UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406

OCT 2 6 1989

Docket No. 50-309

Maine Yankee Atomic Power Company
ATTN: Mr. M. Evringham
Training Manager
83 Edison Drive
Augusta, Maine 04336

Dear Mr. Evringham:

On October 4, 1989, the NRC administered the 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 from your facility who took the examination. Please forward the results and answer sheet to the examinees. A "P" in the column labeled Final Grade 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 NRC's Public Document Room (PDR). The results for individual examinees are exempt from disclosure, therefore, enclosures (3) and (4) will not be placed in the PDR.

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

Sincerely,

Robert M. Gallo, Chief
Operations Branch
Division of Reactor Safety

Enclosures:
1. Examination Form "A" with answers
2. Examination Form "B" with answers
3. Examination Results Summary for facility
4. Copies of Candidates individual asswer sheets

OFFICIAL RECORD COPY

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1/1

cc w/o enclosures:
C. D. Frizzle, President
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OL Facility File

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RI:DRS	RI:DRS	RI:DRS
Curley	Eselgroth	Gallo
10/23/89	10/26/89	10/26/89

Encl I

ANSWER KEY

PWR GFE (FORM A)

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

Pressurized Water Reactor Generic Fundamentals Examination administered October 4, 1989. Questions 14, 39 and 56 were deleted.

Enclosure 1

UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION

Please Print:

Name: _____

Facility: _____

ID Number: _____

INSTRUCTIONS TO CANDIDATE

Use the answer sheet provided. Each question has equal point value. The passing grades require at least 80% on this part of the written licensing examination. All examination papers will be picked up 2.5 hours after the examination starts.

SECTION	Questions	% of Total	Score
COMPONENTS	1 - 43		
REACTOR THEORY	44 - 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

FORM 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 the facility you are associated with.

(3) Fill in the ID-Number you were given at registration.

(4) 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.

(5) Use only the answer sheet provided. Credit will only be given for answers marked on this sheet. Follow the instructions for filling out the answer sheet.

(6) Scrap paper will be provided for calculations.

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

(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, please 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) Please 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.

(12) 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.

GENERIC FUNDAMETALS EXAMINATION SECTION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

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

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

$Pwr = W_f \dot{m}$

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

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

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

CONVERSIONS

1 Curie = 3.7×10^{10} dps

1 hp = 2.54×10^3 BTU/hr

1 BTU = 778 ft-lbf

°C = 5/9 (°F - 32)

1 kg = 2.21 lbm

1 Mw = 3.41×10^6 BTU/hr

°F = 9/5 °C + 32

QUESTION: 1.

The primary purpose of a pressure relief valve is to:

A. maintain system flow.

B. maintain system pressure.

C. maintain system integrity.

D. maintain system temperature.

QUESTION: 2.

When a discharge valve is opened to atmosphere, the pressure on the upstream side of the valve will:

A. remain the same, and the pressure on the downstream side will increase.

B. increase, and the pressure on the downstream side will remain the same.

C. remain the same, and the pressure on the downstream side will decrease.

D. decrease, and the pressure on the downstream side will remain the same.

QUESTION: 3.

The function of a valve backseat is to:

A. isolate system pressure from the packing and stuffing box to minimize packing leakage.

B. isolate system pressure from the packing and stuffing box for the purpose of valve repacking.

C. provide a backup means of flow isolation in the event of primary seat leakage.

D. provide a backup means of flow isolation in the event of a pipe break.

QUESTION: 4.

After manually positioning a motor-operated valve, how is the valve actuator re-engaged?

A. Actuation of the torque switch

B. Manually pulling up on the manual declutch lever

C. Actuation of either the full-open or full-closed limit switch

D. Actuation of the valve actuator motor in either the open or close direction

QUESTION: 5.

To verify the position of a closed manual valve, the operator should operate the valve:

A. to the fully open position, then reclose it using normal force.

B. in the closed direction using normal force.

C. in the open direction until flow sounds are heard, then close the valve using manual force.

D. in the closed direction until it stops, then close it an additional one-half turn using normal force.

QUESTION: 6.

Density compensation is used in flow instruments to change _____ to _____.

A. mass flow rate, volumetric flow rate

B. volumetric flow rate, mass flow rate

C. fluid pressure, volumetric flow rate

D. differential pressure, mass flow rate

QUESTION: 7.

If the liquid flowing through a liquid flow rate sensor contains entrained voids (gas or steam), indicated flow rate will be:

A. erroneously high.

B. erroneously low.

C. unaffected.

D. fluctuating.

QUESTION: 8.

If the equalizing line on a differential pressure (D/P) flow detector is opened, the flow detector indication will:

A. increase slightly.

B. decrease slightly.

C. go to zero.

D. not change.

QUESTION: 9.

Flow detectors (such as an orifice, flow nozzle, and venturi tube) measure flow rate using the principle that flow rate is:

A. **DIRECTLY** proportional to the differential pressure.

B. **INVERSELY** proportional to the differential pressure.

C. **DIRECTLY** proportional to the square root of the differential pressure.

D. **INVERSELY** proportional to the square root of the differential pressure.

QUESTION: 10.

The pressure differential between a reference leg and a variable leg is:

A. **DIRECTLY** proportional to the height of the variable leg.

B. **INVERSELY** proportional to the height of the variable leg.

C. **DIRECTLY** proportional to the density of the reference leg.

D. **INVERSELY** proportional to the temperature of the reference leg.

QUESTION: 11.

If the reference leg of a differential pressure level indicator experiences high ambient temperature, indicated level will:

A. read less than actual level.

B. read greater than actual level.

C. equal the actual level.

D. slowly decrease to zero.

QUESTION: 12.

The level indication for a reference leg differential pressure level instrument will fail **LOW** as a result of:

A. a break on the reference leg.

B. a rupture of the diaphragm in the differential pressure cell.

C. the reference leg flashing to steam.

D. a break on the variable leg.

QUESTION: 13.

A resistance temperature detector (RTD) operates on the principle that the change in electrical resistance of:

A. two dissimilar metals is **DIRECTLY** proportional to the temperature change measured at their junction.

B. two dissimilar metals is **INVERSELY** proportional to the temperature change measured at their junction.

C. a metal is **DIRECTLY** proportional to its change in temperature.

D. a metal is **INVERSELY** proportional to its change in temperature.

QUESTION: 14.

Two differential pressure level transmitters are installed in a large tank. If transmitter I is calibrated at 200 °F and transmitter II is calibrated at 100 °F, then at 150 °F:

A. transmitter I will read greater than transmitter II.

B. transmitter II will read greater than transmitter I.

C. transmitter I and II will read the same.

D. it is impossible to predict how either transmitter will respond.

QUESTION: 15.

Scintillation detectors operate on the principle of:

A. photodisintegration.

B. photokinesis.

C. photomultiplication.

D. photoionization.

QUESTION: 16.

A BF3 proportional counter detects both neutrons and gammas. Which of the following best describes the method used to eliminate the gamma contribution from the detector output?

A. Two counters are used, one sensitive to neutron and gamma and the other sensitive to gamma only. The outputs are electrically opposed to cancel the gamma-induced currents and yield a neutron-only signal for indication use.

B. The BF3 proportional detector records neutron flux of sufficient intensity that the gamma signal is insignificant compared to the neutron signal and yields a neutron-only signal for indication use.

C. Gamma-induced detector pulses are of insufficient width to generate a significant log-level amplifier output. Neutron pulses are the only ones with sufficient width to yield a neutron-only signal for indication use.

D. Neutron-induced current pulses are significantly larger than those from gamma. The detector signal is applied to a circuit which filters out the smaller gamma pulses yielding a neutron-only signal for indication use.

QUESTION: 17.

The difference between the setpoint and the measured parameter in an automatic flow controller is called:

A. gain.

B. bias.

C. feedback.

D. error.

QUESTION: 18.

A controller's output is typically insufficient to accurately drive a valve actuator. To overcome this problem, a control loop normally employs:

A. a lead/lag unit.

B. a regulator.

C. a positioner.

D. an amplifier unit.

QUESTION: 19.

Why must an operator pay particular attention to auto/manual valve controllers left in the manual mode?

A. The manual valve control is usually not stable compared to the automatic mode.

B. The valve position will no longer respond to changes in system parameters.

C. The controlled parameters will no longer be controlled by the valve position.

D. The valve can only be operated locally during this time.

QUESTION: 20.

What precautions must be observed when transferring a valve controller from the automatic mode to manual mode of control?

A. Ensure that the proper offset is established between the automatic mode and manual mode.

B. Ensure that the valve controller output signals are matched between automatic mode and manual mode.

C. Ensure that the valve controller stabilizes in the automatic mode before completely transferring to the manual mode of control.

D. Ensure that the automatic valve controller signal is increasing before transferring to manual mode of control.

QUESTION: 21.

An indication of centrifugal pump cavitation is:

A. pump motor amps pegged high.

B. pump discharge pressure indicating zero.

C. pump motor amps oscillating.

D. pump discharge pressure indicating shutoff head.

QUESTION: 22.

The term "shutoff head" for a centrifugal pump indicates that it is pumping at:

A. maximum capacity and minimum discharge head.

B. maximum capacity and maximum discharge head.

C. minimum capacity and maximum discharge head.

D. minimum capacity and minimum discharge head.

QUESTION: 23.

Operating a motor-driven centrifugal pump for extended periods of time with no flow through the pump will cause:

A. pump failure from overspeed.

B. pump failure from overheating.

C. motor failure from overspeed.

D. motor failure from overheating.

QUESTION: 24.

SHUTTING the discharge valve on an operating centrifugal pump will cause the **MOTOR AMPS** to _____ and the pump **DISCHARGE PRESSURE** to _____.

A. increase, increase

B. decrease, increase

C. increase, decrease

D. decrease, decrease

QUESTION: 25.

If the speed of a positive displacement pump is increased, the available net positive suction head (NPSH) will _____ and the probability of cavitation will _____.

A. increase, increase

B. decrease, decrease

C. increase, decrease

D. decrease, increase

QUESTION: 26.

Reactor coolant pump motor amps will _____ if the rotor is **LOCKED** and the motor speed will _____ if the rotor **SHEARS**.

A. increase, increase

B. increase, decrease

C. decrease, increase

D. decrease, decrease

QUESTION: 27.

If the generator bearings on a motor generator overheat then:

A. the generator voltage will increase.

B. the generator windings will overheat.

C. the motor current will decrease.

D. the motor windings will overheat.

QUESTION: 28.

If the speed of a variable speed centrifugal pump is increased to cause pump flow rate to double, pump motor current will:

A. remain constant.

B. increase two-fold (double).

C. increase four-fold.

D. increase eight-fold.

QUESTION: 29.

The starting current in an A.C. motor is significantly higher than the full-load running current because:

A. starting torque is lower than running torque.

B. starting torque is higher than running torque.

C. rotor current during start is higher than running current.

D. rotor current during start is lower than running current.

QUESTION: 30.

The number of starts for an electric motor in a given period of time should be limited because:

A. overheating of the windings can occur.

B. excessive torque is generated during motor start.

C. running current is much higher than starting current.

D. motors are normally started under full load conditions.

QUESTION: 31.

Severe stress in a mechanical component, induced by a sudden, unequally distributed temperature reduction is a description of:

A. heat stress.

B. thermal shock.

C. thermal strain.

D. heat strain.

QUESTION: 32.

Tube fouling in a heat exchanger causes heat transfer to decrease by:

A. reducing fluid velocity on the shell side of the exchanger.

B. increasing flow rate through the tube side of the exchanger.

C. reducing the overall (total) heat transfer coefficient.

D. increasing the overall (total) heat transfer coefficient.

QUESTION: 33.

Borated water is flowing through the tubes of a heat exchanger being cooled by fresh water. The shell side pressure is less than tube side pressure. What will occur as a result of a tube failure?

A. Depletion of borated water inventory.

B. Depletion of cooling water inventory.

C. Dilution of the borated water system.

D. Shell pressure will decrease.

QUESTION: 34.

What is the reason for bypassing a demineralizer due to high temperature?

A. Resins expand and restrict flow through the demineralizer.

B. The demineralizer decontamination factor is dramatically increased.

C. Organic compounds used as resins will decompose.

D. The creation of preferential flowpath through the demineralizer will occur.

QUESTION: 35.

In the event of a system crud burst, what adverse effect does the crud burst have on demineralizer operation?

A. Increases pressure drop across demineralizer

B. Increases flow rate through demineralizer

C. Increases demineralizer outlet conductivity

D. Increases demineralizer inlet pH

QUESTION: 36.

Boron concentration in the reactor (primary) coolant system has been decreasing steadily at approximately 10 ppm per hour while using the deborating demineralizer. After several hours, the rate decreases to 2 ppm per hour. What is a possible cause for the change in deboration rate?

A. Temperature of the coolant passing through the demineralizer has decreased.

B. pH of the coolant has increased significantly.

C. Flow through the deborating resins has increased sharply.

D. Deborating resins have become boron saturated.

QUESTION: 37.

To de-energize a component and its associated control and indication circuits, the component circuit breaker should be:

A. racked in and tagged in open position.

B. racked in and tagged in closed position.

C. racked out and tagged in racked-out position.

D. in the test position and tagged in test.

QUESTION: 38.

To ensure reliable local breaker indication is being provided the _____ must be reset after breaker operation.

A. OPEN/CLOSED mechanical flag

B. OPEN/CLOSED indicating lights

C. Overcurrent trip flag

D. Spring CHARGE/DISCHARGE flag

QUESTION: 39.

A circuit breaker thermal overload device:

A. compares actual current to a fixed overcurrent setpoint that is equated to temperature and actuates a trip relay.

B. when subjected to high current, overheats and actuates a circuit-interrupting device.

C. senses operating equipment temperature and trips protective circuits at preset limits.

D. is an induction coil that produces a secondary current proportional to the primary current.

QUESTION: 40.

Loss of circuit breaker control power will cause:

A. breaker line voltage to be zero regardless of actual breaker position.

B. the remote breaker position to indicate closed regardless of actual breaker position.

C. inability to operate the breaker locally and remotely.

D. failure of the close spring to charge following local tripping of the breaker.

QUESTION: 41.

If a de-energized bus is not unloaded prior to closing the output breaker of a three-phase generator onto the bus, then:

A. an overvoltage condition will occur on the bus.

B. an overcurrent condition will occur on the generator.

C. an overvoltage condition will occur between generator phases.

D. generator undervoltage relay actuation will occur.

QUESTION: 42.

Which of the following statements is correct concerning the use of disconnect switches?

A. Disconnects should be limited to normal load current interruption.

B. Disconnects may be used to isolate transformers in an unloaded network.

C. Disconnects are similar to oil circuit breakers, but are manually operated.

D. Disconnects must be closed with caution when under load because of possible arcing.

QUESTION: 43.

Closing a generator output breaker with the generator frequency much less than grid frequency will cause the generator to trip on:

A. reverse power.

B. overvoltage.

C. overcurrent.

D. overspeed.

QUESTION: 44.

The operator has just pulled control rods and changed the effective multiplication factor (K_{eff}) from 0.998 to 1.002. The reactor is:

A. prompt critical

B. supercritical

C. exactly critical

D. subcritical

QUESTION: 45.

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation is the:

A. effective multiplication factor

B. fast fission factor

C. neutron non-leakage factor

D. neutron reproduction factor

QUESTION: 46.

Reactivity is defined as the:

A. fractional change in neutron population per generation.

B. number of neutrons by which neutron population changes per generation.

C. rate of change of reactor power in neutrons per second.

D. change in the number of neutrons per second that causes a fission event.

QUESTION: 47.

A given amount of positive reactivity is added to a critical reactor in the source (startup) range. The amount added is less than the average effective delayed neutron fraction. Which of the following will have a significant effect on the magnitude of the stable startup rate achieved for this addition?

A. Prompt neutron lifetime

B. Fuel temperature coefficient

C. Average effective decay constant

D. Moderator temperature coefficient

QUESTION: 48.

Over core life the production of plutonium isotopes with delayed neutron fractions _____ than uranium delayed neutron fractions will cause reactor power transients to be _____ near the end of core life.

A. less, faster

B. less, slower

C. greater, faster

D. greater, slower

QUESTION: 49.

An installed neutron source:

A. maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B. provides a means to allow reactivity changes to occur in a subcritical reactor.

C. generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D. provides a neutron level that is detectable on the source range nuclear instrumentation.

QUESTION: 50.

Why does increasing reactor coolant boron concentration cause the moderator temperature coefficient to become less negative?

A. Reactor coolant temperature increases result in a larger increase in the thermal utilization factor.

B. Reactor coolant temperature increases result in an increase in the resonance escape probability.

C. Reactor coolant temperature increases result in an increase in the total non-leakage probability.

D. The change in resonance escape probability dominates the change in the thermal utilization factor.

QUESTION: 51.

Why does the fuel temperature (Doppler) coefficient becomes less negative at higher fuel temperatures?

A. As reactor power increases, the rate of increase in the fuel temperature diminishes.

B. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

C. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

D. The amount of Doppler broadening per degree change in fuel temperature diminishes.

QUESTION: 52.

A reactivity coefficient measures _____ change while a reactivity defect (deficit) measures a _____ change in reactivity due to a change in the measured parameter.

A. An integrated, total

B. A rate of, differential

C. A differential, total

D. A total, differential

QUESTION: 53.

During power operation, while changing power level, core reactivity is affected most quickly by:

A. boron concentration adjustments.

B. power defect (deficit).

C. xenon transients.

D. fuel depletion.

QUESTION: 54.

As moderator temperature increases, the magnitude of differential rod (CEA) worth increases because:

A. decreased moderator density causes more neutron leakage out of the core.

B. moderator temperature coefficient decreases, causing decreased competition.

C. fuel temperature increases, decreasing neutron absorption in fuel.

D. decreased moderator density increases neutron migration length.

QUESTION: 55.

Control rod (CEA) bank overlap:

A. provides a more uniform differential rod (CEA) worth and axial flux distribution.

B. provides a more uniform differential rod (CEA) worth and allow dampening of Xenon-induced flux oscillations.

C. ensures that all rods (CEAs) remain within the allowable tolerance between their individual position indicators and their group counters and to ensure rod (CEA) insertion limits are not exceeded.

D. ensures that all rods (CEAs) remain within their allowable tolerance between individual position indicators and their group counters and to provide a more uniform axial flux distribution.

QUESTION: 56.

The basis for the maximum power density (kw/ft) power limit is to:

A. prevent fuel clad melt.

B. prevent fuel pellet melt.

C. limit bulk coolant temperature.

D. prevent nucleate boiling.

QUESTION: 57.

The control rod insertion limits are power-level dependent because the magnitude of:

A. control rod worth decreases as power increases.

B. power defect increases as power increases.

C. Doppler (fuel temperature) coefficient decreases as power increases.

D. moderator temperature coefficient increases as power increases.

QUESTION: 58.

Fission products that have substantial neutron capture cross sections are:

A. excited fission products.

B. fission product daughter.

C. radioactive fission products.

D. fission product poisons.

QUESTION: 59.

Following a reactor trip from sustained high power operation, Xenon-135 concentration in the reactor will:

A. decrease because Xenon is produced directly from fission.

B. increase due to the decay of Iodine already in the core.

C. remain the same because the decay of Iodine and Xenon balance each other out.

D. decrease immediately, then slowly increase due to the differences in the half-lives of Iodine and Xenon.

QUESTION: 60.

Following a reactor trip from sustained high power operation, the major Xenon-135 removal process is:

A. ion exchange.

B. beta decay.

C. neutron capture.

D. alpha decay.

QUESTION: 61.

A reactor has been operating at 50 percent power for 7 days when power is ramped to 100 percent over a four hour period. The new equilibrium Xenon value will:

A. be twice the 50 percent value.

B. be less than twice the 50 percent value.

C. be more than twice the 50 percent value.

D. remain the same since it is independent of power.

QUESTION: 62.

Slow changes in axial power distribution in a reactor that has operated at a steady-state power for a long time can be caused by:

A. Xenon peaking.

B. Xenon override.

C. Xenon burnup.

D. Xenon oscillation.

QUESTION: 63.

A reactor that has been operating at rated power for about two weeks reduces power to 50 percent. Xe-135 will reach a new equilibrium condition in _____ hours.

A. 8 to 10 hours

B. 20 to 25 hours

C. 30 to 35 hours

D. 40 to 50 hours

QUESTION: 64.

The reactor is near the end of its operating cycle. In order to stay critical, power and temperature have been allowed to "coastdown." Why is boron no longer used to compensate for fuel depletion?

A. Boron concentration approaches zero and requires excessive amounts of water to dilute.

B. The differential boron worth has decreased below its useable point.

C. The boron in the coolant has been depleted due to neutron absorption.

D. "Coastdown" is preferred due to fuel conditioning limitations.

QUESTION: 65.

While withdrawing control rods during an approach to criticality, the count rate doubles. What will occur if the same amount of reactivity that caused the first doubling is added again?

A. Count rate will increase slightly.

B. Count rate will double.

C. The reactor will remain subcritical.

D. The reactor will be critical or slightly supercritical.

QUESTION: 66.

In a reactor with a source, a non-changing neutron flux over a few minutes is indicative of criticality or:

A. the point of adding heat.

B. supercriticality.

C. subcriticality.

D. equilibrium subcritical count rate.

QUESTION: 67.

At EOL, critical rod (CEA) position has been calculated for a reactor startup four hours after a trip from 100 percent power equilibrium conditions. The actual critical rod (CEA) position will be LOWER than the predicted critical rod (CEA) position if:

A. the startup is delayed until eight hours after the trip.

B. the steam dump pressure setpoint is lowered by 100 psi prior to reactor startup.

C. actual boron concentration is 10 ppm more than the assumed boron concentration.

D. one control rod (CEA) remains fully inserted during the approach to criticality.

QUESTION: 68.

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

A. 1,480 pcm (1.48% delta-k/k)

B. 1,500 pcm (1.50% delta-k/k)

C. 1,520 pcm (1.52% delta-k/k)

D. 1,540 pcm (1.54% delta-k/k)

QUESTION: 69.

If, during a reactor startup, the startup rate is constant and positive without any further reactivity addition, then the reactor is:

A. critical.

B. supercritical.

C. subcritical.

D. prompt critical.

QUESTION: 70.

Given a critical reactor operating below the point of adding heat. What reactivity effects are associated with reaching the point of adding heat?

A. There are no reactivity effects since the reactor is critical.

B. The increase in fuel temperature will begin to create a positive reactivity effect.

C. The decrease in fuel temperature will begin to create a negative reactivity effect.

D. The increase in fuel temperature will begin to create a negative reactivity effect.

QUESTION: 71.

Shortly after a reactor trip reactor power indicates 0.5 percent where a stable negative SUR is attained. Reactor power will be reduced to 0.05 percent in approximately _____ seconds.

A. 360

B. 270

C. 180

D. 90

QUESTION: 72.

The major reason boron is used in a reactor is to permit:

A. a reduction in the shutdown margin.

B. an increase in the amount of control rods (CEAs) installed.

C. an increase in core life.

D. a reduction in the effect of resonance capture.

QUESTION: 73.

An atmospheric pressure of 15 psia equals:

A. 30 psig.

B. 15 psig.

C. 5 psig.

D. 0 psig.

QUESTION: 74.

Condensate depression is defined as:

A. cooling the condensate below its saturation temperature.

B. maintaining the condensate at a constant temperature throughout the system.

C. ensuring that the condensate is below the level of the hotwell pumps.

D. cooling the condensate to the point of saturation.

QUESTION: 75.

What is the reactor coolant system subcooling for Tave = 400°F and pressurizer pressure = 1,000 psia?

A. 75°F

B. 100°F

C. 125°F

D. 145°F

QUESTION: 76.

The plant is maintained at 2,000 psia with a pressurizer temperature of 636°F. A pressurizer safety relief valve is leaking to a collection tank which is being held at 10 psig. What is the temperature of the fluid downstream of the relief valve?

A. 280°F

B. 240°F

C. 190°F

D. 170°F

QUESTION: 77.

Overall plant efficiency will **DECREASE** if:

A. the steam quality is increased by removing moisture from the steam prior to entering the turbine.

B. the temperature of the feedwater entering the steam generator is increased.

C. the amount of condensate depression (subcooling) in the main condenser is decreased.

D. the temperature of the steam at the turbine inlet is decreased.

QUESTION: 78.

The possibility of a water hammer is **MINIMIZED** by:

A. changing valve positions as rapidly as possible.

B. starting centrifugal pumps with the discharge valve fully open.

C. starting positive displacement pumps with the discharge valve closed.

D. venting systems prior to starting centrifugal pumps.

QUESTION: 79.

Cavitation in an operating pump may be caused by:

A. lowering the suction temperature.

B. throttling the pump suction valve.

C. throttling the pump discharge valve.

D. increasing the pump discharge pressure.

QUESTION: 80.

The piping system pressure change caused by suddenly stopping fluid flow is referred to as:

A. cavitation.

B. shutoff head.

C. water hammer.

D. flow head.

QUESTION: 81.

If a flow measuring instrument is **NOT** density compensated, then indicated mass flow rate will be:

A the same as actual mass flow rate with a change in temperature of the fluid.

B. greater than actual mass flow rate with a decrease in temperature of the fluid.

C. less than actual mass flow rate with a decrease in temperature of the fluid.

D. less than actual mass flow rate with an increase in temperature of the fluid.

QUESTION: 82.

Operating two pumps in parallel instead of operating a single pump will result in:

A. a large increase in system head and the same flow rate.

B. the same system head and a small increase in flow rate.

C. a small increase in system head and a large increase in flow rate.

D. a decrease in system head and a large increase in flow rate.

QUESTION: 83.

Excessive amounts of entrained gases passing through a single-phase (liquid) heat exchanger is **UNDESIRABLE** because:

A. flow blockage can occur in the heat exchanger.

B. the laminar layer will increase in the heat exchanger.

C. the heat transfer coefficient will increase in the heat exchanger.

D. the temperature difference across the tubes will decrease through the heat exchanger.

QUESTION: 84.

In a two-loop pressurized water reactor, feedwater flow to each steam generator is 3.3 x 10 lbm/hr at an enthalpy of 419 BTU/lbm. The steam exiting each steam generator is at 800 psia with 100% steam quality. Ignoring blowdown and pump heat, what is the core thermal power?

A. 3,411 MWt

B. 2,915 MWt

C. 2,212 MWt

D. 1,509 MWt

QUESTION: 85.

Why does nucleate boiling improve heat transfer in the core?

A. The formation of steam bubbles at nucleation sites on the fuel clad allows more heat to be transferred by conduction.

B. Heat is removed from the fuel rod as both sensible heat and latent heat of vaporization, and the motion of the steam bubbles cause rapid mixing of the coolant.

C. Heat is removed from the fuel rod as both sensible heat and latent heat of condensation, and the heat is transferred directly to the coolant by radiative heat transfer.

D. The formation of steam bubbles at nucleation sites on the fuel clad reduces coolant flow in that area and allows more heat to be transferred by convection.

QUESTION: 86.

Subcooled nucleate boiling is occurring along a heated surface. The heat flux is then increased slightly. What will be the effect on the delta-T between the surface and the fluid?

A. Large increase in delta-T because of steam blanketing

B. Large increase in delta-T causing radiative heat transfer to become significant

C. Small increase in delta-T because of steam blanketing

D. Small increase in delta-T as vapor bubbles form and collapse

QUESTION: 87.

What parameter change would move the plant farther away from the critical heat flux?

A. Decrease pressurizer pressure

B. Decrease reactor coolant flow

C. Decrease reactor power

D. Increase reactor coolant temperature

QUESTION: 88.

Film boiling is:

A. heat transfer through a vapor blanket that covers the fuel cladding.

B. heat transfer being accomplished with no phase change.

C. the most efficient method of boiling heat transfer.

D. heat transfer through an oxide film on the cladding.

QUESTION: 89.

The departure from nucleate boiling ratio (DNBR) is defined as:

A. the actual heat flux divided by the critical heat flux at any point along a fuel rod.

B. the critical heat flux divided by the actual heat flux at any point along a fuel rod.

C. the core thermal power divided by the total reactor coolant mass flow rate.

D. the number of coolant channels that have reached DNB divided by the number of coolant channels that are subcooled.

QUESTION: 90.

The reactor coolant subcooling margin will be <u>DIRECTLY REDUCED</u> by: (Evaluate each change separately.)

A. increased pressurizer pressure.

B. increased pressurizer level.

C. increased reactor coolant flow.

D. increased reactor coolant temperature.

QUESTION: 91.

Maximizing the elevation difference between the core thermal center and the steam generator thermal centers and minimizing flow restrictions in the reactor coolant system (RCS) piping are plant designs to:

A. minimize the reactor coolant system volume.

B. maximize the reactor coolant system flow rate during forced circulation.

C. ensure a maximum RCS loop transit time.

D. ensure RCS natural circulation flow can be established.

QUESTION: 92.

With the RCS subcooled and all RCPs stopped, the natural circulation flow rate will NOT be affected by an increase in the:

A. reactor coolant pressure increase.

B. time after reactor trip.

C. steam generator level increase.

D. steam generator pressure decrease.

QUESTION: 93.

If departure from nucleate boiling (DNB) is reached in the core, the surface temperature of the fuel clad will:

A. increase rapidly.

B. decrease rapidly.

C. increase gradually.

D. decrease gradually.

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.

Fast neutron irradiation of the reactor vessel results in _____ stresses within the vessel metal, thereby _____ the Nil-Ductility Transition Temperature.

A. increased, increasing

B. increased, decreasing

C. decreased, increasing

D. decreased, decreasing

QUESTION: 96.

The likelihood of brittle fracture failure of the reactor vessel is <u>REDUCED</u> by:

A. increasing vessel age.

B. reducing vessel pressure.

C. reducing vessel temperature.

D. reducing gamma flux exposure.

QUESTION: 97.

Pressure stress on the reactor vessel wall is:

A. compressive across the entire wall.

B. tensile across the entire wall.

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

D. compressive at the inner all, tensile at the outer wall.

QUESTION: 98.

The nil-ductility temperature is that temperature:

A. below which the probability of brittle fracture significantly increases.

B. where failure stress becomes greater than the yield stress of the metal.

C. below which the probability of plastic deformation significantly increases.

D. below which the yield stress of the metal is higher than the critical fracture stress.

QUESTION: 99.

Pressurized thermal shock could most likely be a concern during:

A. an uncontrolled cooldown followed by a rapid repressurization.

B. an uncontrolled depressurization followed by a rapid repressurization.

C. an uncontrolled cooldown followed by a rapid depressurization.

D. an overpressurization from a low-temperature, low-pressure condition.

QUESTION: 100.

During a severe overcooling transient, a major concern to the operator is:

A. accelerated zirconium hydriding.

B. loss of reactor vessel water level.

C. loss of reactor coolant pump net positive suction head.

D. brittle fracture of the reactor vessel.

Enclosure 2

ANSWER KEY
PWR GFE (FORM B)

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

Pressurized Water Reactor Generic Fundamentals Examination administered October 4, 1989. Questions 42, 57 and 84 were deleted.

Enclosure 2

UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION

Please Print:

Name: _____

Facility: _____

ID Number: _____

INSTRUCTIONS TO CANDIDATE

Use the answer sheet provided. Each question has equal point value. The passing grades require at least 80% on this part of the written licensing examination. All examination papers will be picked up 2.5 hours after the examination starts.

SECTION	Questions	% of Total	Score
THERMODYNAMICS	1 - 28		
COMPONENTS	29 - 71		
REACTOR THEORY	72 - 100		
TOTALS	100		

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

_____

Candidate's Signature

FORM 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 the facility you are associated with.

(3) Fill in the ID-Number you were given at registration.

(4) 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.

(5) Use only the answer sheet provided. Credit will only be given for answers marked on this sheet. Follow the instructions for filling out the answer sheet.

(6) Scrap paper will be provided for calculations.

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

(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, please 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) Please 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.

(12) 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.

GENERIC FUNDAMETALS EXAMINATION SECTION
EQUATIONS AND CONVERSIONS HANDOUT SHEET

EQUATIONS

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

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

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

$SUR = 26.06/\tau$

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

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

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

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

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

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

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

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

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

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

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

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

$Pwr = W_f \dot{m}$

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

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

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

CONVERSIONS

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.

An atmospheric pressure of 15 psia equals:

A. 30 psig.

B. 15 psig.

C. 5 psig.

D. 0 psig.

QUESTION: 2.

Condensate depression is defined as:

A. cooling the condensate below its saturation temperature.

B. maintaining the condensate at a constant temperature throughout the system.

C. ensuring that the condensate is below the level of the hotwell pumps.

D. cooling the condensate to the point of saturation.

QUESTION: 3.

What is the reactor coolant system subcooling for Tave = 400°F and pressurizer pressure = 1,000 psia?

A. 75°F

B. 100°F

C. 125°F

D. 145°F

QUESTION: 4.

The plant is maintained at 2,000 psia with a pressurizer temperature of 626°F. A pressurizer safety relief valve is leaking to a collection tank which is being held at 10 psig. What is the temperature of the fluid downstream of the relief valve?

A. 280°F

B. 240°F

C. 190°F

D. 170°F

QUESTION: 5.

Overall plant efficiency will **DECREASE** if:

A. the steam quality is increased by removing moisture from the steam prior to entering the turbine.

B. the temperature of the feedwater entering the steam generator is increased.

C. the amount of condensate depression (subcooling) in the main condenser is decreased.

D. the temperature of the steam at the turbine inlet is decreased.

QUESTION: 6.

The possibility of a water hammer is **MINIMIZED** by:

A. changing valve positions as rapidly as possible.

B. starting centrifugal pumps with the discharge valve fully open.

C. starting positive displacement pumps with the discharge valve closed.

D. venting systems prior to starting centrifugal pumps.

QUESTION: 7.

Cavitation in an operating pump may be caused by:

A. lowering the suction temperature.

B. throttling the pump suction valve.

C. throttling the pump discharge valve.

D. increasing the pump discharge pressure.

QUESTION: 8.

The piping system pressure change caused by suddenly stopping fluid flow is referred to as:

A. cavitation.

B. shutoff head.

C. water hammer.

D. flow head.

QUESTION: 9.

If a flow measuring instrument is **NOT** density compensated, then indicated mass flow rate will be:

A. the same as actual mass flow rate with a change in temperature of the fluid.

B. greater than actual mass flow rate with a decrease in temperature of the fluid.

C. less than actual mass flow rate with a decrease in temperature of the fluid.

D. less than actual mass flow rate with an increase in temperature of the fluid.

QUESTION: 10.

Operating two pumps in parallel instead of operating a single pump will result in:

A. a large increase in system head and the same flow rate.

B. the same system head and a small increase in flow rate.

C. a small increase in system head and a large increase in flow rate.

D. a decrease in system head and a large increase in flow rate.

QUESTION: 11.

Excessive amounts of entrained gases passing through a single-phase (liquid) heat exchanger is **UNDESIRABLE** because:

A. flow blockage can occur in the heat exchanger.

B. the laminar layer will increase in the heat exchanger.

C. the heat transfer coefficient will increase in the heat exchanger.

D. the temperature difference across the tubes will decrease through the heat exchanger.

QUESTION: 12.

In a two-loop pressurized water reactor, feedwater flow to each steam generator is 3.3 x 10 lbm/hr at an enthalpy of 419 BTU/lbm. The steam exiting each steam generator is at 800 psia with 100% steam quality. Ignoring blowdown and pump heat, what is the core thermal power?

A. 3,411 MWt

B. 2,915 MWt

C. 2,212 MWt

D. 1,509 MWt

QUESTION: 13.

Why does nucleate boiling improve heat transfer in the core?

A. The formation of steam bubbles at nucleation sites on the fuel clad allows more heat to be transferred by conduction.

B. Heat is removed from the fuel rod as both sensible heat and latent heat of vaporization, and the motion of the steam bubbles cause rapid mixing of the coolant.

C. Heat is removed from the fuel rod as both sensible heat and latent heat of condensation, and the heat is transferred directly to the coolant by radiative heat transfer.

D. The formation of steam bubbles at nucleation sites on the fuel clad reduces coolant flow in that area and allows more heat to be transferred by convection.

QUESTION: 14.

Subcooled nucleate boiling is occurring along a heated surface. The heat flux is then increased slightly. What will be the effect on the delta-T between the surface and the fluid?

A. Large increase in delta-T because of steam blanketing

B. Large increase in delta-T causing radiative heat transfer to become significant

C. Small increase in delta-T because of steam blanketing

D. Small increase in delta-T as vapor bubbles form and collapse

QUESTION: 15.

What parameter change would move the plant farther away from the critical heat flux?

A. Decrease pressurizer pressure

B. Decrease reactor coolant flow

C. Decrease reactor power

D. Increase reactor coolant temperature

QUESTION: 16.

Film boiling is:

A. heat transfer through a vapor blanket that covers the fuel cladding.

B. heat transfer being accomplished with no phase change.

C. the most efficient method of boiling heat transfer.

D. heat transfer through an oxide film on the cladding.

QUESTION: 17.

The departure from nucleate boiling ratio (DNBR) is defined as:

A. the actual heat flux divided by the critical heat flux at any point along a fuel rod.

B. the critical heat flux divided by the actual heat flux at any point along a fuel rod.

C. the core thermal power divided by the total reactor coolant mass flow rate.

D. the number of coolant channels that have reached DNB divided by the number of coolant channels that are subcooled.

QUESTION: 18.

The reactor coolant subcooling margin will be **DIRECTLY REDUCED** by: (Evaluate each change separately.)

A. increased pressurizer pressure.

B. increased pressurizer level.

C. increased reactor coolant flow.

D. increased reactor coolant temperature.

QUESTION: 19.

Maximizing the elevation difference between the core thermal center and the steam generator thermal centers and minimizing flow restrictions in the reactor coolant system (RCS) piping are plant designs to:

A. minimize the reactor coolant system volume.

B. maximize the reactor coolant system flow rate during forced circulation.

C. ensure a maximum RCS loop transit time.

D. ensure RCS natural circulation flow can be established.

QUESTION: 20.

With the RCS subcooled and all RCPs stopped, the natural circulation flow rate will NOT be affected by an increase in the:

A. reactor coolant pressure increase.

B. time after reactor trip.

C. steam generator level increase.

D. steam generator pressure decrease.

QUESTION: 21.

If departure from nucleate boiling (DNB) is reached in the core, the surface temperature of the fuel clad will:

A. increase rapidly.

B. decrease rapidly.

C. increase gradually.

D. decrease gradually.

QUESTION: 22.

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: 23.

Fast neutron irradiation of the reactor vessel results in _____ stresses within the vessel metal, thereby _____ the Nil-Ductility Transition Temperature.

A. increased, increasing

B. increased, decreasing

C. decreased, increasing

D. decreased, decreasing

QUESTION: 24.

The likelihood of brittle fracture failure of the reactor vessel is <u>REDUCED</u> by:

A. increasing vessel age.

B. reducing vessel pressure.

C. reducing vessel temperature.

D. reducing gamma flux exposure.

QUESTION: 25.

Pressure stress on the reactor vessel wall is:

A. compressive across the entire wall.

B. tensile across the entire wall.

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

D. compressive at the inner all, tensile at the outer wall.

QUESTION: 26.

The nil-ductility temperature is that temperature:

A. below which the probability of brittle fracture significantly increases.

B. where failure stress becomes greater than the yield stress of the metal.

C. below which the probability of plastic deformation significantly increases.

D. below which the yield stress of the metal is higher than the critical fracture stress.

QUESTION: 27.

Pressurized thermal shock could most likely be a concern during:

A. an uncontrolled cooldown followed by a rapid repressurization.

B. an uncontrolled depressurization followed by a rapid repressurization.

C. an uncontrolled cooldown followed by a rapid depressurization.

D. an overpressurization from a low-temperature, low-pressure condition.

QUESTION: 28.

During a severe overcooling transient, a major concern to the operator is:

A. accelerated zirconium hydriding.

B. loss of reactor vessel water level.

C. loss of reactor coolant pump net positive suction head.

D. brittle fracture of the reactor vessel.

QUESTION: 29.

The primary purpose of a pressure relief valve is to:

A. maintain system flow.

B. maintain system pressure.

C. maintain system integrity.

D. maintain system temperature.

QUESTION: 30.

When a discharge valve is opened to atmosphere, the pressure on the upstream side of the valve will:

A. remain the same, and the pressure on the downstream side will increase.

B. increase, and the pressure on the downstream side will remain the same.

C. remain the same, and the pressure on the downstream side will decrease.

D. decrease, and the pressure on the downstream side will remain the same.

QUESTION: 31.

The function of a valve backseat is to:

A. isolate system pressure from the packing and stuffing box to minimize packing leakage.

B. isolate system pressure from the packing and stuffing box for the purpose of valve repacking.

C. provide a backup means of flow isolation in the event of primary seat leakage.

D. provide a backup means of flow isolation in the event of a pipe break.

QUESTION: 32.

After manually positioning a motor-operated valve, how is the valve actuator re-engaged?

A. Actuation of the torque switch

B. Manually pulling up on the manual declutch lever

C. Actuation of either the full-open or full-closed limit switch

D. Actuation of the valve actuator motor in either the open or close direction

QUESTION: 33.

To verify the position of a closed manual valve, the operator should operate the valve:

A. to the fully open position, then reclose it using normal force.

B. in the closed direction using normal force.

C. in the open direction until flow sounds are heard, then close the valve using manual force.

D. in the closed direction until it stops, then close it an additional one-half turn using normal force.

QUESTION: 34.

Density compensation is used in flow instruments to change _____ to _____.

A. mass flow rate, volumetric flow rate

B. volumetric flow rate, mass flow rate

C. fluid pressure, volumetric flow rate

D. differential pressure, mass flow rate

QUESTION: 35.

If the liquid flowing through a liquid flow rate sensor contains entrained voids (gas or steam), indicated flow rate will be:

A. erroneously high.

B. erroneously low.

C. unaffected.

D. fluctuating.

QUESTION: 36.

If the equalizing line on a differential pressure (D/P) flow detector is opened, the flow detector indication will:

A. increase slightly.

B. decrease slightly.

C. go to zero.

D. not change.

QUESTION: 37.

Flow detectors (such as an orifice, flow nozzle, and venturi tube) measure flow rate using the principle that flow rate is:

A. **DIRECTLY** proportional to the differential pressure.

B. **INVERSELY** proportional to the differential pressure.

C. **DIRECTLY** proportional to the square root of the differential pressure.

D. **INVERSELY** proportional to the square root of the differential pressure.

QUESTION: 38.

The pressure differential between a reference leg and a variable leg is:

A. **DIRECTLY** proportional to the height of the variable leg.

B. **INVERSELY** proportional to the height of the variable leg.

C. **DIRECTLY** proportional to the density of the reference leg.

D. **INVERSELY** proportional to the temperature of the reference leg.

QUESTION: 39.

If the reference leg of a differential pressure level indicator experiences high ambient temperature, indicated level will:

A. read less than actual level.

B. read greater than actual level.

C. equal the actual level.

D. slowly decrease to zero.

QUESTION: 40.

The output for a reference leg differential pressure level instrument will fail **LOW** as a result of:

A. a break on the reference leg.

B. a rupture of the diaphragm in the differential pressure cell.

C. the reference leg flashing to steam.

D. a break on the variable leg.

QUESTION: 41.

A resistance temperature detector (RTD) operates on the principle that the change in electrical resistance of:

A. two dissimilar metals is **DIRECTLY** proportional to the temperature change measured at their junction.

B. two dissimilar metals is **INVERSELY** proportional to the temperature change measured at their junction.

C. a metal is **DIRECTLY** proportional to its change in temperature.

D. a metal is **INVERSELY** proportional to its change in temperature.

QUESTION: 42.

Two differential pressure level transmitters are installed in a large tank. If transmitter I is calibrated at 200 degrees F and transmitter II is calibrated at 100 degrees F, then at 150 degrees F:

A. transmitter I will read greater than transmitter II.

B. transmitter II will read greater than transmitter I.

C. transmitter I and II will read the same.

D. it is impossible to predict how either transmitter will respond.

QUESTION: 43.

Scintillation detectors operate on the principle of:

A. photodisintegration.

B. photokinesis.

C. photomultiplication.

D. photoionization.

QUESTION: 44.

A BF3 proportional counter detects both neutrons and gammas. Which of the following best describes the method used to eliminate the gamma contribution from the detector output?

A. Two counters are used, one sensitive to neutron and gamma and the other sensitive to gamma only. The outputs are electrically opposed to cancel the gamma-induced currents and yield a neutron-only signal for indication use.

B. The BF3 proportional detector records neutron flux of sufficient intensity that the gamma signal is insignificant compared to the neutron signal and yields a neutron-only signal for indication use.

C. Gamma-induced detector pulses are of insufficient width to generate a significant log-level amplifier output. Neutron pulses are the only ones with sufficient width to yield a neutron-only signal for indication use.

D. Neutron-induced current pulses are significantly larger than those from gamma. The detector signal is applied to a circuit which filters out the smaller gamma pulses yielding a neutron-only signal for indication use.

QUESTION: 45.

The difference between the setpoint and the measured parameter in an automatic flow controller is called:

A. gain.

B. bias.

C. feedback.

D. error.

QUESTION: 46.

A controller's output is typically insufficient to accurately drive a valve actuator. To overcome this problem, a control loop normally employs:

A. a lead/lag unit.

B. a regulator.

C. a positioner.

D. an amplifier unit.

QUESTION: 47.

Why must an operator pay particular attention to auto/manual valve controllers left in the manual mode?

A. The manual valve control is usually not stable compared to the automatic mode.

B. The valve position will no longer respond to changes in system parameters.

C. The controlled parameters will no longer be controlled by the valve position.

D. The valve can only be operated locally during this time.

QUESTION: 48.

What precautions must be observed when transferring a valve controller from the automatic mode to manual mode of control?

A. Ensure that the proper offset is established between the automatic mode and manual mode.

B. Ensure that the valve controller output signals are matched between automatic mode and manual mode.

C. Ensure that the valve controller stabilizes in the automatic mode before completely transferring to the manual mode of control.

D. Ensure that the automatic valve controller signal is increasing before transferring to manual mode of control.

QUESTION: 49.

An indication of centrifugal pump cavitation is:

A. pump motor amps pegged high.

B. pump discharge pressure indicating zero.

C. pump motor amps oscillating.

D. pump discharge pressure indicating shutoff head.

QUESTION: 50.

The term "shutoff head" for a centrifugal pump indicates that it is pumping at:

A. maximum capacity and minimum discharge head.

B. maximum capacity and maximum discharge head.

C. minimum capacity and maximum discharge head.

D. minimum capacity and minimum discharge head.

QUESTION: 51.

Operating a motor-driven centrifugal pump for extended periods of time with no flow through the pump will cause:

A. pump failure from overspeed.

B. pump failure from overheating.

C. motor failure from overspeed.

D. motor failure from overheating.

QUESTION: 52.

SHUTTING the discharge valve on an operating centrifugal pump will cause the MOTOR AMPS to _____ and the pump DISCHARGE PRESSURE to _____.

A. increase, increase

B. decrease, increase

C. increase, decrease

D. decrease, decrease

QUESTION: 53.

If the speed of a positive displacement pump is increased, the available net positive suction head (NPSH) will _____ and the probability of cavitation will _____.

A. increase, increase

B. decrease, decrease

C. increase, decrease

D. decrease, increase

QUESTION: 54.

Reactor coolant pump motor amps will _____ if the rotor is **LOCKED** and the motor speed will _____ if the rotor **SHEARS**.

A. increase, increase

B. increase, decrease

C. decrease, increase

D. decrease, decrease

QUESTION: 55.

If the generator bearings on a motor generator overheat then:

A. the generator voltage will increase.

B. the generator windings will overheat.

C. the motor current will decrease.

D. the motor windings will overheat.

QUESTION: 56.

If the speed of a variable speed centrifugal pump is increased to cause pump flow rate to double, pump motor current will:

A. remain constant.

B. increase two-fold (double).

C. increase four-fold.

D. increase eight-fold.

QUESTION: 57.

The starting current in an A.C. motor is significantly higher than the full-load running current because:

A. starting torque is lower than running torque.

B. starting torque is higher than running torque.

C. rotor current during start is higher than running current.

D. rotor current during start is lower than running current.

QUESTION: 58.

The number of starts for an electric motor in a given period of time should be limited because:

A. overheating of the windings can occur.

B. excessive torque is generated during motor start.

C. running current is much higher than starting current.

D. motors are normally started under full load conditions.

QUESTION: 59.

Severe stress in a mechanical component, induced by a sudden, unequally distributed temperature reduction is a description of:

A. heat stress.

B. thermal shock.

C. thermal strain.

D. heat strain.

QUESTION: 60.

Tube fouling in a heat exchanger causes heat transfer to decrease by:

A. reducing fluid velocity on the shell side of the exchanger.

B. increasing flow rate through the tube side of the exchanger.

C. reducing the overall (total) heat transfer coefficient.

D. increasing the overall (total) heat transfer coefficient.

QUESTION: 61.

Borated water is flowing through the tubes of a heat exchanger being cooled by fresh water. The shell side pressure is less than tube side pressure. What will occur as a result of a tube failure?

A. Depletion of borated water inventory.

B. Depletion of cooling water inventory.

C. Dilution of the borated water system.

D. Shell pressure will decrease.

QUESTION: 62.

What is the reason for bypassing a demineralizer due to high temperature?

A. Resins expand and restrict flow through the demineralizer.

B. The demineralizer decontamination factor is dramatically increased.

C. Organic compounds used as resins will decompose.

D. The creation of preferential flowpath through the demineralizer will occur.

QUESTION: 63.

In the event of a system crud burst, what adverse effect does the crud burst have on demineralizer operation?

A. Increases pressure drop across demineralizer

B. Increases flow rate through demineralizer

C. Increases demineralizer outlet conductivity

D. Increases demineralizer inlet pH

QUESTION: 64.

Boron concentration in the reactor (primary) coolant system has been decreasing steadily at approximately 10 ppm per hour while using the deborating demineralizer. After several hours, the rate decreases to 2 ppm per hour. What is a possible cause for the change in deboration rate?

A. Temperature of the coolant passing through the demineralizer has decreased.

B. pH of the coolant has increased significantly.

C. Flow through the deborating resins has increased sharply.

D. Deborating resins have become boron saturated.

QUESTION: 65.

To de-energize a component and its associated control and indication circuits, the component circuit breaker should be:

A. racked in and tagged in open position.

B. racked in and tagged in closed position.

C. racked out and tagged in racked-out position.

D. in the test position and tagged in test.

QUESTION: 66.

To ensure reliable local breaker indication is being provided the _____ must be reset after breaker operation.

A. OPEN/CLOSED mechanical flag

B. OPEN/CLOSED indicating lights

C. Overcurrent trip flag

D. Spring CHARGE/DISCHARGE flag

QUESTION: 67.

A circuit breaker thermal overload device:

A. compares actual current to a fixed overcurrent setpoint that is equated to temperature and actuates a trip relay.

B. when subjected to high current, overheats and actuates a circuit-interrupting device.

C. senses operating equipment temperature and trips protective circuits at preset limits.

D. is an induction coil that produces a secondary current proportional to the primary current.

QUESTION: 68.

Loss of circuit breaker control power will cause:

A. breaker line voltage to be zero regardless of actual breaker position.

B. the remote breaker position to indicate closed regardless of actual breaker position.

C. inability to operate the breaker locally and remotely.

D. failure of the close spring to charge following local tripping of the breaker.

QUESTION: 69.

If a de-energized bus is not unloaded prior to closing the output breaker of a three-phase generator onto the bus, then:

A. an overvoltage condition will occur on the bus.

B. an overcurrent condition will occur on the generator.

C. an overvoltage condition will occur between generator phases.

D. generator undervoltage relay actuation will occur.

QUESTION: 70.

Which of the following statements is correct concerning the use of disconnect switches?

A. Disconnects should be limited to normal load current interruption.

B. Disconnects may be used to isolate transformers in an unloaded network.

C. Disconnects are similar to oil circuit breakers, but are manually operated.

D. Disconnects must be closed with caution when under load because of possible arcing.

QUESTION: 71.

Closing a generator output breaker with the generator frequency much less than grid frequency will cause the generator to trip on:

A. reverse power.

B. overvoltage.

C. overcurrent.

D. overspeed.

QUESTION: 72.

The operator has just pulled control rods and changed the effective multiplication factor (Keff) from 0.998 to 1.002. The reactor is:

A. prompt critical

B. supercritical

C. exactly critical

D. subcritical

QUESTION: 73.

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation is the:

A. effective multiplication factor

B. fast fission factor

C. neutron non-leakage factor

D. neutron reproduction factor

QUESTION: 74.

Reactivity is defined as the:

A. fractional change in neutron population per generation.

B. number of neutrons by which neutron population changes per generation.

C. rate of change of reactor power in neutrons per second.

D. change in the number of neutrons per second that causes a fission event.

QUESTION: 75.

A given amount of positive reactivity is added to a critical reactor in the source (startup) range. The amount added is less than the average effective delayed neutron fraction. Which of the following will have a significant effect on the magnitude of the stable startup rate achieved for this addition?

A. Prompt neutron lifetime

B. Fuel temperature coefficient

C. Average effective decay constant

D. Moderator temperature coefficient

QUESTION: 76.

Over core life the production of plutonium isotopes with delayed neutron fractions _____ than uranium delayed neutron fractions will cause reactor power transients to be _____ near the end of core life.

A. less, faster

B. less, slower

C. greater, faster

D. greater, slower

QUESTION: 77.

An installed neutron source:

A. maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B. provides a means to allow reactivity changes to occur in a subcritical reactor.

C. generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D. provides a neutron level that is detectable on the source range nuclear instrumentation.

QUESTION: 78.

Why does increasing reactor coolant boron concentration cause the moderator temperature coefficient to become less negative?

A. Reactor coolant temperature increases result in a larger increase in the thermal utilization factor.

B. Reactor coolant temperature increases result in an increase in the resonance escape probability.

C. Reactor coolant temperature increases result in an increase in the total non-leakage probability.

D. The change in resonance escape probability dominates the change in the thermal utilization factor.

QUESTION: 79.

Why does the fuel temperature (Doppler) coefficient becomes less negative at higher fuel temperatures?

A. As reactor power increases, the rate of increase in the fuel temperature diminishes.

B. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

C. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

D. The amount of Doppler broadening per degree change in fuel temperature diminishes.

QUESTION: 80.

A reactivity coefficient measures _____ change while a reactivity defect (deficit) measures a _____ change in reactivity due to a change in the measured parameter.

A. an integrated, total

B. a rate of, differential

C. a differential, total

D. a total, differential

QUESTION: 81.

During power operation, while changing power level, core reactivity is affected most quickly by:

A. boron concentration adjustments.

B. power defect (deficit).

C. xenon transients.

D. fuel depletion.

QUESTION: 82.

As moderator temperature increases, the magnitude of differential rod (CEA) worth increases because:

A. decreased moderator density causes more neutron leakage out of the core.

B. moderator temperature coefficient decreases, causing decreased competition.

C. fuel temperature increases, decreasing neutron absorption in fuel.

D. decreased moderator density increases neutron migration length.

QUESTION: 83.

Control rod (CEA) bank overlap:

A. provides a more uniform differential rod (CEA) worth and axial flux distribution.

B. provides a more uniform differential rod (CEA) worth and allows dampening of Xenon-induced flux oscillations.

C. ensures that all rods (CEAs) remain within the allowable tolerance between their individual position indicators and their group counters and ensures rod (CEA) insertion limits are not exceeded.

D. ensures that all rods (CEAs) remain within their allowable tolerance between individual position indicators and their group counters and provides a more uniform axial flux distribution.

QUESTION: 84.

The basis for the maximum power density (kw/ft) power limit is to:

A. prevent fuel clad melt.

B. prevent fuel pellet melt.

C. limit bulk coolant temperature.

D. prevent nucleate boiling.

QUESTION: 85.

The control rod insertion limits are power-level dependent because the magnitude of:

A. control rod worth decreases as power increases.

B. power defect increases as power increases.

C. Doppler (fuel temperature) coefficient decreases as power increases.

D. moderator temperature coefficient increases as power increases.

QUESTION: 86.

Fission products that have substantial neutron capture cross sections are:

A. excited fission products.

B. fission product daughter.

C radioactive fission products.

D. fission product poisons.

QUESTION: 87.

Following a reactor trip from sustained high power operation, Xenon-135 concentration in the reactor will:

A. decrease because Xenon is produced directly from fission.

B. increase due to the decay of Iodine already in the core.

C. remain the same because the decay of Iodine and Xenon balance each other out.

D. decrease immediately, then slowly increase due to the differences in the half-lives of Iodine and Xenon.

QUESTION: 88.

Following a reactor trip from sustained high power operation, the major Xenon 135 removal process is:

A. ion exchange.

B. beta decay.

C. neutron capture.

D. alpha decay.

QUESTION: 89.

A reactor has been operating at 50 percent power for 7 days when power is ramped to 100 percent over a four hour period. The new equilibrium Xenon value will:

A. be twice the 50 percent value.

B. be less than twice the 50 percent value.

C. be more than twice the 50 percent value.

D. remain the same since it is independent of power.

QUESTION: 90.

Slow changes in axial power distribution in a reactor that has operated at a steady-state power for a long time can be caused by:

A. Xenon peaking.

B. Xenon override.

C. Xenon burnup.

D. Xenon oscillation.

QUESTION: 91.

A reactor that has been operating at rated power for about two weeks reduces power to 50 percent. Xe-135 will reach a new equilibrium condition in _____ hours.

A. 8 to 10 hours

B. 20 to 25 hours

C. 30 to 35 hours

D. 40 to 50 hours

QUESTION: 92.

The reactor is near the end of its operating cycle. In order to stay critical, power and temperature have been allowed to "coastdown." Why is boron no longer used to compensate for fuel depletion?

A. Boron concentration approaches zero and requires excessive amounts of water to dilute.

B. The differential boron worth has decreased below its useable point.

C. The boron in the coolant has been depleted due to neutron absorption.

D. "Coastdown" is preferred due to fuel conditioning limitations.

QUESTION: 93.

While withdrawing control rods during an approach to criticality, the count rate doubles. What will occur if the same amount of reactivity that caused the first doubling is added again?

A. Count rate will increase slightly.

B. Count rate will double.

C. The reactor will remain subcritical.

D The reactor will be critical or slightly supercritical.

QUESTION: 94.

In a reactor with a source, a non-changing neutron flux over a few minutes is indicative of criticality or:

A. the point of adding heat.

B. supercriticality.

C. subcriticality.

D. equilibrium subcritical count rate.

QUESTION: 95.

At EOL, critical rod (CEA) position has been calculated for a reactor startup four hours after a trip from 100 percent power equilibrium conditions. The actual critical rod (CEA) position will be LOWER than the predicted critical rod (CEA) position if:

A. the startup is delayed until eight hours after the trip.

B. the steam dump pressure setpoint is lowered by 100 psi prior to reactor startup.

C. actual boron concentration is 10 ppm more than the assumed boron concentration.

D. one control rod (CEA) remains fully inserted during the approach to criticality.

QUESTION: 96.

With keff = 0.985, how much reactivity must be added to make the reactor critical?

A. 1,480 pcm (1.48% delta-k/k)

B. 1,500 pcm (1.50% delta-k/k)

C. 1,520 pcm (1.52% delta-k/k)

D. 1,540 pcm (1.54% delta-k/k)

QUESTION: 97.

If, during a reactor startup, the startup rate is constant and positive without any further reactivity addition, then the reactor is:

A. critical.

B. supercritical.

C. subcritical.

D. prompt critical.

QUESTION: 98.

Given a critical reactor operating below the point of adding heat, what reactivity effects are associated with reaching the point of adding heat?

A. There are no reactivity effects since the reactor is critical.

B. The increase in fuel temperature will begin to create a positive reactivity effect.

C. The decrease in fuel temperature will begin to create a negative reactivity effect.

D. The increase in fuel temperature will begin to create a negative reactivity effect.

QUESTION: 99.

Shortly after a reactor trip, reactor power indicates 0.5 percent where a stable negative SUR is attained. Reactor power will be reduced to 0.05 percent in approximately _____ seconds.

A. 360

B. 270

C. 180

D. 90

QUESTION: 100.

The major reason boron is used in a reactor is to permit:

A. a reduction in the shutdown margin.

B. an increase in the amount of control rods (CEAs) installed.

C. an increase in core life.

D. a reduction in the effect of resonance capture.