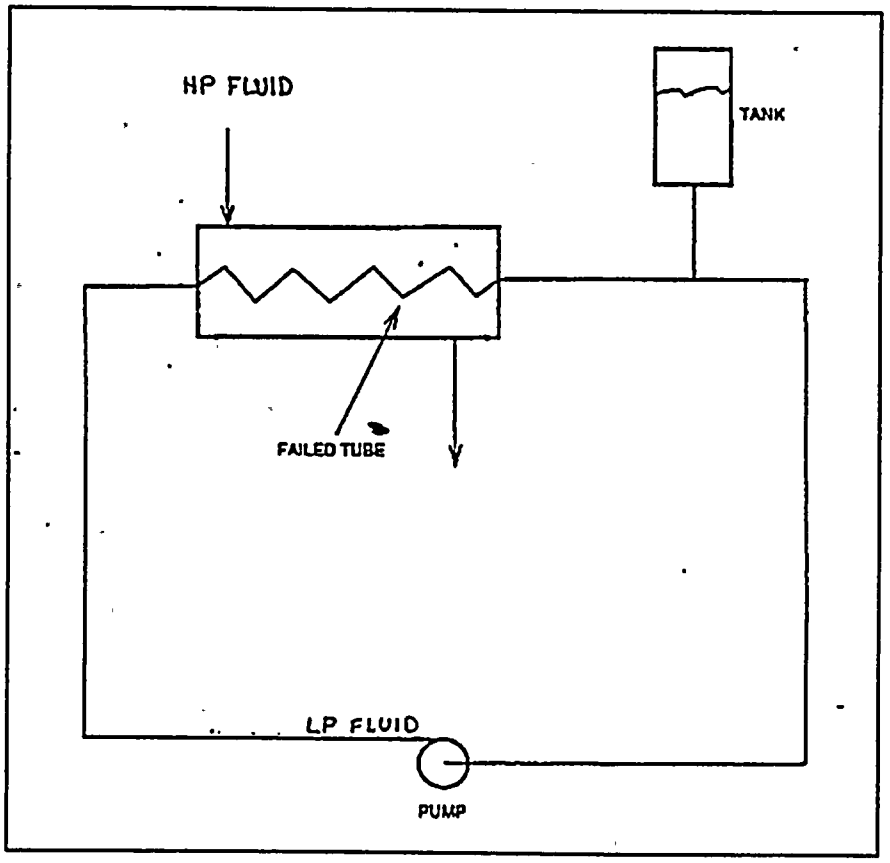
Which of the following effects would occur as a result of a tube FAILURE in the heat exchanger?

A. High pressure fluid inventory increases.

B. Flow in the low pressure system reverses.

C. Temperature in the low pressure system increases.

D. Level in the tank increases.



QUESTION: 91

When a mixed-bed demineralizer resin is exhausted, the resin should be replaced or regenerated because:

A. the resin will physically bond together, thereby causing a flow blockage.

B. ions previously removed by the resin will be released to solution.

C. the resin will fracture and possibly escape through the retention screens.

D. particles previously filtered out of solution will be released.

QUESTION: 92

A demineralizer that has been exposed to _____ should be bypassed because the resin beads may decompose.

A. high temperature

B. low flow

C. low temperature

D. high flow

QUESTION: 93

A demineralizer is BORON SATURATED when:

A. the demineralizer discharges large amounts of boron into the reactor coolant.

B. the demineralizer absorbs greater than 200 ppm boron per hour.

C. the demineralizer boron removal rate decreases rapidly.

D. outlet temperature of the demineralizer begins to increase rapidly.

QUESTION: 94

During maintenance activities, breakers in the open position are TAGGED and RACKED OUT to:

A. deenergize components and associated control and indication circuits.

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

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

D. permit immediate availability of the breaker if required for emergency use.

QUESTION: 95

While locally investigating the condition of a large circuit breaker, the operator observes the following indications:

- OPEN/CLOSED mechanical flag indication indicates open.
- OPEN/CLOSED indicating lights indicate open.
- Overcurrent trip flags are actuated on all phases.
- Load-side voltmeter indicates zero volts.
- Load-side ammeter indicates zero amperes.

Based on these indications, the operator should report that the circuit breaker is open, racked _____, with _____ condition indicated.

A. in, overload

B. in, no overload

C. out, overload

D. out, no overload

QUESTION: 96

Which of the following would cause a loss of ability to remotely trip a circuit breaker AND a loss of position indication?

A. Loss of breaker control power

B. Failure of breaker control switch

C. Mechanical binding of breaker

D. Breaker in "test" position

QUESTION: 97

Closing the output breaker of the main generator with the frequency of the generator HIGHER than grid frequency will result in the generator:

A. behaving as a real load to the grid.

B. behaving as a reactive load to the grid.

C. picking up a portion of the grid real load (MWe).

D. picking up a portion of the grid reactive load (MVAR).

QUESTION: 98

Which of the following generator conditions is MOST LIKELY to cause generator damage because of high current?

A. Tripping the output breaker under full-load conditions

B. Tripping the generator prime mover under full-load conditions

C. Closing the output breaker on a bus that has an open-circuit fault

D. Closing the output breaker on a bus that has a short-circuit fault

QUESTION: 99

The function of high voltage electrical disconnects is to:

A. isolate equipment electrically during no-load conditions.

B. isolate equipment electrically during overload conditions.

C. protect circuits during overcurrent conditions.

D. protect circuits during undervoltage conditions.

QUESTION: 100

The following indications are observed for a breaker in the control room.

- Red (energized) (closed) indicating light "off"

- Green (de-energized) (open) indicating light "off"

- Load amps indicate normal load current

Assuming one of the indicating lights is burnt out, what is the condition of the breaker?

A. Open and racked in

B. Shut and racked in

C. Open and racked to "test" position

D. Shut and racked to "test"