TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B73 (P2673)

Refer to the drawing of a differential pressure manometer (see figure below).

A differential pressure manometer filled with water is installed across an orifice in a ventilation duct to determine the direction of airflow. With the ventilation conditions as shown, the pressure at P1 is __________ than P2, and airflow is __________.

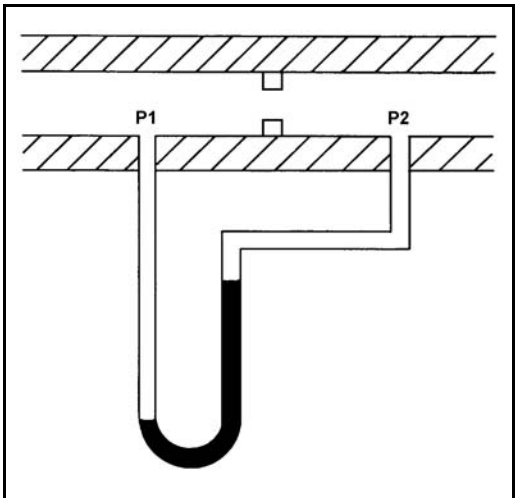
A. greater; left to right

B. greater; right to left

C. less; left to right

D. less; right to left

ANSWER: A.



DIFFERENTIAL PRESSURE MANOMETER

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B373 (P374)

Refer to the drawing of four tank differential pressure (D/P) level detectors (see figure below). The tanks are identical and are being maintained at 17 psia and the same constant water level. They are surrounded by atmospheric pressure.

Which one of the level detectors is sensing the greatest D/P?

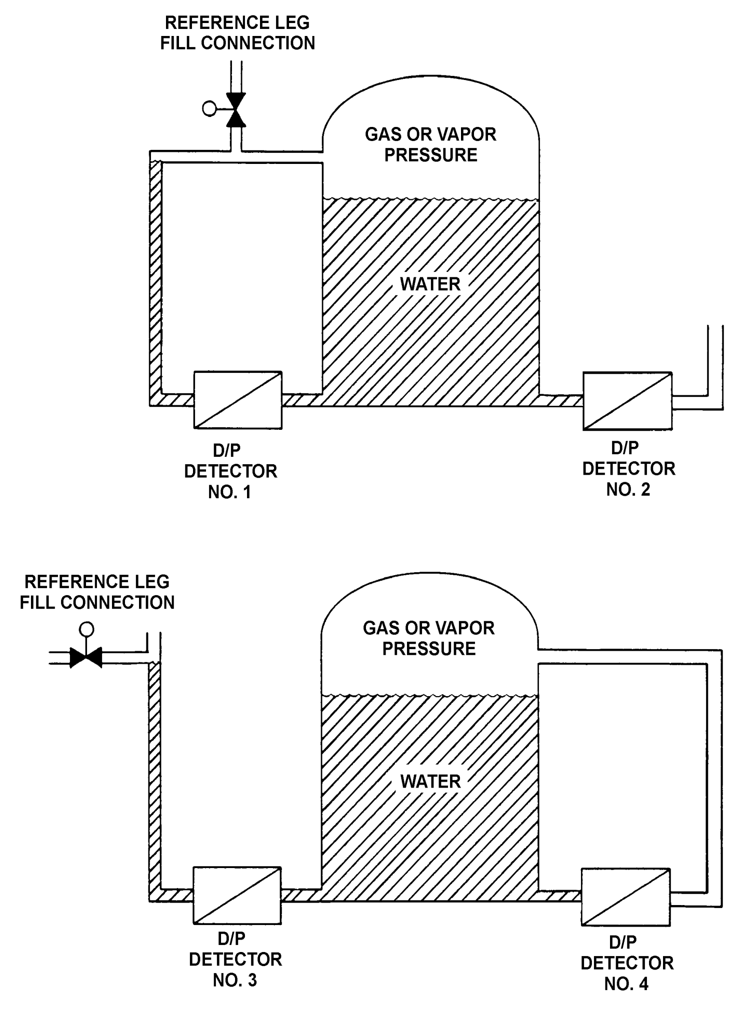
A. No. 4

B. No. 3

C. No. 2

D. No. 1

ANSWER: C.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B673 (P2973)

Refer to the drawing of a differential pressure manometer (see figure below).

A differential pressure manometer filled with water is installed across an orifice in a ventilation duct to determine the direction of airflow. P1 and P2 are pressures sensed in the ventilation duct. With the conditions shown, P1 is __________ than P2 and airflow is to the __________.

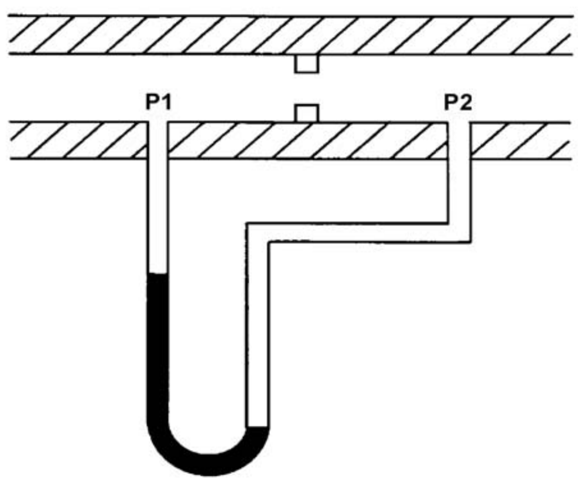
A. greater; right

B. less; right

C. greater; left

D. less; left

ANSWER: D.



DIFFERENTIAL PRESSURE MANOMETER

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B1073 (P2873)

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

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

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

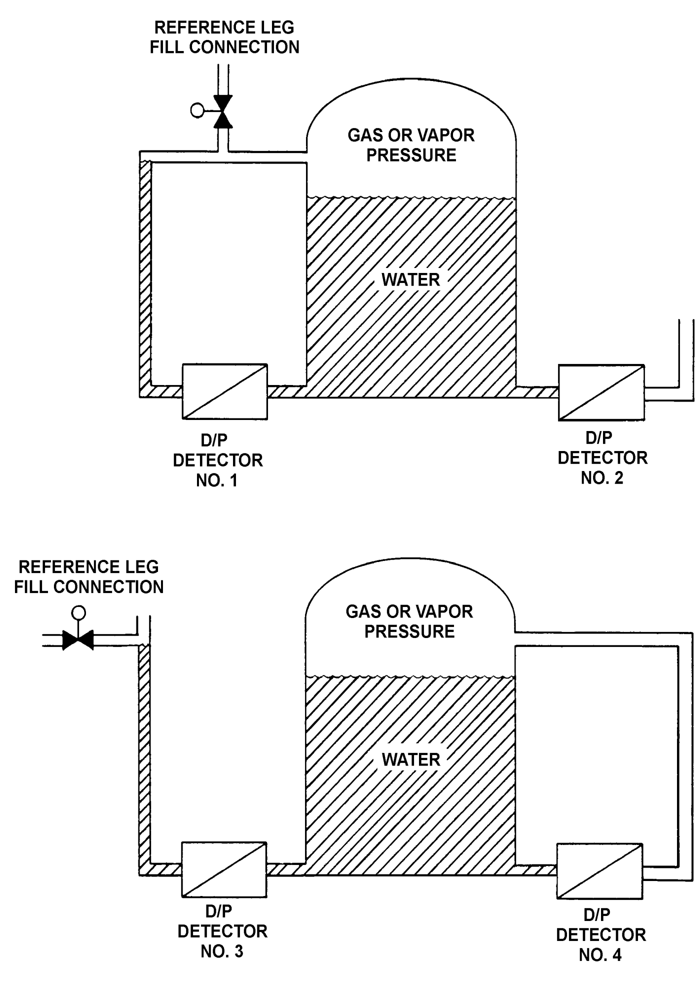
A. No. 1 only

B. No. 2 only

C. No. 1, 2, and 3

D. No. 2, 3, and 4

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B1174 (P1673)

Refer to the drawing of four identical tank differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are currently at 2 psig overpressure, the same constant water level, and a temperature of 60°F. They are surrounded by atmospheric pressure. All level detectors have been calibrated and are producing the same level indication.

If a leak in the top of each tank causes a complete loss of overpressure, which level detector(s) will produce the lowest level indication?

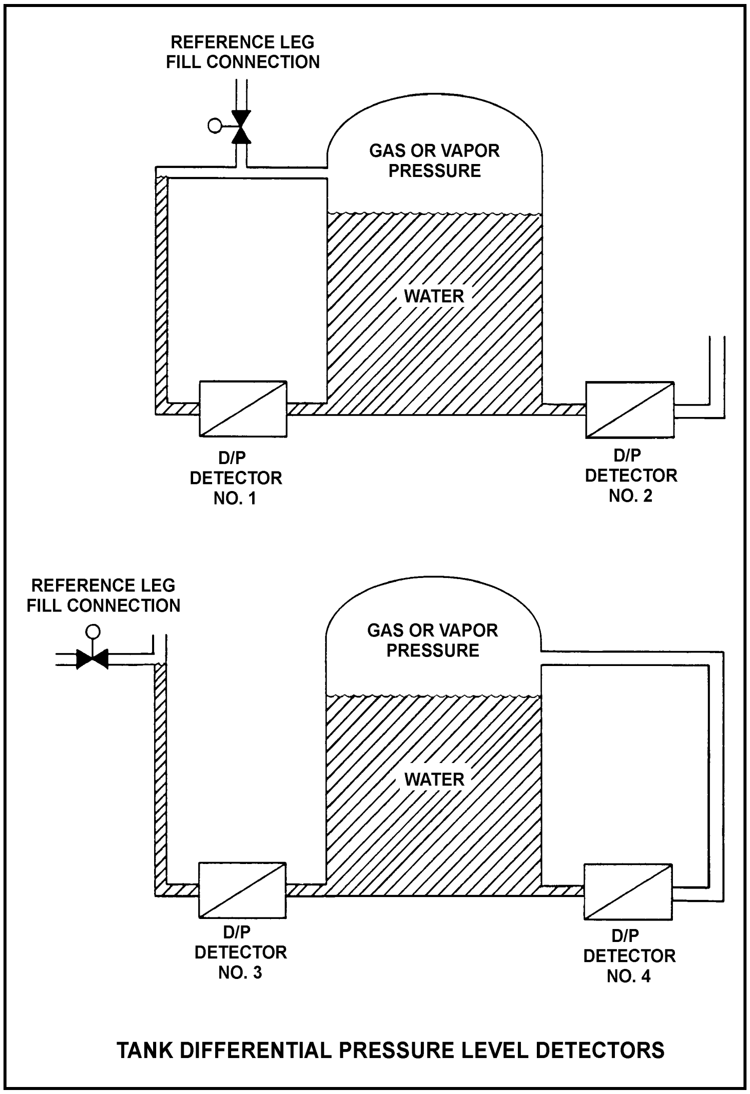
A. No. 1 only

B. No. 2 only

C. No. 1 and 4

D. No. 2 and 3

ANSWER: D.



TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B1873 (P573)

A water storage tank is enclosed to prevent vapors from escaping to the environment. The tank is also pressurized with nitrogen to prevent air inleakage. A differential pressure detector with a dry reference leg is used to measure the tank level.

To achieve the greatest accuracy of measurement, the low pressure side of the detector should sense which one of the following?

A. The pressure at the bottom of the tank

B. The pressure of the atmosphere surrounding the tank

C. The pressure of a column of water external to the tank

D. The pressure of the gas space at the top of the tank

ANSWER: D.

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B2373 (P2373)

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

The tanks are identical and they are presently at 2 psig overpressure, 60°F, and the same constant water level. They are located within a sealed containment structure that is being maintained at atmospheric pressure. All level detectors have been calibrated and are producing the same level indication.

If a ventilation malfunction causes containment structure pressure to decrease to 12 psia, which level detectors will produce the lowest level indication?

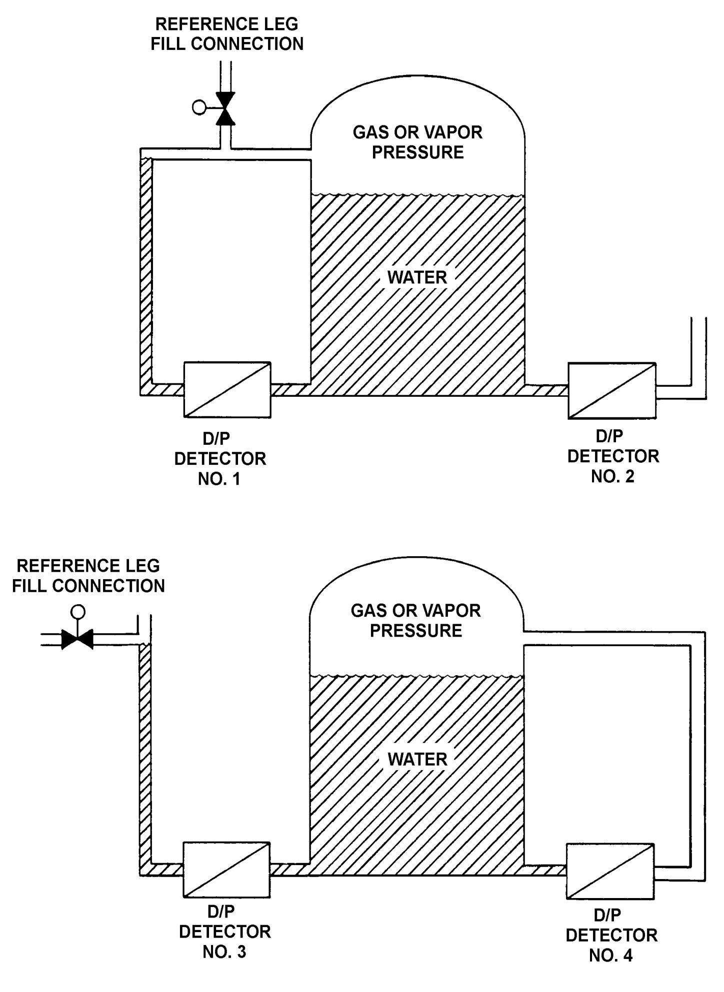
A. 1 and 3

B. 2 and 4

C. 1 and 4

D. 2 and 3

ANSWER: C



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B2573 (P2574)

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

The tanks are identical and are presently at 2 psig overpressure, 60°F, and the same constant water level. They are located within a sealed containment structure that is being maintained at atmospheric pressure. All level detectors have been calibrated and are producing the same level indication. A ventilation malfunction causes the containment structure pressure to decrease to 13 psia.

Which level detectors will produce the highest indication?

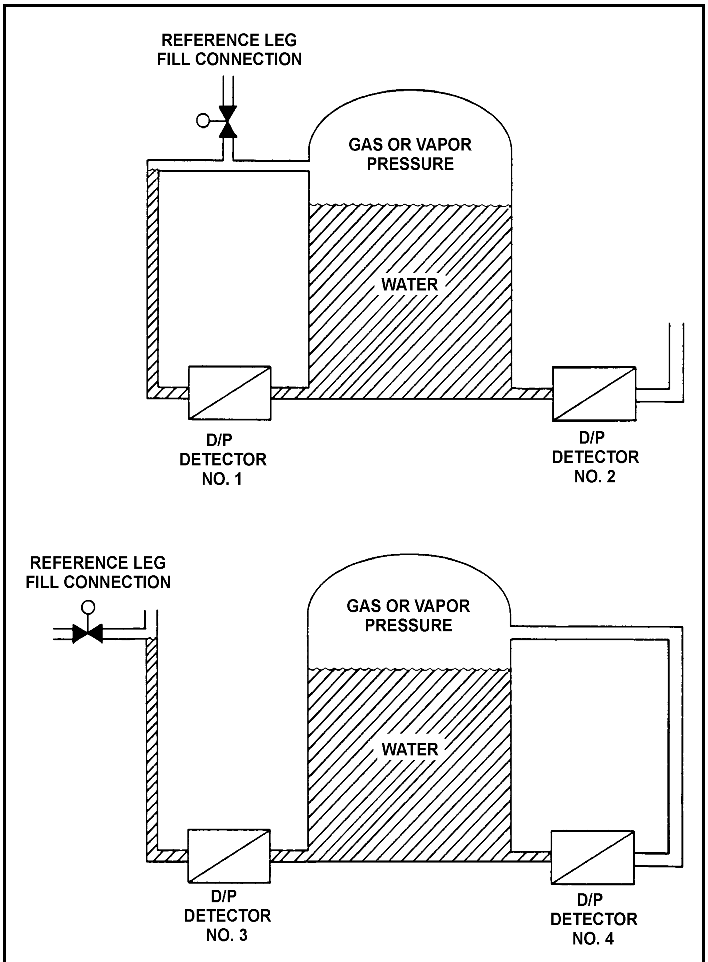
A. 1 and 2

B. 3 and 4

C. 1 and 4

D. 2 and 3

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B2773 (P2473)

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

The tanks are identical and are being maintained at 30 psia and a water level of 20 feet. They are surrounded by standard atmospheric pressure. The water in the tank and reference leg is at 70°F.

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

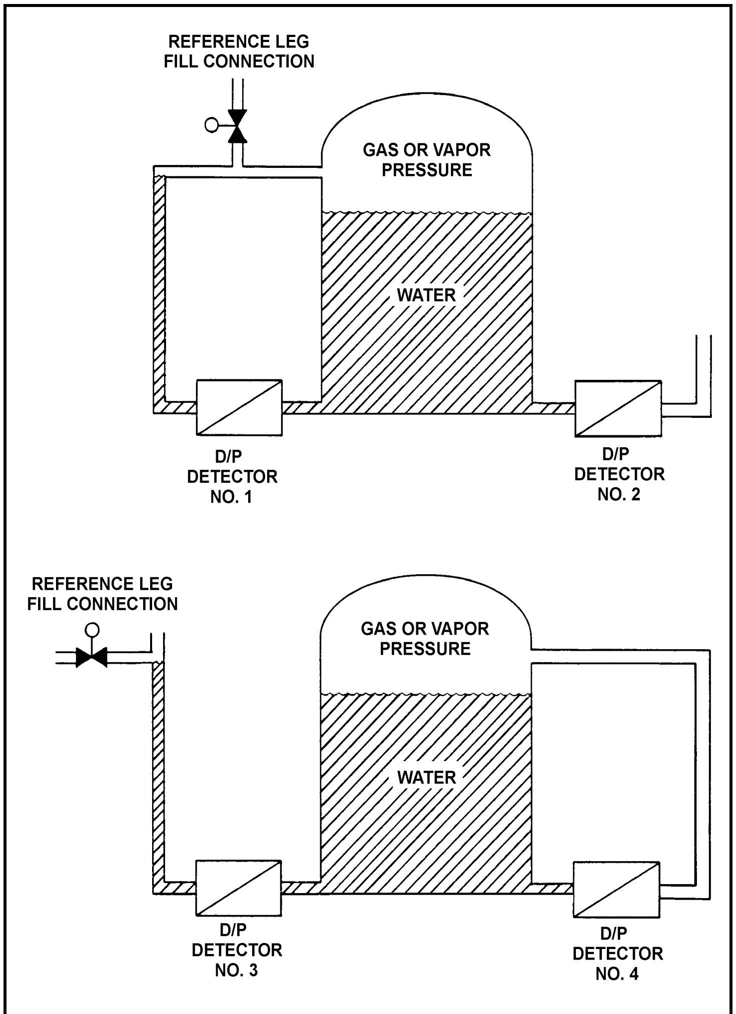
A. No. 1 only

B. No. 2 only

C. No. 1 and 3

D. No. 2 and 4

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B3173 (P3173)

A water storage tank is vented to atmosphere. The tank is located at sea level and contains 100,000 gallons of 80°F water. A pressure gauge at the bottom of the tank reads 5.6 psig. What is the approximate water level in the tank?

A. 13 feet

B. 17 feet

C. 21 feet

D. 25 feet

ANSWER: A.

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B3673 (P3673)

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

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

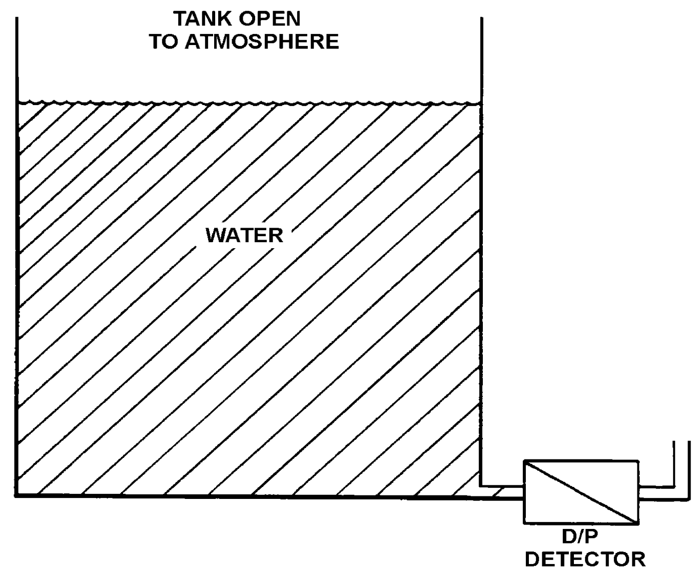
A. 2 psid

B. 13 psid

C. 20 psid

D. 28 psid

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B3873 (P3873)

A water storage tank is vented to atmosphere. The tank is located at sea level and contains 100,000 gallons of water at 80°F. A pressure gauge at the bottom of the tank reads 7.3 psig. What is the approximate water level in the tank?

A. 13 feet

B. 17 feet

C. 21 feet

D. 25 feet

ANSWER: B.

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B4537 (P4537)

A water storage tank is vented to atmosphere. The tank is located at sea level and contains 100,000 gallons of water at 80°F. A pressure gauge at the bottom of the tank reads 9.0 psig. What is the approximate water level in the tank?

A. 13 feet

B. 17 feet

C. 21 feet

D. 25 feet

ANSWER: C.

TOPIC: 293001
KNOWLEDGE: K1.03 [2.5/2.7]
QID: B4837 (P4837)

Refer to the drawing of four identical tank differential pressure (D/P) level detectors with different piping configurations (see figure below).

The tanks are identical and are presently at 2 psig overpressure, the same constant water level, and a temperature of 60°F. They are surrounded by atmospheric pressure. All level detectors have been calibrated and are producing the same level indication. A leak in the top of each tank causes a complete loss of overpressure in both tanks.

Which level detector(s) will produce the highest level indication?

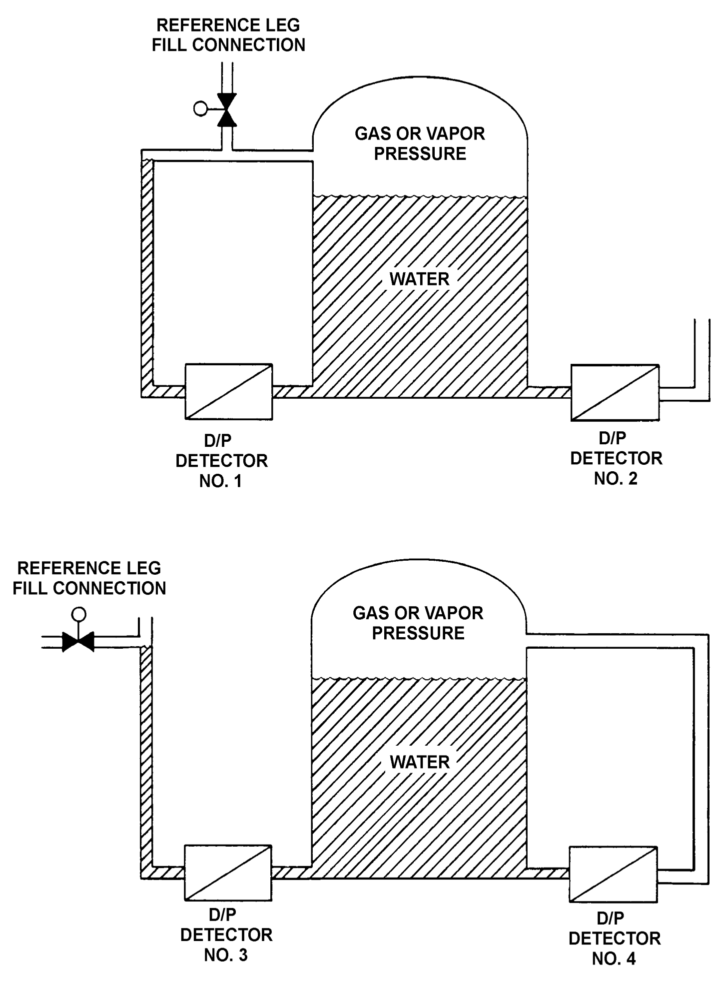
A. No. 1 only

B. No. 2 only

C. No. 1 and 4

D. No. 2 and 3

ANSWER: C.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

There are no test items available for topic 293002.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B474

Water is initially saturated with a quality of 50%, when a small amount of heat is added. Assuming the water pressure remains constant and the water remains saturated, water quality will ___________ and water temperature will ___________.

A. increase; increase

B. increase; remain the same

C. remain the same; increase

D. remain the same; remain the same

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B1074 (P674)

A liquid is saturated with 0% quality. Assuming pressure remains constant, the addition of a small amount of heat will...

A. raise the liquid temperature above the boiling point.

B. result in a subcooled liquid.

C. result in vaporization of the liquid.

D. result in a superheated vapor.

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B1874 (P1374)

Consider a water/steam mixture with a quality of 95%. If pressure remains constant and heat is added to the mixture, the temperature of the mixture will __________ and the quality of the mixture will __________. (Assume the mixture remains saturated.)

A. increase; remain the same

B. increase; increase

C. remain the same; remain the same

D. remain the same; increase

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B1974 (P1474)

If 1 lbm of liquid water is in a saturated condition at a constant pressure, the addition of 1 Btu will...

A. raise the temperature of the water by 1°F.

B. vaporize a portion of the water.

C. increase the density of the water.

D. result in 1°F of superheat.

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B3374 (P2874)

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

A. result in 4°F of superheat.

B. vaporize a portion of the water.

C. increase the density of the water.

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

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B3474

The temperature of a quantity of water is 212°F.

Which one of the following additional water parameters, when paired with the temperature, provides <u>insufficient</u> data to determine whether the water is a saturated <u>liquid</u> rather than a saturated <u>liquid-vapor mixture</u>?

A. Enthalpy

B. Entropy

C. Pressure

D. Specific volume

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.07 [2.7/2.8]
QID: B3574 (P1974)

A steam-water mixture is initially saturated with a quality of 50%, when a small amount of heat is added. Assuming pressure remains constant and the mixture remains saturated, mixture steam quality will ____________ and mixture temperature will ____________.

A. increase; increase

B. increase; remain the same

C. remain the same; increase

D. remain the same; remain the same

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B146

Given a constant pressure, any further addition of heat will result in an increase in the temperature of...

A. saturated vapors and subcooled liquids.

B. wet vapors and saturated vapors.

C. saturated liquids and saturated vapors.

D. subcooled liquids and wet vapors.

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B875 (P874)

Consider a water/steam mixture with a current quality of 99%. If pressure remains constant and heat is removed from the mixture, the temperature of the mixture will __________ and the quality of the mixture will __________. (Assume the mixture remains saturated.)

A. decrease; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1274

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

A. temperature will decrease.

B. density will decrease.

C. specific volume will decrease.

D. enthalpy will increase.

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1474

Which one of the following will decrease if heat is added to a saturated vapor at a constant pressure?

A. Density

B. Temperature

C. Entropy

D. Enthalpy

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1574 (P1574)

Consider a steam-water mixture with a current quality of 79%. If pressure remains constant and heat is added to the mixture, the temperature of the mixture will __________ and the quality of the mixture will __________. (Assume the mixture remains saturated.)

A. remain the same; increase

B. remain the same; remain the same

C. increase; increase

D. increase; remain the same

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2074 (P2074)

Consider a saturated water/steam mixture at 500°F with a quality of 90%. If the pressure of the mixture is decreased with no heat gain or loss, the temperature of the mixture will __________ and the quality of the mixture will __________. (Assume the mixture remains saturated.)

A. decrease; decrease

B. decrease; increase

C. remain the same; decrease

D. remain the same; increase

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2174

Consider a saturated vapor at 470°F. If the pressure of the vapor remains constant and heat is added, vapor temperature will __________ and vapor quality will __________ .

A. remain the same; remain the same

B. remain the same; increase

C. increase; remain the same

D. increase; increase

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2975 (P2974)

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

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

A. decrease; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.12 [2.5/2.6]
QID: B141

What is the approximate quality of wet steam leaving a nuclear reactor at 530 psig with an enthalpy of 928.9 Btu/lbm?

A. 25%

B. 37%

C. 63%

D. 75%

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.12 [2.5/2.6]
QID: B2375 (P2374)

Which one of the following describes the effect of removing heat from a steam-water mixture that is in a saturated condition? (Assume the mixture remains saturated.)

A. Temperature will increase.

B. Temperature will decrease.

C. Quality will increase.

D. Quality will decrease.

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.12 [2.5/2.6]
QID: B2874 (P1976)

Which one of the following is the approximate steam quality of a steam-water mixture at 467°F with an enthalpy of 1,000 Btu/lbm?

A. 24%

B. 27%

C. 73%

D. 76%

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.12 [2.5/2.6]
QID: B3075 (P3074)

The temperature of a saturated steam-water mixture is 467°F.

Which one of the following additional parameter values, when paired with the temperature, provides insufficient data to determine the approximate steam quality of the mixture?

A. Pressure at 499.96 psia

B. Enthalpy at 977.33 Btu/lbm

C. Entropy at 1.17 Btu/lbm -°R

D. Specific volume at 0.817 ft^3/lbm

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.16 [2.8/2.8]
QID: B74

Given an operating nuclear reactor at 985 psig and a feed-water inlet temperature of 400°F, what will be the approximate feedwater subcooling?

A. 136.6°F

B. 140.6°F

C. 144.6°F

D. 148.6°F

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.16 [2.8/2.8]
QID: B775

What effect will occur if heat is removed from water that is in a subcooled condition?

A. Temperature of the water will increase.

B. Enthalpy of the water will decrease.

C. Quality of the water will increase.

D. Density of the water will decrease.

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.16 [2.8/2.8]
QID: B2973 (P2975)

An open vessel contains one pound-mass of water at 206°F and atmospheric pressure. Which one of the following will be caused by the addition of 3.0 Btu to the water?

A. The water temperature will rise by approximately 3°F.

B. Approximately 3% of the water mass will vaporize.

C. The water density will decrease by approximately 3%.

D. The water will become superheated by approximately 3°F.

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.22 [2.9/3.2]
QID: B1175 (P1675)

Which one of the following is the approximate temperature of a water-steam mixture that has an enthalpy of 1,150 Btu/lbm and a quality of 95%?

A. 220°F

B. 270°F

C. 360°F

D. 440°F

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.22 [2.9/3.2]
QID: B1377

Saturated steam undergoes an ideal expansion process in an ideal turbine from 1,000 psia to 28 inches Hg vacuum. Approximately how much specific work is being performed by the turbine?

A. 1,189 Btu/lbm

B. 775 Btu/lbm

C. 414 Btu/lbm

D. 388 Btu/lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.22 [2.9/3.2]
QID: B1577

Saturated steam undergoes an ideal expansion process in an ideal turbine from 294 psig to 27 inches Hg vacuum. Approximately how much specific work is being performed by the turbine?

A. 1,203 Btu/lbm

B. 418 Btu/lbm

C. 343 Btu/lbm

D. 308 Btu/lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.22 [2.9/3.2]
QID: B1675

Which one of the following is the approximate reactor coolant heatup rate, assuming an initial reactor pressure of 470 psig and a final reactor pressure of 980 psig 2 hours later?

A. 40°F/hr

B. 60°F/hr

C. 80°F/hr

D. 120°F/hr

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B75

The saturation pressure corresponding to 400°F is approximately...

A. 232 psia.

B. 247 psia.

C. 262 psia.

D. 444 psia.

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B103

An operator suspects that a steam line temperature instrument reading is <u>not</u> correct. A recently calibrated pressure gauge sensing steam pressure for the same steam line indicates 351 psig.

Assuming the system is operating at saturation pressure, what approximate temperature should the temperature instrument indicate?

A. 424°F

B. 428°F

C. 432°F

D. 436°F

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B139

The saturation temperature for steam at a pressure of 785 psig is approximately...

A. 510°F.

B. 513°F.

C. 515°F.

D. 518°F.

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B190

Which one of the following is the approximate quality of steam leaving a cyclone separator at 985 psig and 1,186 Btu/lbm?

A. 95%

B. 96%

C. 97%

D. 99%

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B275 (P275)

The saturation pressure for water at 328°F is approximately...

A. 85 psig.

B. 100 psig.

C. 115 psig.

D. 130 psig.

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B375

Saturated steam at 250 psia enters turbine X. Superheated steam at 250 psia and 500°F enters turbine Y. Both turbines are 100% efficient and exhaust to a condenser at 1 psia.

Which one of the following lists the approximate percentages of moisture at the exhausts of turbines X and Y?

A. Turbine X = 24.5%; turbine Y = 20.8%

B. Turbine X = 26.3%; turbine Y = 13.0%

C. Turbine X = 24.5%; turbine Y = 13.0%

D. Turbine X = 26.3%; turbine Y = 20.8%

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B382

Cooling water exits a fuel channel with an enthalpy of 1,195 Btu/lbm at a reactor pressure of 1,050 psig. What is the state of the fluid at the exit of the fuel channel?

A. Saturated

B. Superheated

C. Compressed

D. Subcooled

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B974

Which one of the following sets of water parameters will result in the highest fluid quality?

A. 500°F; 1,100 Btu/lbm

B. 320°F; 1,070 Btu/lbm

C. 200°F; 1,040 Btu/lbm

D. 160°F; 960 Btu/lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B975

Which one of the following represents the value of enthalpy (h) for steam at 235.3 psig and 500°F?

A. h = 1,201.1, Btu/lbm

B. h = 1,202.2, Btu/lbm

C. h = 1,263.5, Btu/lbm

D. h = 1,286.6, Btu/lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B1375

A steam/water mixture leaving the nuclear reactor core has the following parameter values:

Temperature = 550.5°F
Pressure = 1,035 psig
Quality = 14.5%

Which one of the following is the approximate enthalpy of the steam-water mixture?

A. 610 Btu/lbm

B. 643 Btu/lbm

C. 720 Btu/lbm

D. 860 Btu/lbm

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B1575

A steam-water mixture leaving the nuclear reactor core has the following parameter values:

Temperature	= 550.5°F
Pressure	= 1,035 psig
Quality	= 20%

Which one of the following is the approximate enthalpy of the steam-water mixture?

A. 641 Btu/lbm

B. 678 Btu/lbm

C. 751 Btu/lbm

D. 1,063 Btu/lbm

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B1776 (P1775)

Which one of the following is the approximate amount of heat required to convert 3 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A. 889 Btu

B. 1,119 Btu

C. 2,666 Btu

D. 3,358 Btu

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2075 (P2077)

A nuclear power plant is operating with the following main steam parameters at a main turbine steam inlet valve:

Pressure: 900 psia
Quality: 98%

The main turbine steam chest pressure is 400 psia. Which one of the following is the quality of the steam in the steam chest?

A. 97%

B. 98%

C. 99%

D. 100%

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2275 (P2275)

1.0×10^6 lbm/hr saturated steam at 30% steam quality is leaving a main turbine and entering a condenser at 2.0 psia. Condensate is entering the hotwell at 118°F.

Which one of the following is the approximate condenser heat transfer rate?

A. 3.1×10^8 Btu/hr

B. 5.8×10^8 Btu/hr

C. 7.2×10^8 Btu/hr

D. 9.9×10^8 Btu/hr

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2374 (P2375)

Which one of the following is the approximate amount of heat required to convert 2.0 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A. 1,119 Btu

B. 1,187 Btu

C. 2,238 Btu

D. 2,374 Btu

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2474

Turbine X is an ideal steam turbine that exhausts to a condenser at 1.0 psia. Turbine X is driven by saturated steam (100% quality) at 500 psia. Which one of the following lists the approximate specific work output of turbine X and moisture content of the steam exiting turbine X?

	Specific Work	Moisture Content
A.	388 Btu/lbm	72%
B.	388 Btu/lbm	28%
C.	817 Btu/lbm	72%
D.	817 Btu/lbm	28%

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2475 (P2475)

A steam line is carrying steam at 500 psia and 507°F. Approximately how much ambient heat loss is required before moisture formation occurs in the steam line?

A. 31 Btu/lbm

B. 45 Btu/lbm

C. 58 Btu/lbm

D. 71 Btu/lbm

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2575 (P2575)

Which one of the following is the approximate amount of heat required to convert 2.0 lbm of water at 100°F and 100 psia to a superheated vapor at 400°F and 100 psia?

A. 1,119 Btu

B. 1,159 Btu

C. 2,238 Btu

D. 2,318 Btu

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2675 (P2675)

What is the approximate specific heat (Btu/lbm-°F) of water at 300°F and 100 psia?

A. 1.03 Btu/lbm-°F

B. 1.11 Btu/lbm-°F

C. 1.17 Btu/lbm-°F

D. 1.25 Btu/lbm-°F

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2774 (P2778)

The theoretical maximum efficiency of a steam cycle is given by the equation:

$$Eff_{thmax} = (1 - T_{out}/T_{in}) \times 100\%,$$

where T_{out} is the absolute temperature for heat rejection and T_{in} is the absolute temperature for heat addition. (Fahrenheit temperature is converted to absolute temperature by adding 460°.)

A nuclear power plant is operating with a stable reactor vessel pressure of 900 psia. What is the approximate theoretical maximum steam cycle efficiency this plant can achieve by establishing its main condenser vacuum at 1.0 psia?

A. 35%

B. 43%

C. 65%

D. 81%

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2776 (P2775)

With a nuclear power plant operating near rated power, air inleakage into the main condenser causes main condenser pressure to increase from 1.0 psia to 2.0 psia.

Given the following:

- Initial main condenser condensate depression was 4°F.
- After the plant stabilizes, with main condenser pressure at 2.0 psia, main condenser condensate depression is 2°F.

Which one of the following is the approximate increase in main condenser specific heat rejection needed to restore condensate depression to 4°F?

A. 2 Btu/lbm

B. 4 Btu/lbm

C. 8 Btu/lbm

D. 16 Btu/lbm

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B2875

A nuclear power plant is operating at a low power level. Main steam at the main turbine steam inlet valve has the following properties:

Pressure: 900 psia
Quality: 99%

The main turbine steam chest pressure is 300 psia. Which one of the following is the approximate temperature of the steam in the steam chest?

A. 417°F

B. 439°F

C. 496°F

D. 532 °F

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3074 (P3077)

A nuclear power plant is operating at 100% rated power. Steam is escaping to atmosphere through a flange leak in a steam supply line to the low pressure section of the main turbine.

Given:

- Steam line pressure is 300 psia.
- Steam line temperature is 440°F.

What is the approximate temperature of the steam as it reaches atmospheric pressure?

A. 212°F

B. 268°F

C. 322°F

D. 358°F

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3175 (P3175)

A steam line is carrying saturated steam vapor at 500 psia and 467°F. Approximately how much heat addition to the steam vapor is necessary to achieve 60°F of superheat?

A. 31 Btu/lbm

B. 45 Btu/lbm

C. 58 Btu/lbm

D. 71 Btu/lbm

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3274 (P3275)

An ideal main turbine generator (MTG) is producing 1000 MW of electrical power while being supplied with 100% quality steam at 920 psig. Steam supply pressure is then gradually increased to 980 psig at the same quality. Assume turbine control valve position and condenser vacuum remain the same.

Which one of the following describes why the MTG output increases as steam pressure increases?

A. Each lbm of steam entering the turbine has a higher specific heat.

B. Each lbm of steam entering the turbine has a higher specific enthalpy.

C. Each lbm of steam passing through the turbine expands to fill a greater volume.

D. Each lbm of steam passing through the turbine performs increased work in the turbine.

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3275

A nuclear power plant is shutdown at normal operating temperatures and pressures. Reactor coolant temperature is being controlled by dumping main steam (100% quality) to the main condenser.

Given the following:

- Main steam pressure: 1000 psia
- Main condenser vacuum: 28"Hg

Which one of the following is the approximate temperature of the steam as it enters the main condenser?

A. 102°F

B. 212°F

C. 295°F

D. 358°F

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3475 (P3475)

Which one of the following is the approximate amount of heat required to convert 2 lbm of water at 100°F and 100 psia to a saturated vapor at 100 psia?

A. 560 Btu

B. 1,120 Btu

C. 2,238 Btu

D. 3,356 Btu

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3575 (P3577)

Saturated steam (100% quality) at 1000 psia is being supplied to the inlet of a partially-open steam throttle valve on a main turbine. Pressure in the steam chest downstream of the throttle valve is 150 psia. Assume a typical throttling process with no heat gain or loss to/from the steam.

When compared to the conditions at the inlet to the throttle valve, which one of the following describes the conditions in the steam chest for specific enthalpy and entropy?

	Steam Chest Specific Enthalpy	Steam Chest Specific Entropy
A.	About the same	About the same
B.	About the same	Significantly higher
C.	Significantly lower	About the same
D.	Significantly lower	Significantly higher

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3675 (P3677)

A nuclear power plant is shutdown and steam is escaping to atmosphere through a leak in a main steam line. If main steam line pressure is 300 psia, what is the approximate temperature of the steam as it reaches atmospheric pressure? (Assume the steam in the main steam line has a quality of 100%.)

A. 212°F

B. 268°F

C. 322°F

D. 358°F

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3774 (P3775)

A 100 ft^3 vessel contains a saturated water-steam mixture at 1,000 psia. The water portion occupies 30 ft^3 and the steam portion occupies the remaining 70 ft^3. What is the approximate total mass of the mixture in the vessel?

A. 1,547 lbm

B. 2,612 lbm

C. 3,310 lbm

D. 4,245 lbm

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B3938 (P3939)

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

Given:

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

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

A. 450°F

B. 475°F

C. 500°F

D. 525°F

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4038

A 100 ft^3 vessel contains a saturated water-steam mixture at 1,000 psia. The water portion occupies 70 ft^3 and the steam portion occupies the remaining 30 ft^3. What is the approximate total mass of the mixture in the vessel?

A. 1,547 lbm

B. 2,612 lbm

C. 3,310 lbm

D. 4,245 lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4138 (P4139)

Saturated steam at 50% steam quality is leaving a main turbine at a flow rate of 1.0×10^6 lbm/hr and entering a condenser at 1.6 psia. Condensate is entering the hotwell at 112°F.

Which one of the following is the approximate condenser heat transfer rate?

A. 3.1×10^8 Btu/hr

B. 3.8×10^8 Btu/hr

C. 4.5×10^8 Btu/hr

D. 5.2×10^8 Btu/hr

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4338 (P4339)

A nuclear power plant is operating at full rated power. The main turbine has one high pressure (HP) unit and one low pressure (LP) unit.

Main steam enters the HP unit of the main turbine with the following parameters:

Pressure: 1,000 psia
Quality: 100%

The exhaust steam exits the HP unit at 200 psia, then goes through a moisture separator/reheater, and enters the LP units with the following parameters:

Pressure: 200 psia
Temperature: 500°F

The main condenser pressure is 1.0 psia. Assume that each unit of the main turbine is 100% efficient.

The higher enthalpy steam is being supplied to the ________ unit of the main turbine; and the greater moisture content is found in the exhaust of the ___________ unit.

A. LP; LP

B. LP; HP

C. HP; LP

D. HP; HP

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4738 (P4739)

Consider a 100 lbm quantity of a steam-water mixture at standard atmospheric pressure. The mixture has a quality of 70 percent. Assume that pressure remains constant and there is no heat loss from the mixture.

Which one of the following is the approximate heat addition needed to increase the quality of the mixture to 100 percent?

A. 5,400 Btu

B. 12,600 Btu

C. 29,100 Btu

D. 67,900 Btu

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4838 (P4839)

An open vessel contains one pound-mass of water at 204°F and standard atmospheric pressure. If 16.0 Btu of heat is added to the water, the water temperature will rise by about ___________; and approximately ___________ of the water mass will become vapor.

A. 8°F; 1 percent

B. 8°F; 10 percent

C. 16°F; 1 percent

D. 16°F; 10 percent

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B4938 (P4939)

Water enters an ideal convergent-divergent nozzle with the following parameters:

Pressure	= 300 psia
Temperature	= 102°F
Velocity	= 50 ft/sec

The velocity of the water at the throat of the nozzle is 200 ft/sec.

Given that nozzles convert enthalpy to kinetic energy, and assuming no heat transfer to or from the nozzle, what is the approximate pressure of the water at the throat of the nozzle?

A. 296 psia

B. 150 psia

C. 75 psia

D. 50 psia

ANSWER: D.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B5038 (P5039)

An open vessel contains one pound-mass of water at 206°F and standard atmospheric pressure. Which one of the following will be caused by the addition of 12.0 Btu to the water?

A. The water temperature will rise by about 6°F and none of the water will vaporize.

B. The water temperature will rise by about 6°F and some of the water will vaporize.

C. The water temperature will rise by about 12°F and none of the water will vaporize.

D. The water temperature will rise by about 12°F and some of the water will vaporize.

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B5138 (P5139)

A feedwater pump discharges into a 16-inch diameter discharge line. Given the following:

Pump discharge pressure: 950 psia
Feedwater temperature: 300°F
Feedwater velocity: 15.2 ft/sec

What is the feedwater pump discharge flow rate in pounds-mass per hour (lbm/hr)?

A. 1.1×10^6 lbm/hr

B. 4.4×10^6 lbm/hr

C. 1.8×10^7 lbm/hr

D. 5.3×10^7 lbm/hr

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B5238 (P5239)

Saturated steam enters a frictionless convergent-divergent nozzle with the following parameters:

Pressure = 850 psia
Velocity = 10 ft/sec

The steam at the throat of the nozzle has a subsonic velocity of 950 ft/sec.

Given that nozzles convert enthalpy to kinetic energy, and assuming no heat transfer to or from the nozzle, what is the enthalpy of the steam at the throat of the nozzle?

A. 1,162 Btu/lbm

B. 1,171 Btu/lbm

C. 1,180 Btu/lbm

D. 1,189 Btu/lbm

ANSWER: C.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B5338 (P5340)

A nuclear power plant is operating with the following main steam parameters at a main turbine steam inlet valve:

Pressure: 900 psia
Quality: 99%

The main turbine steam chest pressure is 300 psia. Which one of the following is the quality of the steam in the steam chest?

A. 100%

B. 98%

C. 88%

D. 87%

ANSWER: B.

TOPIC: 293003
KNOWLEDGE: K1.23
QID: B5438 (P5439)

An ideal auxiliary steam turbine exhausts to the atmosphere. The steam turbine is supplied with saturated steam at 900 psia. Which one of the following is the maximum specific work (Btu/lbm) that can be extracted from the steam by the steam turbine?

A. 283 Btu/lbm

B. 670 Btu/lbm

C. 913 Btu/lbm

D. 1,196 Btu/lbm

ANSWER: A.

TOPIC: 293003
KNOWLEDGE: K1.23 [2.8/3.1]
QID: B5638

A main steam line safety valve is leaking by, allowing 100% quality steam from the reactor vessel to enter the discharge pipe, which remains at a constant pressure of 10 psig. Initial safety valve discharge pipe temperature is elevated but stable. Assume no heat loss from the safety valve discharge pipe.

Upon discovery of the leak, the reactor is shut down and a plant cooldown and depressurization are commenced. As the main steam pressure slowly decreases from 1,000 psig to 800 psig, the safety valve discharge pipe temperature will...

A. decrease, because the entropy of the safety valve discharge will be decreasing.

B. decrease, because the enthalpy of the safety valve discharge will be decreasing.

C. increase, because the safety valve discharge will become more superheated as reactor vessel pressure decreases.

D. remain the same, because the safety valve discharge will remain a saturated steam-water mixture at 10 psig.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B76

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation with supersonic steam velocities.

At which one of the following locations is the <u>lowest</u> pressure experienced?

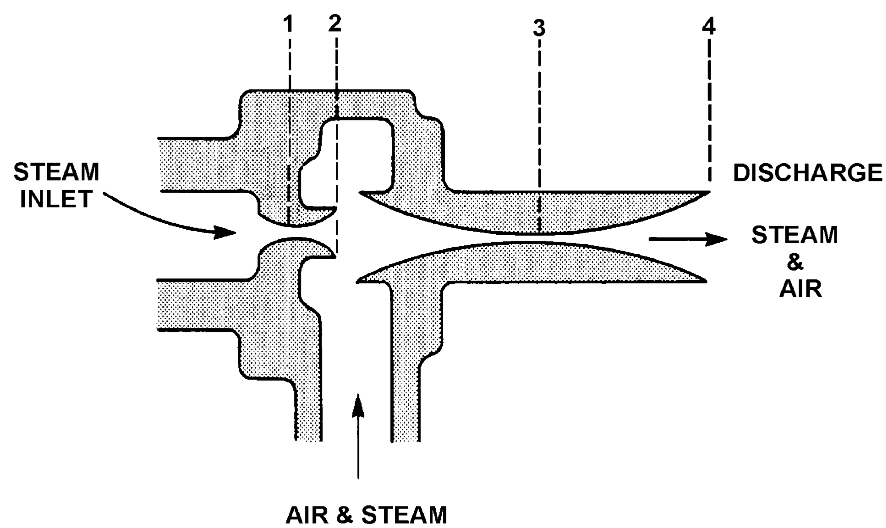
A. 1

B. 2

C. 3

D. 4

ANSWER: B.



STEAM-JET AIR EJECTOR

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B376

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation with steam reaching supersonic velocities.

Steam flowing from D to E undergoes a pressure __________ and a velocity __________.

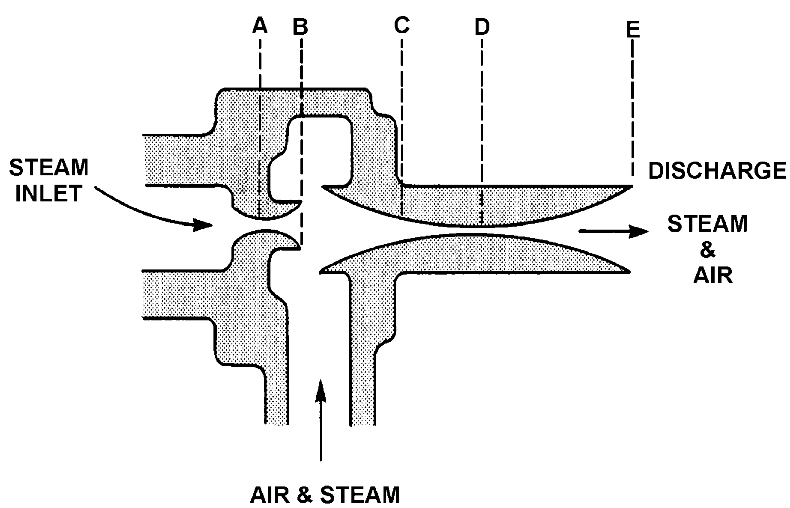
A. decrease; decrease

B. decrease; increase

C. increase; increase

D. increase; decrease

ANSWER: D.



STEAM-JET AIR EJECTOR

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B476

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation.

The section of the air ejector that converts steam pressure into kinetic energy is called the...

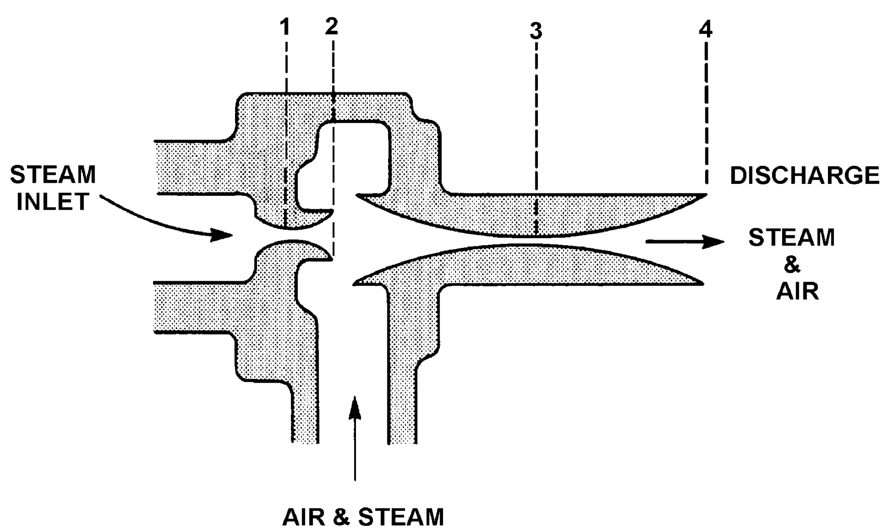
A. diffuser.

B. nozzle.

C. intercondenser.

D. riser.

ANSWER: B.



STEAM-JET AIR EJECTOR

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B1276

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

A. kinetic energy; pressure

B. enthalpy; kinetic energy

C. kinetic energy; velocity

D. enthalpy; pressure

ANSWER: B.

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B1476

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

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: B.

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B1775

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation with supersonic steam velocities.

Steam flowing from 1 to 2 undergoes a pressure __________ and a velocity __________.

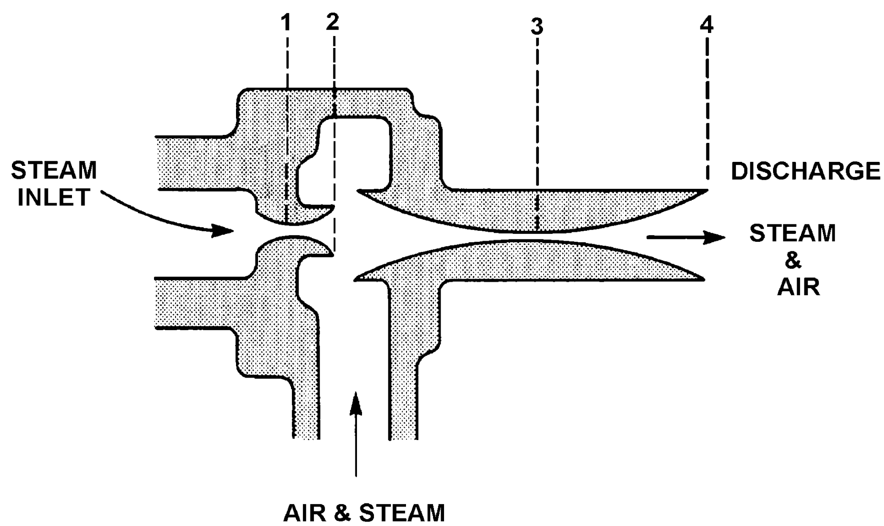
A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

ANSWER: D.



STEAM-JET AIR EJECTOR

TOPIC: 293004
KNOWLEDGE: K1.04 [2.5/2.6]
QID: B3476

Refer to the drawing of a steam-jet air ejector (see figure below) in normal operation with supersonic steam velocities.

Steam flowing from C to D undergoes a pressure __________ and a velocity __________.

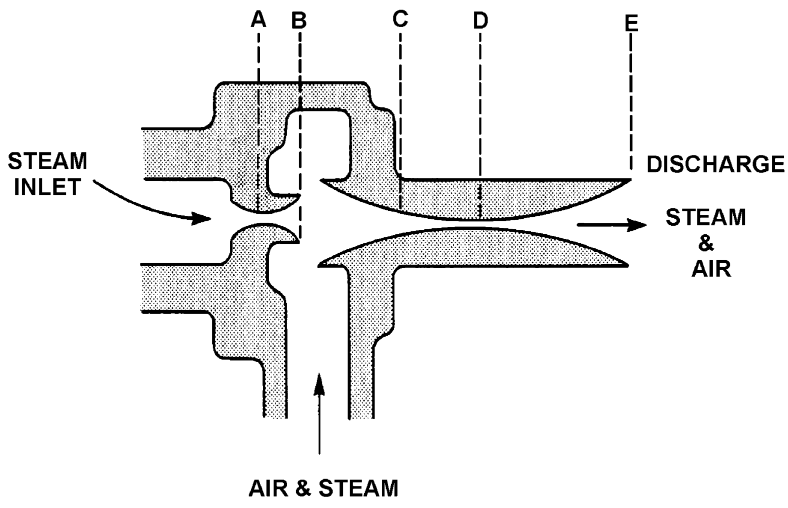
A. decrease; decrease

B. decrease; increase

C. increase; increase

D. increase; decrease

ANSWER: D.



STEAM-JET AIR EJECTOR

TOPIC: 293004
KNOWLEDGE: K1.05 [2.7/2.7]
QID: B276

During jet pump operation, high pressure and low velocity fluid flow is supplied through a ___________ where the pressure drops and the velocity increases, creating a low pressure area in the ___________ section.

A. nozzle; throat

B. nozzle; diffuser

C. diffuser; throat

D. diffuser; nozzle

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.05 [2.7/2.7]
QID: B1076

The lowest pressure in a liquid jet pump exists in the...

A. throat.

B. diffuser.

C. rams head.

D. impeller eye.

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B77

Condensate depression (subcooling) will increase if the ___________ increases.

A. main turbine load

B. condenser cooling water temperature

C. condenser cooling water flow rate

D. air leakage rate into the condenser

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B78 (P2276)

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

A. decreasing power from 100% to 25%.

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

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

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

ANSWER: D.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B200

A nuclear power plant is operating at 90% of rated power. Which one of the following effects will result from an increase in main condenser vacuum (lower absolute pressure)? (Assume reactor power, main steam flow rate, and main condenser cooling water flow rate are unchanged.)

A. An increase in condensate temperature.

B. An increase in the amount of noncondensible gas in the main condenser.

C. An increase in main turbine efficiency.

D. An increase in condensate subcooling.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B277 (P477)

Main condenser pressure is 1.0 psia. During the cooling process in the condenser, the temperature of the low pressure turbine exhaust decreases to 100°F, at which time it is a...

A. saturated liquid.

B. saturated vapor.

C. subcooled liquid.

D. superheated vapor.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B1484 (P3576)

A main condenser is operating at 28 inches of Hg vacuum with a condensate outlet temperature of 92°F. Which one of the following is the approximate amount of condensate depression?

A. 6°F

B. 10°F

C. 13°F

D. 17°F

ANSWER: B.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B1876 (P876)

Which one of the following is the approximate condensate subcooling in a steam condenser operating at 26 inches Hg vacuum with a condensate temperature of 100°F?

A. 2°F

B. 19°F

C. 25°F

D. 53°F

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2077 (P2476)

A nuclear power plant is operating at 90% of rated power. Main condenser pressure is 1.69 psia and hotwell condensate temperature is 120°F.

Which one of the following describes the effect of a 5% decrease in cooling water flow rate through the main condenser?

A. Overall steam cycle thermal efficiency will increase because the work output of the turbine will increase.

B. Overall steam cycle thermal efficiency will increase because condensate depression will decrease.

C. Overall steam cycle thermal efficiency will decrease because the work output of the turbine will decrease.

D. Overall steam cycle thermal efficiency will decrease because condensate depression will increase.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2176 (P1176)

A nuclear power plant is operating at 80% of rated power with 5°F of condensate depression in the main condenser. If the condensate depression increases to 10°F, plant efficiency will ____________ and the probability of condensate pump cavitation will ____________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: D.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2277

Condensate depression is the process of...

A. removing condensate from turbine exhaust steam.

B. spraying condensate into turbine exhaust steam.

C. heating turbine exhaust steam above its saturation temperature.

D. cooling turbine exhaust steam below its saturation temperature.

ANSWER: D.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2576 (P2576)

A nuclear power plant is operating at 80% power with 5°F of condensate depression in the main condenser. If the condensate depression decreases to 2°F, plant thermal efficiency will ____________ and the probability of condensate pump cavitation will ____________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2676 (P576)

Which one of the following explains why condensate subcooling is necessary in a nuclear power plant steam cycle?

A. To provide a better condenser vacuum.

B. To maximize overall steam cycle thermal efficiency.

C. To provide net positive suction head for the condensate pumps.

D. To minimize turbine blade and condenser tube erosion by entrained moisture.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2775 (P1977)

Condensate is collecting in a main condenser hotwell at 90°F with a condenser pressure of 28 inches Hg vacuum. Which one of the following will improve steam cycle efficiency?

A. Main condenser cooling water flow rate decreases by 5% with no change in condenser vacuum.

B. Main condenser cooling water inlet temperature decreases by 10°F with no change in condenser vacuum.

C. Main condenser vacuum decreases to 27 inches Hg due to buildup of noncondensible gases.

D. Steam flow through the turbine decreases by 10% with no change in condenser vacuum.

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B2976 (P1576)

What is the approximate condensate depression in a condenser operating at 28 inches Hg vacuum with a condensate temperature of 100°F?

A. Less than 2°F

B. 3°F to 5°F

C. 6°F to 8°F

D. 9°F to 11°F

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.12 [2.9/3.1]
QID: B3877 (P3876)

Main turbine exhaust enters a main condenser and condenses at 126°F. The condensate is cooled to 100°F before entering the main condenser hotwell. Assuming main condenser vacuum does not change, which one of the following would improve the thermodynamic efficiency of the steam cycle?

A. Increase condenser cooling water flow rate by 5%.

B. Decrease condenser cooling water flow rate by 5%.

C. Increase main condenser hotwell level by 5%.

D. Decrease main condenser hotwell level by 5%.

ANSWER: B.

TOPIC: 293004
KNOWLEDGE: K1.13 [2.5/2.6]
QID: B377

A nuclear power plant is operating at 100% power when the only in-service steam jet air ejector is inadvertently isolated from the main condenser. The operator verifies that condenser cooling water system parameters have not changed. If no operator action is taken over the next 60 minutes, condenser vacuum will...

A. slowly increase (lower absolute pressure).

B. slowly decrease and stabilize at a slightly lower vacuum (higher absolute pressure).

C. slowly and continuously decrease (higher absolute pressure) towards atmospheric pressure.

D. remain essentially the same (constant absolute pressure).

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.13 [2.5/2.6]
QID: B877

Which one of the following explains why condensation of the steam entering a main condenser creates a vacuum?

A. The entropy of the steam increases.

B. The entropy of the steam decreases.

C. The specific volume of the steam increases.

D. The specific volume of the steam decreases.

ANSWER: D.

TOPIC: 293004
KNOWLEDGE: K1.13 [2.5/2.6]
QID: B977

A nuclear power plant is operating at 90% of rated power. Which one of the following describes the effect of increasing cooling water flow rate through the main condenser?

A. The saturation temperature in the main condenser decreases.

B. The enthalpy of the condensate leaving the main condenser increases.

C. The temperature of the cooling water leaving the main condenser increases.

D. The total rate of heat transfer from the turbine exhaust steam to the cooling water decreases.

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.13 [2.5/2.6]
QID: B1177

A nuclear power plant is operating at 100% power. Which one of the following describes how and why main condenser pressure changes when condenser cooling water flow rate significantly decreases?

A. Decreases because main condenser saturation temperature increases.

B. Decreases because main condenser condensate subcooling decreases.

C. Increases because main condenser saturation temperature increases.

D. Increases because main condenser condensate subcooling decreases.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.13 [2.5/2.6]
QID: B2377

A nuclear power plant is operating at 100% power. Which one of the following describes how and why main condenser pressure changes when condenser cooling water flow rate increases significantly?

A. Decreases because main condenser saturation (shell) temperature decreases

B. Decreases because main condenser condensate subcooling increases

C. Increases because main condenser saturation (shell) temperature decreases

D. Increases because main condenser condensate subcooling increases

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B577

During normal nuclear power plant operation at full power, the operating pressure in the main condenser is directly affected by the: (Assume each parameter remains within its normal operating range.)

A. amount of condensate subcooling.

B. level of the condensate in the hotwell.

C. temperature of the condenser cooling water.

D. quality of the steam entering the high pressure turbine.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B1677

Which one of the following is a primary function performed by a main condenser?

A. Deaerate turbine exhaust condensate

B. Remove ions from main condensate

C. Filter out impurities from main condensate

D. Provide net positive suction head for feed water pumps

ANSWER: A.

TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B1777

A nuclear power plant is operating normally at 80% power. Which one of the following will result in the most rapid initial loss of condenser vacuum?

A. All air ejectors are isolated from the main condenser.

B. All feed and condensate pumps are stopped.

C. All condenser cooling water flow is stopped.

D. All condenser hotwell makeup water flow is stopped.

ANSWER: C.

TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B3077 (P3078)

Which one of the following will be caused by a decrease in main condenser vacuum (higher absolute pressure) on a nuclear power plant operating at full power? (Assume main steam flow rate and condenser circulating water flow rate are unchanged.)

A. Decrease in the condensate temperature

B. Decrease in the ideal steam cycle efficiency

C. Decrease in the condensate pump required NPSH

D. Decrease in the mass of noncondensible gas in the condenser

ANSWER: B.

TOPIC: 293004
KNOWLEDGE: K1.14 [2.6/2.7]
QID: B3777 (P3734)

A nuclear power plant is operating near rated power with the following initial conditions:

Main steam pressure: 900 psia
Main steam quality: 100%, saturated vapor
Main condenser pressure: 1.0 psia

Air leakage into the main condenser results in the main condenser pressure increasing and stabilizing at 2.0 psia. Assume that all main steam parameters (e.g., pressure, quality, and mass flow rate) remain the same and that the main turbine efficiency remains at 100%.

Which one of the following is the approximate percent by which the main generator output will decrease as a result of the main condenser pressure increase?

A. 5.0%

B. 6.3%

C. 7.5%

D. 8.8%

ANSWER: C.

TOPIC: 293005
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B678

The location in a main turbine that experiences the greatest amount of blade erosion is in the __________ stage of the __________ pressure turbine.

A. last; high

B. last; low

C. first; high

D. first; low

ANSWER: B.

TOPIC: 293005
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B1978 (P2678)

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

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

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

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

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

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B2678

A steam plant main turbine consists of a high-pressure (HP) unit and several low-pressure (LP) units. The main turbine is most likely to experience stress-related failures of the rotor blades in the _____ stages of the ________ unit(s).

A. inlet; HP

B. inlet; LP

C. outlet; HP

D. outlet; LP

ANSWER: D.

TOPIC: 293005
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B2978 (P2278)

If the moisture content of the steam supplied to a main turbine increases, (assume <u>no</u> change in steam pressure, condenser pressure, or control valve position) turbine work will...

A. decrease, because the enthalpy of the steam being supplied to the turbine has decreased.

B. decrease, because moist steam results in more windage losses in the turbine.

C. increase, because the enthalpy of the steam being supplied to the turbine has increased.

D. increase, because moist steam results in less windage losses in the turbine.

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B129

What is the effect of isolating extraction steam to a high-pressure feed water heater while at 90% of rated power?

A. The core inlet subcooling remains the same while the turbine generator MWe output decreases.

B. The core inlet subcooling and the reactor power (MWt) decrease.

C. The reactor power (MWt) and the turbine generator MWe output remain the same.

D. The core inlet subcooling increases and the turbine generator MWe output increases.

ANSWER: D.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B140

A direct advantage of using feed water heaters in a typical steam cycle is that heaters increase...

A. cycle efficiency.

B. turbine efficiency.

C. turbine kW output.

D. feed water pump net positive suction head.

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B278

Which one of the following is the most probable location for superheated steam in a boiling water reactor steam cycle that uses moisture separator reheaters?

A. The outlet of the high pressure turbine

B. The inlet of the low pressure turbines

C. The inlet of the high pressure turbine

D. The outlet of the low pressure turbines

ANSWER: B.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B978

A nuclear power plant is operating steady-state at 85% of rated power when the extraction steam to a high-pressure feedwater heater is isolated. Which one of the following describes the initial effect on main turbine- generator output (MWe)? (Assume no operator action and no reactor protection actuation.)

A. MWe increases because plant efficiency increases.

B. MWe decreases because plant efficiency decreases.

C. MWe increases because the total steam flow rate through the turbine increases.

D. MWe decreases because the total steam flow rate through the turbine decreases.

ANSWER: C.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B1278

A nuclear power plant was initially operating normally at 90% reactor power when heating steam (extracted from the main turbine) was automatically isolated to several feedwater heaters. Reactor power was returned to 90% and the plant is currently stable.

Compared to the initial main generator MW load, the current main generator MW load is...

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

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

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

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

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B1378

A nuclear power plant is operating at 80% of rated power with 10°F of condensate subcooling. Which one of the following initially will increase plant thermodynamic efficiency? (Assume main condenser vacuum does not change unless otherwise stated.)

A. Isolating heating steam to a feedwater heater.

B. Decreasing main condenser cooling water flow rate.

C. Decreasing main condenser cooling water temperature.

D. Decreasing main condenser vacuum (increasing pressure).

ANSWER: B.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B1679 (P1980)

A nuclear power plant is initially operating at 85% reactor power when extraction steam to a high-pressure feedwater heater is isolated. Main generator load is returned to its initial value. When the plant stabilizes, reactor power will be __________ than 85% and overall plant thermal efficiency will be __________.

A. greater; lower

B. greater; higher

C. less; lower

D. less; higher

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B1879 (P1878)

A nuclear power plant is operating at 85% of rated thermal power when the extraction steam to a high-pressure feedwater heater is isolated. After the transient, the operator returns reactor power to 85% and stabilizes the plant. Compared to conditions just prior to the transient, current main turbine generator output (MWe) is...

A. higher because increased steam flow causes the turbine generator to pick up load.

B. lower because decreased steam flow causes the turbine generator to reject load.

C. higher because plant efficiency has increased.

D. lower because plant efficiency has decreased.

ANSWER: D.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B2178 (P2178)

If superheating of the inlet steam to the low pressure turbines is reduced, low pressure turbine work output will __________ and low pressure turbine exhaust steam moisture content will ___________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: C.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B3378 (P3375)

Given the following:

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

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

A. 10 lbm

B. 20 lbm

C. 30 lbm

D. 40 lbm

ANSWER: B.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B3578 (P378)

Steam turbines X and Y are identical 100% efficient turbines that exhaust to a condenser at 1.0 psia. Saturated steam at 250 psia enters turbine X. Superheated steam at 250 psia and 500°F enters turbine Y.

Which one of the following lists the percentage of moisture at the exhaust of turbines X and Y?

	Turbine X	Turbine Y
A.	24.5%	20.5%
B.	26.3%	13.0%
C.	24.5%	13.0%
D.	26.3%	20.5%

ANSWER: A.

TOPIC: 293005
KNOWLEDGE: K1.05 [2.7/2.8]
QID: B3778 (P3774)

Given the following:

- A saturated steam-water mixture with an inlet quality of 40% is flowing through a moisture separator.
- The moisture separator is 100% efficient for removing water.

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

A. 10 lbm

B. 20 lbm

C. 30 lbm

D. 40 lbm

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.03 [2.4/2.5]
QID: B925 (P1921)

Refer to the drawing of a centrifugal pump operating curve and system curve (see figure below).

Which one of the following determines the general shape of the curve from point C to point D?

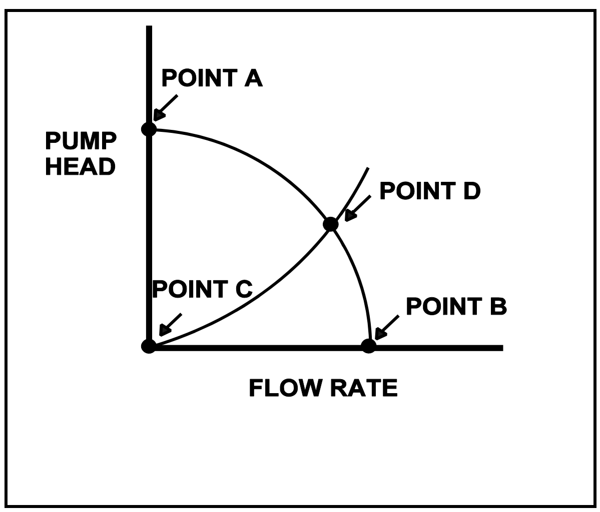
A. The pump flow losses due to the decrease in available net positive suction head as the system flow rate increases.

B. The pump flow losses due to back leakage through the clearances between the pump impeller and casing as the D/P across the pump increases.

C. The frictional and throttling losses in the piping system as the system flow rate increases.

D. The frictional losses between the pump impeller and its casing as the differential pressure (D/P) across the pump increases.

ANSWER: C.



TOPIC: 293006
KNOWLEDGE: K1.03 [2.4/2.5]
QID: B979

Head loss is the...

A. reduction in discharge pressure experienced by a real pump due to slippage.

B. reduction in discharge pressure experienced by a real pump due to mechanical friction.

C. conversion of system fluid pressure and velocity to heat energy as a result of friction.

D. decrease in static pressure in a piping system resulting from decreases in elevation.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B79 (P80)

If a valve closure suddenly stops fluid flow, the resulting piping system pressure change is referred to as...

A. cavitation.

B. shutoff head.

C. water hammer.

D. valve chatter.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B148 (P2279)

Which one of the following operating practices <u>minimizes</u> the possibility of water hammer?

A. Change valve position as rapidly as possible.

B. Start a centrifugal pump with the discharge valve throttled.

C. Start a positive displacement pump with the discharge valve closed.

D. Vent a system only after initiating system flow.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B279 (P679)

A sudden stop of fluid flow in a piping system, due to rapid closure of an isolation valve, will <u>most likely</u> result in...

A. check valve slamming.

B. pump runout.

C. piping hanger damage.

D. pressurized thermal shock.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B380 (P381)

The major concern with starting a main feedwater pump with downstream fluid in a saturated condition is...

A. cavitation.

B. water hammer.

C. thermal shock.

D. positive reactivity addition.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B1180 (P2480)

Which one of the following will increase the possibility of water hammer?

A. Opening and closing system valves very slowly

B. Venting liquid systems only after initiating system flow

C. Starting centrifugal pumps with the discharge valve closed

D. Starting positive displacement pumps with the discharge valve open

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B2081 (P2079)

Which one of the following will minimize the possibility of water hammer?

A. Draining the discharge line of a centrifugal pump after shutdown

B. Draining condensate out of steam lines before and after initiating flow

C. Starting a centrifugal pump with its discharge valve fully open

D. Starting a positive displacement pump with its discharge valve partially closed

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B2679 (P2279)

Which one of the following operating practices minimizes the possibility of water hammer?

A. Change valve positions as rapidly as possible.

B. Start centrifugal pumps with the discharge valve throttled.

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

D. Vent systems only after initiating system flow.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B2779 (P1879)

Which one of the following describes why large steam lines are gradually warmed instead of suddenly admitting full steam flow?

A. To minimize the possibility of stress corrosion cracking of the steam lines.

B. To minimize the total thermal expansion of the steam lines.

C. To minimize the potential for water hammer in the steam lines.

D. To minimize the heat loss from the steam lines.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.05 [3.2/3.3]
QID: B4041 (P4042)

Refer to the drawing of two lengths of 6-inch diameter pipe, each containing an identical automatic isolation valve. The actual pipe lengths are proportional to their symbols in the drawing

Water at 65°F is flowing at 1,000 gpm through each pipe. If the isolation valves instantly close, valve A and its associated piping will experience a pressure increase that is _________ the pressure increase experienced by valve B and its associated piping. The pressure spike will dissipate quicker in the _________ length of pipe.

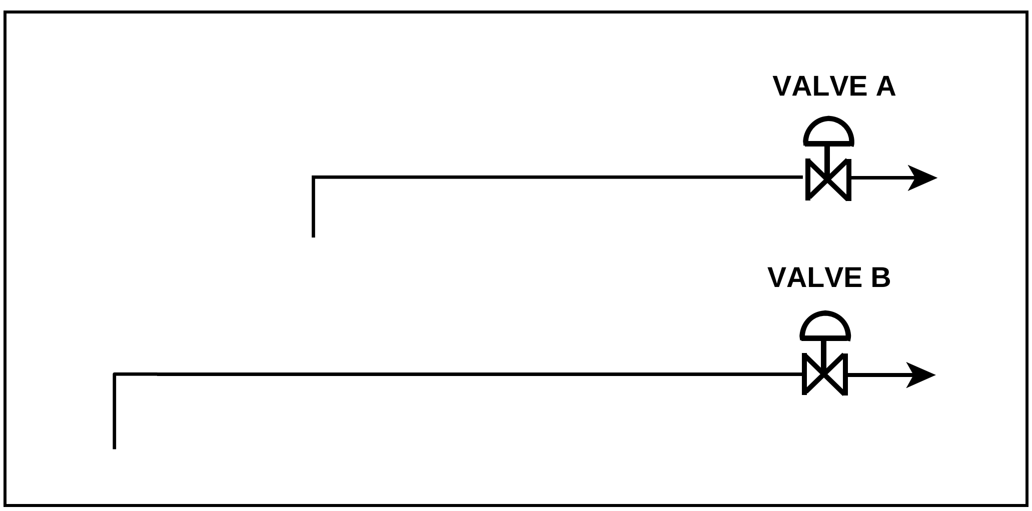
A. equal to; shorter

B. equal to; longer

C. less than; shorter

D. less than; longer

ANSWER: A.



TOPIC: 293006
KNOWLEDGE: K1.06 [2.5/2.6]
QID: B1480

Which one of the following components of a centrifugal pump has the specific primary function of converting the kinetic energy of a fluid into pressure?

A. Volute

B. Impeller

C. Pump shaft

D. Discharge nozzle

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.07 [2.5/2.6]
QID: B479

If the discharge valve of an operating ideal positive displacement pump is repositioned from fully open to 75% open, pump head will ____________ and pump flow rate will ___________.

A. increase; remain the same

B. increase; decrease

C. remain the same; remain the same

D. remain the same; decrease

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.07 [2.5/2.6]
QID: B1280

Which one of the following describes pump head?

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

B. The energy added by a pump in excess of shutoff head

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

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

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.07 [2.5/2.6]
QID: B1680 (P3525)

An ideal positive displacement pump is pumping to a system operating at 100 psig. Assume pump speed is constant, zero pump slip, and pump backpressure remains within normal pump operating limits.

If system pressure increases to 200 psig, the pump head will ________; and pump flow rate will ________.

A. increase; remain the same

B. increase; decrease

C. remain the same; remain the same

D. remain the same; decrease

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.08 [2.5/2.6]
QID: B198

Which one of the following statements describes application of centrifugal pump laws?

A. Pump head is directly proportional to speed.

B. Power varies as the square of the speed.

C. Pump head varies as the square of the speed.

D. Capacity varies as the cube of the speed.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.08 [2.5/2.6]
QID: B322 (P325)

Increasing the flow rate from a centrifugal pump by throttling open the discharge valve will cause pump head to...

A. increase and stabilize at a higher value.

B. decrease and stabilize at a lower value.

C. remain constant because pump head is a design parameter.

D increase, then decrease following the pump's efficiency curve.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.08 [2.5/2.6]
QID: B2579

Decreasing the flow rate from a centrifugal pump by throttling the pump discharge valve will cause pump head to...

A. increase and stabilize at a higher value.

B. decrease and stabilize at a lower value.

C. remain constant because pump head is a design parameter.

D. decrease, then increase following the pump's efficiency curve.

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.08 [2.5/2.6]
QID: B3579 (P2923)

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

A two-speed centrifugal pump is operating at fast speed in a cooling water system and discharging through a heat exchanger. The pump is then switched to slow speed.

Which set of curves illustrates the initial and final pump operating conditions?

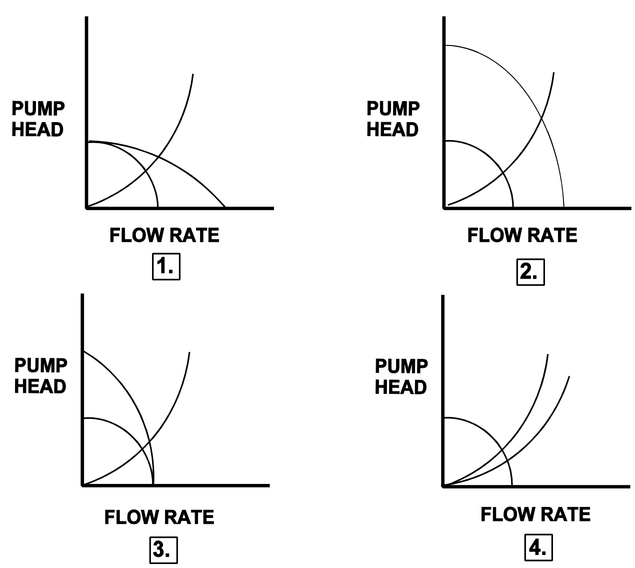
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: B.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.09 [2.8/2.9]
QID: B80 (P382)

Which one of the following is most likely to cause cavitation of an operating centrifugal pump?

A. Lowering the suction temperature.

B. Throttling the pump suction valve.

C. Throttling the pump discharge valve.

D. Decreasing the pump speed.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.09 [2.8/2.9]
QID: B280 (P2680)

Cavitation is the formation of vapor bubbles in the ______________ pressure area of a pump followed by the ______________ of these bubbles within the pump casing.

A. low; expansion

B. low; collapse

C. high; expansion

D. high; collapse

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.09 [2.8/2.9]
QID: B1880

Complete the following statement.

Pump cavitation occurs when vapor bubbles are formed at the eye of a pump impeller...

A. because the localized flow velocity exceeds sonic velocity for the existing fluid temperature.

B. because the localized pressure exceeds the vapor pressure for the existing fluid temperature.

C. and enter a high pressure region of the pump where they collapse causing damaging pressure pulsations.

D. and are discharged from the pump where they expand into larger bubbles causing damaging pressure pulsations.

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.10 [2.7/2.8]
QID: B82

Net positive suction head is the...

A. difference between pump suction pressure and the saturation pressure of the fluid being pumped.

B. difference between the total suction head and the pressure at the eye of the pump.

C. amount of suction pressure required to prevent cavitation.

D. difference between the pump suction pressure and the pump discharge pressure.

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.10 [2.7/2.8]
QID: B281

The available net positive suction head of a centrifugal pump...

A. decreases with increased subcooling to the pump.

B. decreases with an increase in pump flow rate.

C. increases as the suction temperature increases.

D. decreases as pump discharge pressure increases.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.10 [2.7/2.8]
QID: B1381

Which one of the following sets of parameters directly affects available net positive suction head for the recirculation pumps?

A. Feed water temperature, reactor power, and reactor water level

B. Feed water temperature, reactor pressure, and reactor water level

C. Reactor water level, feed water flow rate, and reactor power

D. Reactor pressure, reactor power, and feed water flow rate

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.11 [2.4/2.5]
QID: B381

A single stage centrifugal pump is operating in an open system. Which one of the following is the force caused by subjecting the pump impeller to the unequal pressures that exist at the suction and the discharge of the pump?

A. Axial thrust

B. Radial thrust

C. Kingsbury thrust

D. Journal thrust

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.11 [2.4/2.5]
QID: B680

An ac motor-driven centrifugal pump is operating at rated flow and pressure in a cooling water system. A break occurs in the pump discharge piping resulting in a loss of pump backpressure.

As a result of the break, the pump will operate at a ________ flow rate and the pump motor will draw ________ electrical power.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.12 [2.9/2.9]
QID: B143 (P279)

A centrifugal water pump is being returned to service after maintenance. However, the operator fails to vent the pump.

Compared to normal operations, after the pump is started, the operator will see __________ flow rate and __________ discharge head.

A. higher; lower

B. higher; higher

C. lower; lower

D. lower; higher

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B283

A single-speed centrifugal pump, A, is operating in a closed system. An identical centrifugal pump, B, is started in parallel with pump A. The major effect of operating pump B in parallel with pump A is...

A. increased system pressure.

B. increased system flow rate.

C. decreased system pressure.

D. decreased system flow rate.

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B880

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

Pumps A and B are identical single-speed centrifugal pumps, but only pump A is operating. Assume real (non-ideal) system and pump operating characteristics.

If pump B is started, system flow rate will __________ and the total pump head will __________.

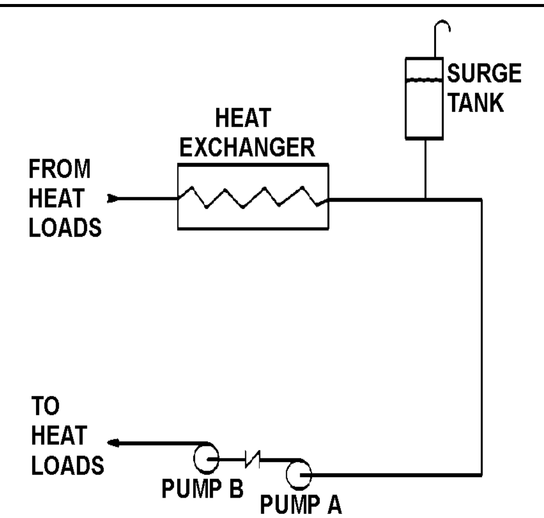
A. increase; increase

B. increase; remain the same

C. remain the same; increase

D. remain the same; remain the same

ANSWER: A.



COOLING WATER SYSTEM

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B1578 (P926)

Refer to the drawing of four sets of centrifugal pump operating curves (see figure below). Each set of curves shows the results of a change in pump/system operating conditions.

Two identical constant-speed centrifugal pumps are operating in series in an open system when one pump trips.

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

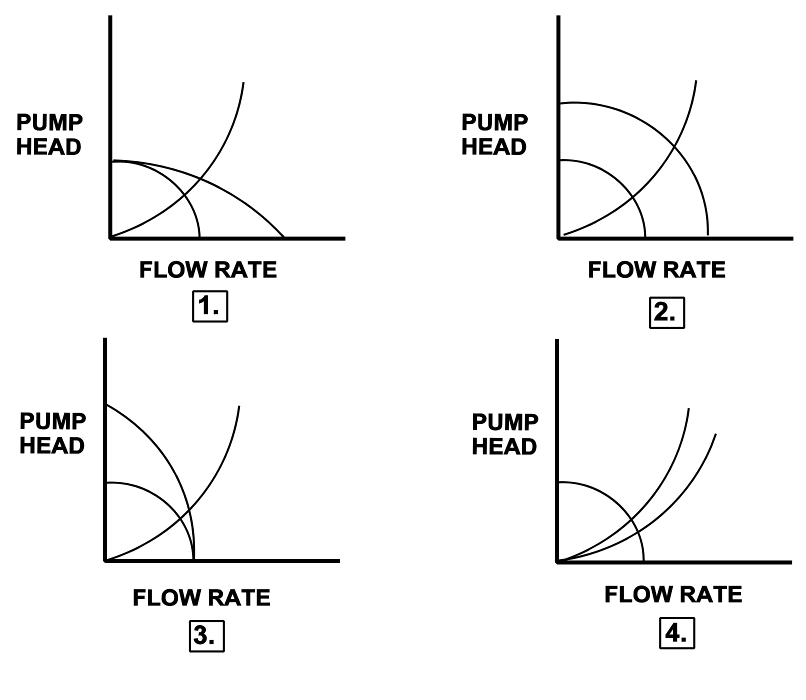
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: C.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B1678

Refer to the drawing of a cooling water system and the associated centrifugal pump operating curve showing two-pump operation (see figure below).

Pumps A and B are identical single-speed centrifugal pumps and both pumps are operating.

If pump B trips, system flow rate will __________ and common pump discharge pressure will __________.

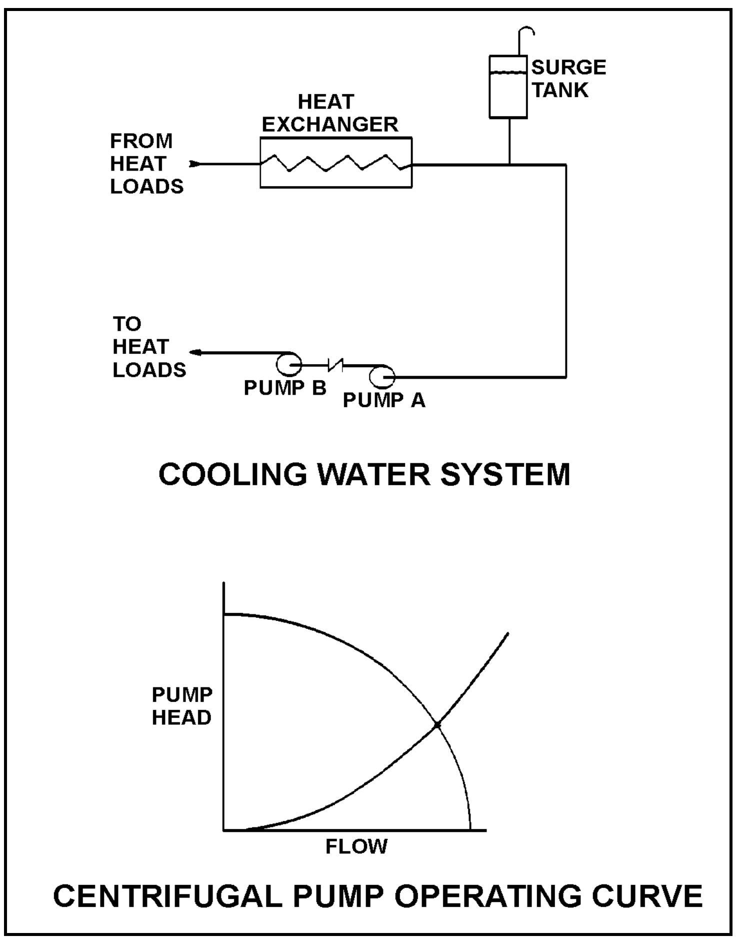
A. remain the same; decrease

B. decrease; remain the same

C. remain the same; remain the same

D. decrease; decrease

ANSWER: D.



TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B1725 (P1784)

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,000 psig.

Given the following information:

Centrifugal Pumps

Shutoff head:	1,500 psig
Maximum design pressure:	2,000 psig

Positive Displacement Pumps

Maximum design pressure:	2,000 psig

Which one of the following pump configurations will supply the lowest makeup flow rate to the system if system pressure is at 1,700 psig?

A. Two CPs in series

B. Two CPs in parallel

C. One PDP and one CP in series (CP supplying PDP)

D. One PDP and one CP in parallel

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B1780 (P1724)

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

A centrifugal pump is initially operating in a closed water system and discharging through a heat exchanger. A second heat exchanger, in parallel with the first, is then placed in service.

Which set of curves illustrates the initial and final operating conditions?

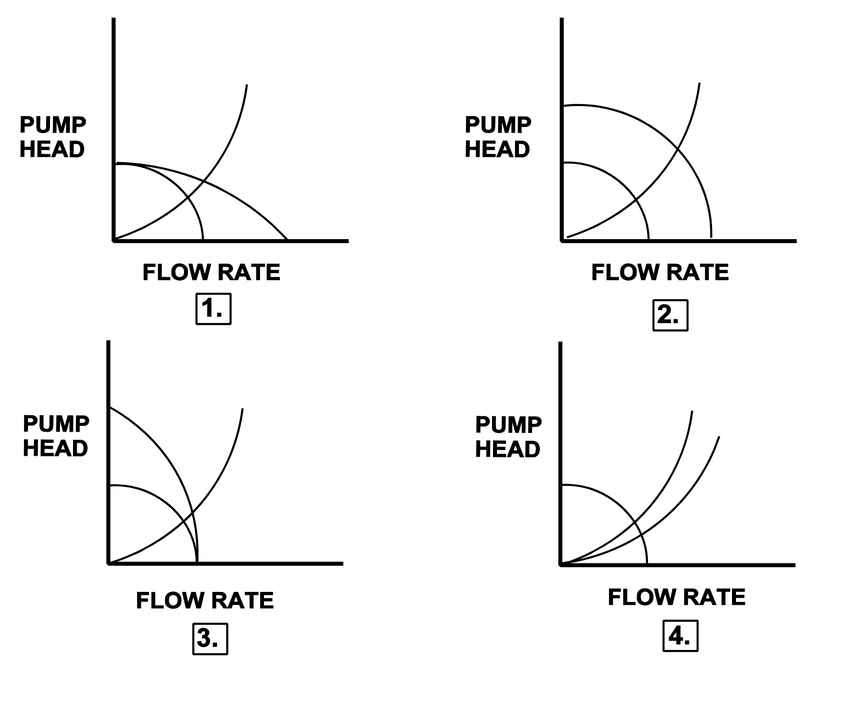
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: D.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B1878 (P1324)

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

A centrifugal pump is operating in a cooling water system. Another identical centrifugal pump is started in series with the first. Which set of curves illustrates the resulting change in system parameters?

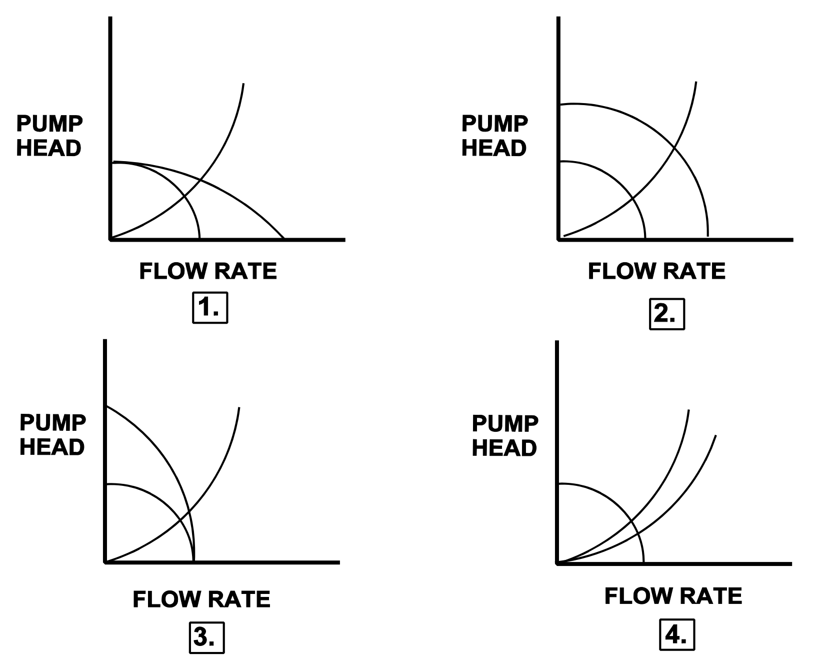
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: C.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B2279 (P1524)

Refer to the drawing of four sets of centrifugal pump operating curves (see figure below). Each set of curves shows the results of a change in pump/system operating conditions.

Two identical constant-speed centrifugal pumps are operating in parallel in an open system when one pump trips.

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

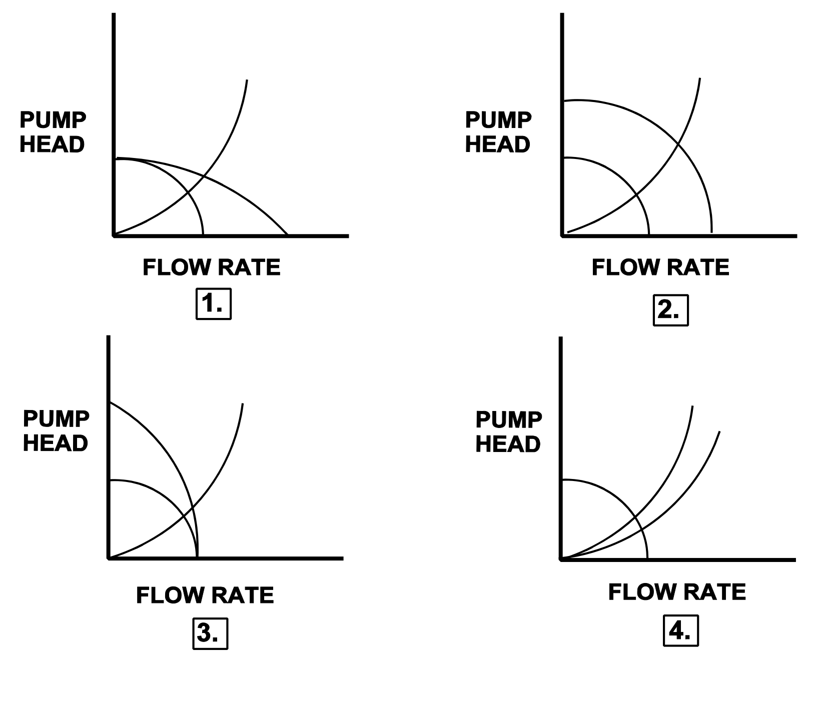
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: A.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B2324 (P2383)

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,200 psig.

Given the following information:

<u>Centrifugal Pumps</u>

Shutoff head:	1,500 psig
Maximum design pressure:	2,000 psig

<u>Positive Displacement Pumps</u>

Maximum design pressure:	2,000 psig

Which one of the following pump configurations will supply the <u>highest</u> makeup flow rate to the system if system pressure is at 500 psig?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One CP and one PDP in series (CP supplying PDP)

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B2723 (P2783)

Two identical centrifugal pumps (CPs) and two identical positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1200 psig.

Given the following information:

Centrifugal Pumps

Shutoff head:	1,500 psig
Maximum design pressure:	2,000 psig
Flow rate with no backpressure:	180 gpm

Positive Displacement Pumps

Maximum design pressure:	2,000 psig

Which one of the following pump configurations will supply the highest makeup flow rate to the cooling water system if system pressure is at 1,700 psig?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One CP and one PDP in series (CP supplying PDP)

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B2879 (P2823)

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

A two-speed centrifugal pump is operating in low speed in a cooling water system and discharging through a heat exchanger. The pump is then switched to high speed.

Which set of curves illustrates the initial and final operating conditions?

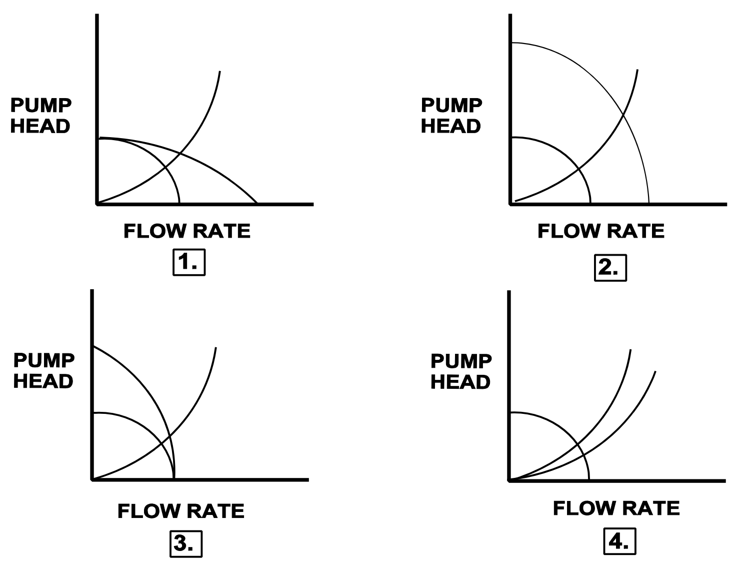
A. 1.

B. 2.

C. 3.

D. 4.

ANSWER: B.



CENTRIFUGAL PUMP CURVES

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B3681 (P3683)

Two identical single-speed centrifugal pumps (CPs) and two identical single-speed positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,200 psig.

Given the following information:

Centrifugal Pumps

Discharge pressure at shutoff head:	1,500 psig
Maximum design pressure:	2,000 psig
Flow rate with no backpressure:	180 gpm

Positive Displacement Pumps

Maximum design pressure:	2,000 psig

Which one of the following makeup water pump configurations will supply the highest initial flow rate to a cooling water system that is drained and depressurized?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One CP and one PDP in series (CP supplying PDP)

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.13 [2.6/2.7]
QID: B4342 (P4343)

Two identical single-speed centrifugal pumps (CPs) and two identical single-speed positive displacement pumps (PDPs) are able to take suction on a vented water storage tank and provide makeup water flow to a cooling water system. The pumps are capable of being cross-connected to provide multiple configurations. In single pump alignment, each pump will supply 100 gpm at a system pressure of 1,200 psig.

Given the following information:

Centrifugal Pumps

Discharge pressure at shutoff head:	1,500 psig
Maximum design pressure:	2,000 psig
Flow rate with no backpressure:	180 gpm

Positive Displacement Pumps

Maximum design pressure:	2,000 psig

Which one of the following pump configurations will supply the lowest initial flow rate of makeup water to a cooling water system that is drained and depressurized?

A. Two CPs in series

B. Two CPs in parallel

C. Two PDPs in parallel

D. One CP and one PDP in series (CP supplying PDP)

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.19 [2.7/2.9]
QID: B1181 (P1222)

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

High pressure coolant injection (HPCI) pumps:	1,200 psia
Low pressure coolant injection (LPCI) pumps:	200 psia

Which pumps are currently threatened for operability and why?

A. LPCI pumps due to pump overheating

B. LPCI pumps due to motor overheating

C. HPCI pumps due to pump overheating

D. HPCI pumps due to motor overheating

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.19 [2.7/2.9]
QID: B3281

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

High pressure coolant injection (HPCI) pumps:	800 psia
Low pressure coolant injection (LPCI) pumps:	200 psia

Which pumps are currently threatened for operability and why?

A. Only the LPCI pumps due to pump overheating

B. All LPCI and HPCI pumps due to pump overheating

C. Only the HPCI pumps due to motor overheating

D. All LPCI and HPCI pumps due to motor overheating

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.21 [2.4/2.6]
QID: B1980

A reactor heatup is in progress. Which one of the following reactor temperatures will result in a main steam line pressure of approximately 530 psig?

A. 462°F

B. 468°F

C. 476°F

D. 484°F

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B383 (P380)

An 85 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 50 psig?

A. 33.3 gpm

B. 42.5 gpm

C. 51.7 gpm

D. 60.1 gpm

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B681 (P680)

A 55 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 50 psig?

A. 27.5 gpm

B. 31.8 gpm

C. 38.9 gpm

D. 43.4 gpm

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B1783 (P1779)

A 100 gpm leak to atmosphere has developed from a cooling water system that is operating at 45 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 30 psig?

A. 25 gpm

B. 50 gpm

C. 67 gpm

D. 82 gpm

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B1979 (P1580)

A 60 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A. 15 gpm

B. 30 gpm

C. 42 gpm

D. 53 gpm

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2080 (P2080)

An 80 gpm leak to atmosphere has developed from in a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A. 69 gpm

B. 60 gpm

C. 51 gpm

D. 40 gpm

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2281 (P2282)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec. The pipe then splits into two pipes, a 4-inch diameter pipe and an 8-inch diameter pipe.

Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 4-inch and 8-inch diameter pipes?

	4-inch Pipe (lbm/sec)	8-inch Pipe (lbm/sec)
A.	20	80
B.	25	75
C.	30	70
D.	33	67

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2381 (P2379)

A 60 gpm leak to atmosphere has developed from a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 100 psig?

A. 27 gpm

B. 35 gpm

C. 40 gpm

D. 49 gpm

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2479 (P2481)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec. The pipe then splits into two pipes, a 3-inch diameter pipe and a 6-inch diameter pipe. Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 3-inch and 6-inch diameter pipes? (Assume fluid velocity is the same in each pipe.)

	3-inch Pipe (lbm/sec)	6-inch Pipe (lbm/sec)
A.	10	90
B.	20	80
C.	25	75
D.	33	67

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2581 (P2582)

Water at 90°F and 50 psig is flowing through a 10-inch diameter pipe at 100 lbm/sec. The pipe then splits into two pipes, a 6-inch diameter pipe and an 8-inch diameter pipe.

Disregarding any flow restrictions other than pipe size, which one of the following lists the approximate flow rates through the 6-inch and 8-inch diameter pipes? (Assume fluid velocity is the same in each pipe.)

	6-inch Pipe (lbm/sec)	8-inch Pipe (lbm/sec)
A.	24	76
B.	32	68
C.	36	64
D.	40	60

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2781 (P2779)

An 80 gpm leak to atmosphere has developed in a cooling water system that is operating at 150 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 75 psig?

A. 20 gpm

B. 40 gpm

C. 49 gpm

D. 57 gpm

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B2981 (P1679)

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

A. 33.3 gpm

B. 53.0 gpm

C. 57.7 gpm

D. 70.7 gpm

ANSWER: C.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B3181 (P3080)

A 75 gpm leak to atmosphere has developed from a cooling water system that is operating at 100 psig. Which one of the following will be the approximate leak rate when system pressure has decreased to 80 psig?

A. 26.5 gpm

B. 38.9 gpm

C. 56.4 gpm

D. 67.1 gpm

ANSWER: D.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B3581

A reactor shutdown has been performed because of leakage from the main condenser cooling water system into the main condenser through a tube leak.

Given the following initial conditions:

Main condenser pressure is 1.0 psia.
Main condenser cooling water system pressure is 10 psig.
Main condenser cooling water inlet temperature is 60°F.
Cooling water leak rate into the main condenser is 100 gpm.

If the main condenser is brought to atmospheric pressure, with no changes to the main condenser cooling water system parameters, what will be the approximate rate of cooling water leakage into the main condenser?

A. 17 gpm

B. 28 gpm

C. 42 gpm

D. 65 gpm

ANSWER: D.

TOPIC: 293006 (Also 291002K1.01)
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B4242 (P4243)

Refer to the drawing of a venturi in a main steamline (see figure below). The venturi inlet and outlet pipe diameters are equal.

A main steamline break downstream of the venturi causes the main steam mass flow rate through the venturi to increase. Soon, the steam reaches sonic velocity in the throat of the venturi.

How will the main steam mass flow rate through the venturi be affected as the steam pressure downstream of the venturi continues to decrease?

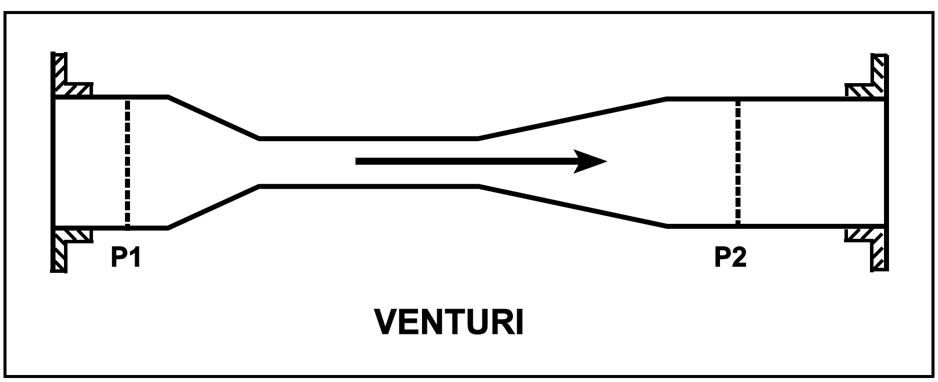
A. It will continue to increase at a rate that is dependent on the steam velocity in the throat of the venturi.

B. It will continue to increase at a rate that is dependent on the differential pressure (P1 - P2) across the venturi.

C. It will not continue to increase because the steam velocity cannot increase above sonic velocity in the throat of the venturi.

D. It will not continue to increase because the differential pressure (P1 - P2) across the venturi cannot increase further once the steam reaches sonic velocity in the throat of the venturi.

ANSWER: C.



TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B4542 (P4543)

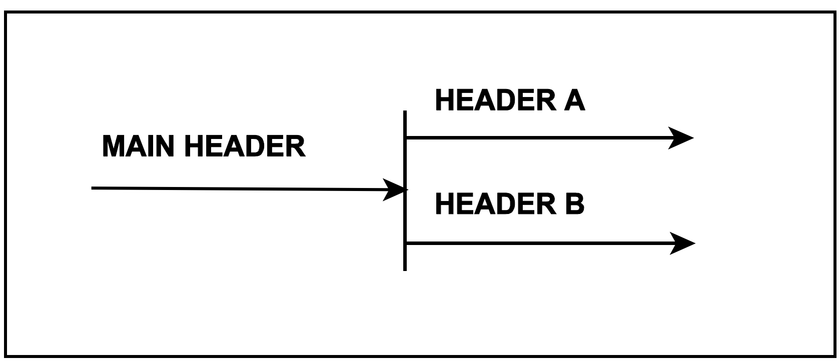
Refer to the drawing of a main water header that splits into two parallel headers (see figure below).

Header A has a 2-inch diameter and header B has a 3-inch diameter. The velocity of the water in both headers is the same.

If the main water header has a flow rate of 500 gpm, what is the approximate flow rate in each of the parallel headers?

	HEADER A (gpm)	HEADER B (gpm)
A.	125	375
B.	154	346
C.	200	300
D.	222	278

ANSWER: B.



TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B4642 (P4643)

A length of pipe in a cooling water system uses a reducer fitting to decrease the pipe diameter from 6 inches to 4 inches. The flow rate in the 6-inch diameter section of pipe is 200 gpm. What is the flow rate in the 4-inch diameter section of pipe?

A. 133 gpm

B. 200 gpm

C. 300 gpm

D. 450 gpm

ANSWER: B.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B5342 (P5342)

A heat exchanger has the following <u>initial</u> cooling water inlet temperature and differential pressure (ΔP) parameters:

Inlet Temperature = 70°F
Heat Exchanger ΔP = 10 psi

Six hours later, the <u>current</u> heat exchanger cooling water parameters are:

Inlet Temperature = 85°F
Heat Exchanger ΔP = 10 psi

In comparison to the initial cooling water mass flow rate, the current mass flow rate is...

A. lower because the density of the cooling water has decreased.

B. higher because the velocity of the cooling water has increased.

C. the same because the changes in cooling water velocity and density offset.

D. the same because the heat exchanger cooling water ΔP is the same.

ANSWER: A.

TOPIC: 293006
KNOWLEDGE: K1.29 [2.6/2.7]
QID: B5542 (P5543)

A vented water storage tank contains 60 feet of water at 70°F. A cracked weld at the bottom rim of the tank results in a leak rate of 12 gpm. If makeup water flow rate is 5 gpm, at what water level will the tank stabilize? (Ignore any frictional head losses as the water exits the tank.)

A. 38.7 feet

B. 25.0 feet

C. 10.4 feet

D. 0.0 feet

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B87

The dominant heat transfer mechanism that occurs when film boiling is present is...

A. convection.

B. radiation.

C. conduction.

D. induction.

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B144

The heat-transfer mechanism using direct contact transfer of kinetic energy from molecular motion is...

A. radiation.

B. convection.

C. transmission.

D. conduction.

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B188

Which one of the following methods of heat transfer is defined as "the exchange of energy between bodies of electromagnetic waves through an intervening space"?

A. Conduction

B. Convection

C. Electrokinetics

D. Radiation

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B285

The heat transfer mechanism that accounts for the <u>majority</u> of core heat removal during a loss of coolant accident after total core voiding is...

A. conduction.

B. convection.

C. radiolysis.

D. radiation.

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B482

The primary mode of heat transfer from the fuel cladding surface during steam blanketing conditions is...

A. radiation.

B. convection.

C. ionization.

D. conduction.

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B882 (P584)

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

Which one of the following is the primary method of heat transfer through the gap between the reactor fuel and the fuel clad?

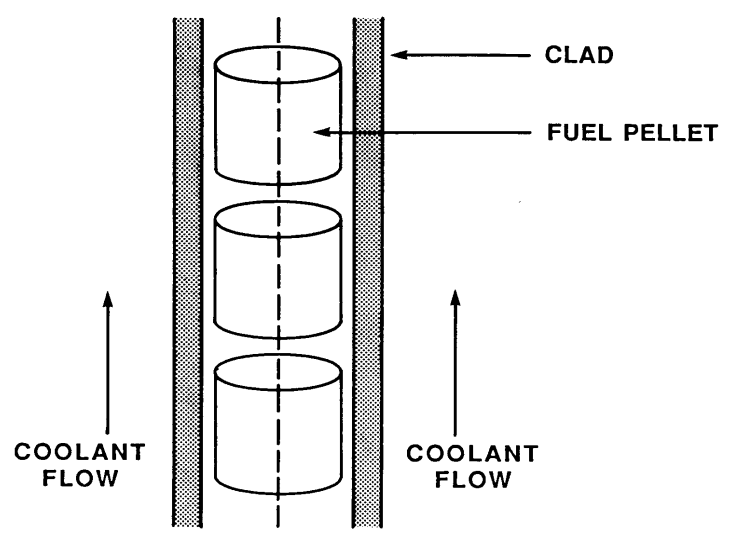
A. Conduction

B. Convection

C. Radiation

D. Natural circulation

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B1282

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

A. radiation.

B. conduction.

C. forced convection.

D. natural convection.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B1582

During normal nuclear power plant operating conditions, which one of the following is the major mode of heat transfer occurring as steam travels from the reactor vessel to the main turbine?

A. Radiolysis

B. Radiation

C. Conduction

D. Convection

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B1982 (P985)

Nuclear reactor fuel rods are normally charged with __________ gas to improve the heat transferred by __________ from the fuel pellets to the cladding.

A. helium; convection

B. helium; conduction

C. nitrogen; convection

D. nitrogen; conduction

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B2282

Which one of the following describes a heat transfer process in which convection is the most significant heat transfer mechanism?

A. From the reactor fuel to the core barrel during core uncovery.

B. Through the tube walls in a main condenser during normal operation at 100% power.

C. From the reactor fuel to the steam outlet of the reactor vessel during a station blackout.

D. From the fuel pellet centerline to the fuel clad during normal operation at 100% power.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B2882 (P2884)

Which one of the following describes a heat transfer flow path in which conduction is the most significant heat transfer mechanism?

A. From the reactor fuel to the core barrel during core uncovery.

B. From the main turbine exhaust steam to the atmosphere via main condenser cooling water and a cooling tower during normal operation.

C. From the reactor fuel to the steam outlet of the reactor vessel during a station blackout.

D. From a fuel pellet to the fuel clad via the fuel rod fill gas during normal operation.

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.02 [2.4/2.6]
QID: B1185

In an operating cooling water system, an increased stagnant fluid film thickness ____________ heat transfer because conduction heat transfer is ____________ efficient than convective heat transfer.

A. enhances; more

B. enhances; less

C. inhibits; more

D. inhibits; less

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.02 [2.4/2.6]
QID: B1682

The buildup of fission gases in a fuel rod causes thermal conductivity of the fuel pellets to _______________ and thermal conductivity of the fill gas to _______________. (Consider only the direct effect of the fission gases.)

A. decrease; decrease

B. decrease; increase

C. increase; decrease

D. increase; increase

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.02 [2.4/2.6]
QID: B2582

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

A. Fuel pellet

B. Fuel clad

C. Fuel rod fill gas

D. Fission product gases

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.03 [2.7/2.8]
QID: B86

The order of reactor coolant heat transfer mechanisms, from the most efficient to the least efficient, is...

A. nucleate boiling, transition boiling, stable film boiling.

B. stable film boiling, nucleate boiling, transition boiling.

C. nucleate boiling, stable film boiling, transition boiling.

D. stable film boiling, transition boiling, nucleate boiling.

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.03 [2.7/2.8]
QID: B286

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

A. increases; decrease

B. increases; increase

C. decreases; decrease

D. decreases; increase

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.03 [2.7/2.8]
QID: B1483

Which one of the following is the order of core heat transfer mechanisms, from the least desirable to the most desirable?

A. Film boiling, single-phase convection, nucleate boiling

B. Film boiling, nucleate boiling, single-phase convection

C. Single-phase convection, nucleate boiling, film boiling

D. Single-phase convection, film boiling, nucleate boiling

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.03 [2.7/2.8]
QID: B2782

The order of reactor coolant heat transfer mechanisms, from the least efficient to the most efficient, is...

A. transition boiling, stable film boiling, nucleate boiling.

B. transition boiling, nucleate boiling, stable film boiling.

C. stable film boiling, nucleate boiling, transition boiling.

D. stable film boiling, transition boiling, nucleate boiling.

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B149

Which one of the following describes parallel and/or counter-flow heat exchangers?

A. Counter-flow heat exchangers are more efficient than parallel-flow heat exchangers due to the high initial ΔT.

B. Counter-flow heat exchangers allow the exiting cooled fluid temperature to be below the exiting cooling fluid temperature.

C. Parallel-flow heat exchangers are more efficient than counter-flow heat exchangers due to the high initial ΔT.

D. Parallel-flow heat exchangers allow the exiting cooled fluid temperature to be below the exiting cooling fluid temperature.

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B199

Which one of the following equations is representative of the heat-transfer rate across the tubes of a heat exchanger?

Where:

h_t = fluid enthalpy inside tubes
h_{ss} = fluid enthalpy on heat exchanger shell side
T_t = fluid temperature inside tubes
T_{ss} = fluid temperature on heat exchanger shell side

A. $\dot{Q} = \dot{m} c_p (h_t - h_{ss})$

B. $\dot{Q} = UA (h_t - h_{ss})$

C. $\dot{Q} = \dot{m} c_p (T_t - T_{ss})$

D. $\dot{Q} = UA (T_t - T_{ss})$

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B1083

A counterflow lube oil heat exchanger is in operation when the cooling water flow rate is reduced to one-half of its former value. Which one of the following will decrease as a result?

A. Lube oil outlet temperature

B. Cooling water outlet temperature

C. Lube oil ΔT

D. Cooling water ΔT

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B1283

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

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

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

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

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

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B1782

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

The lube oil heat exchanger is in operation when the cooling water flow rate is increased to twice its former value. Which one of the following will increase as a result?

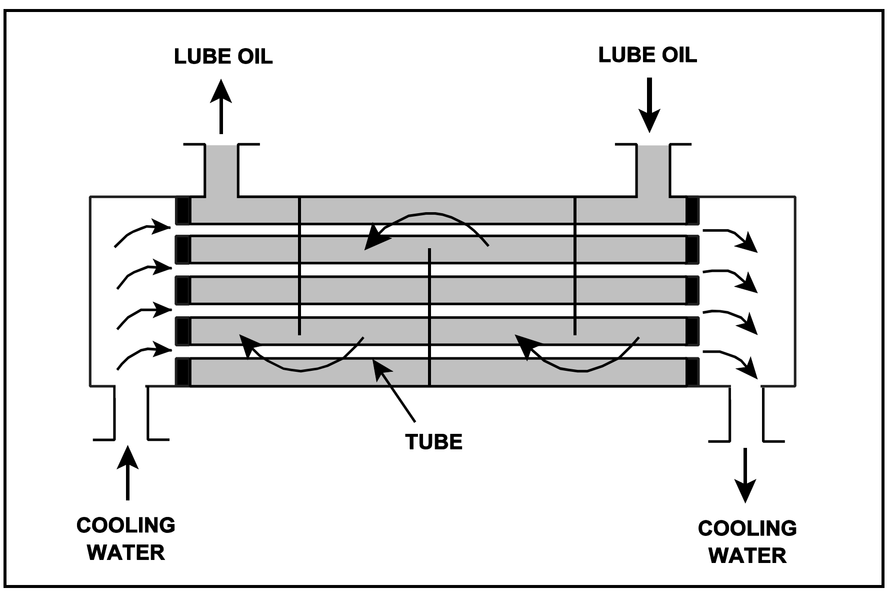
A. Lube oil outlet temperature

B. Cooling water outlet temperature

C. Lube oil ΔT

D. Cooling water ΔT

ANSWER: C.



TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B2583

During a nuclear power plant outage, 6% of the main condenser tubes were plugged. The following 100% power conditions existed before the outage:

Main condenser pressure:	1.10 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	86°F

After the outage, the plant was returned to 100% power. The following 100% power conditions existed after the outage:

Main condenser pressure:	1.20 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	?

If the total heat transfer rate in the main condenser is the same, which one of the following will be the approximate final cooling water outlet temperature?

A. 86°F

B. 88°F

C. 90°F

D. 92°F

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.06 [2.7/2.8]
QID: B3082 (P3034)

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

Given the following lube oil cooling system conditions:

The lube oil flow rate in the lube oil heat exchanger is 200 lbm/min.
The lube oil enters the heat exchanger at 140ºF.
The lube oil leaves the heat exchanger at 100ºF.
The specific heat of the lube oil is 0.8 Btu/lbm-ºF.
The cooling water flow rate is 400 lbm/min.
The cooling water enters the lube oil heat exchanger at 60ºF.
The specific heat of the cooling water is 1.0 Btu/lbm-ºF.

What is the approximate temperature of the cooling water leaving the lube heat exchanger?

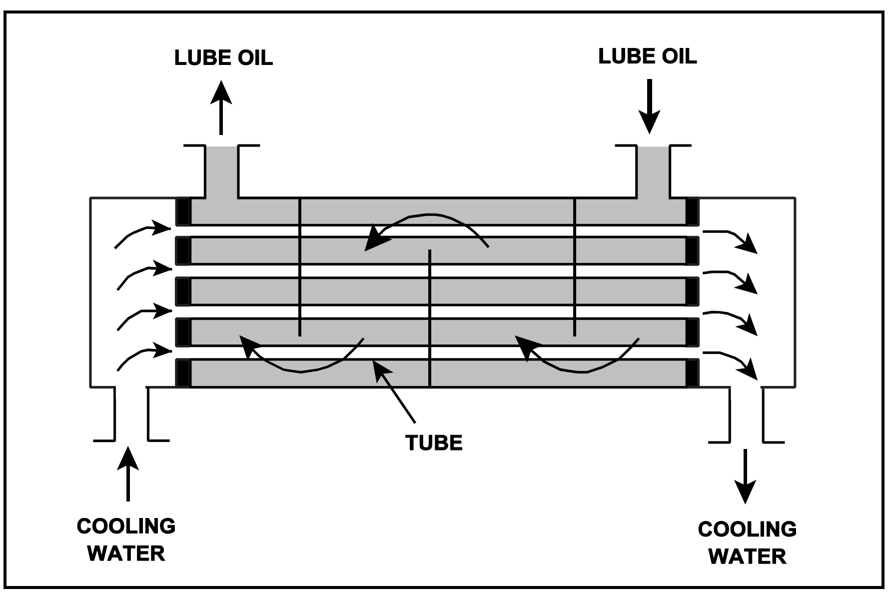
A. 76ºF

B. 85ºF

C. 92ºF

D. 124ºF

ANSWER: A.



TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B484

Excessive amounts of entrained gases passing through a single-phase (liquid) heat exchanger are undesirable because...

A. flow blockage can occur in the heat exchanger.

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

C. the heat exchanger heat transfer coefficient will increase.

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

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B1882 (P1184)

Why is bulk boiling in the tubes of a single-phase heat exchanger undesirable?

A. The bubble formation will break up the laminar layer in the heat exchanger tubes.

B. The thermal conductivity of the heat exchanger tubes will decrease.

C. The ΔT across the tubes will decrease through the heat exchanger.

D. The turbulence will restrict fluid flow through the heat exchanger tubes.

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B2084

The following 100% power conditions existed before a nuclear power plant outage:

Main condenser pressure:	1.20 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	92°F

During the outage, 6% of the main condenser tubes were plugged. After the outage, the following 100% rated power conditions exist:

Main condenser pressure:	1.31 psia
Cooling water inlet temperature:	60°F
Cooling water outlet temperature:	?

Which one of the following is the approximate cooling water outlet temperature after the outage?

A. 92°F

B. 94°F

C. 96°F

D. 98°F

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B2184 (P2184)

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

A. Oil to water in a lube oil cooler

B. Air to water in an air compressor after-cooler

C. Steam to water in a turbine exhaust steam condenser

D. Water to water in a cooling water heat exchanger

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B2383 (P2384)

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the smallest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

A. Oil to water in a lube oil cooler

B. Air to water in an air compressor after-cooler

C. Steam to water in a turbine exhaust steam condenser

D. Water to water in a cooling water heat exchanger

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B3084 (P3084)

A nuclear power plant is operating near100% power. Main turbine extraction steam is being supplied to a feedwater heater. Extraction steam parameters are as follows:

Steam pressure: 414 psia
Steam flow rate: 7.5×10^5 lbm/hr
Steam enthalpy: 1,150 Btu/lbm

Assume the extraction steam condenses to a saturated liquid at 414 psia and then leaves the feedwater heater via a drain line.

Assuming an ideal heat transfer process, what is the heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A. 3.8×10^7 Btu/hr

B. 8.6×10^7 Btu/hr

C. 5.4×10^8 Btu/hr

D. 7.2×10^8 Btu/hr

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B3383 (P3384)

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

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

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

A. 1.7 psia

B. 2.3 psia

C. 3.0 psia

D. 4.6 psia

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B3684 (P3684)

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

A. Oil to water in a lube oil cooler

B. Steam to water in a feedwater heater

C. Water to air in a ventilation heating unit

D. Water to water in a cooling water heat exchanger

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.07 [2.7/2.9]
QID: B5143 (P5144)

A nuclear power plant is operating near 100% power. Main turbine extraction steam is being supplied to a feedwater heater. Extraction steam parameters are as follows:

Steam pressure: 500 psia
Steam flow rate: 7.0×10^5 lbm/hr
Steam enthalpy: 1,135 Btu/lbm

Assume the extraction steam condenses to a saturated liquid at 500 psia and then leaves the feedwater heater via a drain line.

Assuming an ideal heat transfer process, what is the heat transfer rate from the extraction steam to the feedwater in the feedwater heater?

A. 3.2×10^8 Btu/hr

B. 4.8×10^8 Btu/hr

C. 5.3×10^8 Btu/hr

D. 7.9×10^8 Btu/hr

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.08 [3.0/3.1]
QID: B378

Which one of the following actions will <u>decrease</u> nuclear power plant efficiency?

A. Reducing turbine inlet steam moisture content

B. Reducing condensate depression

C. Increasing turbine exhaust pressure

D. Increasing temperature of feed-water entering the reactor vessel

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.08 [3.0/3.1]
QID: B1585

Which one of the following actions will increase nuclear power plant efficiency?

A. Increasing turbine inlet steam moisture content

B. Increasing condensate depression

C. Decreasing turbine exhaust pressure

D. Decreasing temperature of feed water entering the reactor vessel

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.09 [2.5/2.7]
QID: B147

Which one of the following statements explains why condensate subcooling is necessary in the steam condensing phase of a nuclear power plant steam cycle?

A. To increase overall secondary efficiency

B. To provide an improved condenser vacuum

C. To allow use of a higher circulating water temperature

D. To provide net positive suction head to the condensate pumps

ANSWER: D.

TOPIC: 293007
KNOWLEDGE: K1.09 [2.5/2.7]
QID: B583

Which one of the following statements describes condensate depression (subcooling) in the main condenser?

A. Increasing condensate depression improves the available net positive suction head for the condensate pumps.

B. Decreasing condenser vacuum increases condensate depression.

C. Increasing circulating water temperature increases condensate depression.

D. Decreasing condensate depression decreases plant efficiency.

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.09 [2.5/2.7]
QID: B883

A condenser is operating at 28 inches of Hg vacuum and a condensate outlet temperature of 88°F. Which one of the following most closely approximates the value for the condensate depression?

A. 8°F

B. 14°F

C. 24°F

D. 38°F

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.09 [2.5/2.7]
QID: B1084

The purpose of condensate depression in the turbine/condenser phase of a nuclear power plant steam cycle is to...

A. maximize condenser vacuum.

B. maximize total plant efficiency.

C. minimize cavitation of the condensate pumps.

D. minimize thermal gradients in the condenser hotwell.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.09 [2.5/2.7]
QID: B2483

A condenser is operating at 28.5 inches of Hg vacuum with a condensate outlet temperature of 88°F. Which one of the following is the approximate value of condensate depression?

A. 2°F

B. 9°F

C. 13°F

D. 17°F

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.10 [2.7/2.9]
QID: B684

The measure of heat input per unit time from a nuclear reactor core to the reactor coolant in units of megawatts defines...

A. specific heat.

B. power density.

C. core thermal power.

D. percent reactor power.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.11 [2.6/3.1]
QID: B385

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

A. Core flow rate

B. Steam flow rate

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

D. The sum of both recirculation loop flow rates

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.11 [2.6/3.1]
QID: B984

Which one of the following expressions describes core thermal power?

A. $\dot{Q}_{core} = \dot{Q}_{Feedwater} - \dot{Q}_{Steam} - \dot{Q}_{CRD} - \dot{Q}_{Recirc} + \dot{Q}_{Ambient} + \dot{Q}_{RWCU}$

B. $\dot{Q}_{core} = \dot{Q}_{Steam} - \dot{Q}_{Feedwater} + \dot{Q}_{CRD} + \dot{Q}_{Recirc} - \dot{Q}_{Ambient} - \dot{Q}_{RWCU}$

C. $\dot{Q}_{core} = \dot{Q}_{Steam} - \dot{Q}_{Feedwater} - \dot{Q}_{CRD} - \dot{Q}_{Recirc} + \dot{Q}_{Ambient} + \dot{Q}_{RWCU}$

D. $\dot{Q}_{core} = \dot{Q}_{Steam} - \dot{Q}_{Feedwater} - \dot{Q}_{CRD} - \dot{Q}_{Recirc} - \dot{Q}_{Ambient} - \dot{Q}_{RWCU}$

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.11 [2.6/3.1]
QID: B2984 (P2985)

A nuclear reactor is operating at power. The feedwater flow rate to the reactor vessel is 7.0×10^6 lbm/hr at a temperature of 440°F. The steam exiting the reactor vessel is at 1000 psia with 100% steam quality.

Ignoring all other heat gain and loss mechanisms, what is the core thermal power?

A. 1335 MWt

B. 1359 MWt

C. 1589 MWt

D. 1612 MWt

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.12 [2.6/3.1]
QID: B1384

Given the following data for a steam condenser:

Total tube area	= 500,000 ft^2
Cooling water flow rate	= 200,000 gpm
Condenser pressure	= 1 psia
Specific heat of cooling water (c_p)	= 1 Btu/lbm-°F
Cooling water inlet temperature	= 60°F
Cooling water outlet temperature	= 80°F
Steam condensing rate	= 3,000,000 lbm/hr
Mass of cooling water	= 8.34 lbm/gal

What is the condenser heat load in megawatts thermal (MWt)?

A. 587 MWt

B. 629 MWt

C. 671 MWt

D. 733 MWt

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B150

Given the following data for a typical steam condenser, select the approximate heat load rejected in megawatts thermal.

Total tube area	= 500,000 ft^2
Cooling water flow rate	= 200,000 gpm
Condenser pressure	= 1 psia
Specific heat of cooling water (c_p)	= 1 Btu/lbm-°F
Cooling water inlet temperature	= 60°F
Cooling water outlet temperature	= 85°F
Steam condensing rate	= 3,000,000 lbm/hr
Mass of cooling water	= 8.34 lbm/gal

A. 704 MWt

B. 734 MWt

C. 784 MWt

D. 834 MWt

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B386 (P384)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being <u>greater</u> than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was higher than actual feedwater temperature.

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

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

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

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B1684

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being lower than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 10°F lower than actual feed water temperature.

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

C. The feed flow rate used in the heat balance calculation was 10% lower than actual feed flow rate.

D. The steam pressure used in the heat balance calculation was 50 psi lower than actual steam pressure.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2183 (P2185)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being lower than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 20°F higher than actual feedwater temperature.

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

C. The feed water flow rate used in the heat balance calculation was 10% higher than actual flow rate.

D. The steam pressure used in the heat balance calculation was 50 psi lower than actual steam pressure.

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2284 (P2685)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being lower than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 20°F higher than actual feedwater temperature.

B. The reactor recirculation pump heat input term used in the heat balance was 10% lower than actual.

C. The steam and feedwater flow rates used in the heat balance calculation were 10% higher than actual flow rates.

D. The operator miscalculated the enthalpy of the steam exiting the reactor vessel to be 10 Btu/lbm higher than actual.

ANSWER: A.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2484

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being <u>lower</u> than actual reactor power?

A. The feed water temperature used in the heat balance calculation was 20°F lower than actual feed water temperature.

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

C. The ambient heat loss value used in the heat balance calculation was only half the actual ambient heat loss.

D. The feed water flow rates used in the heat balance calculation were 10% higher than actual flow rates.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2684 (P2485)

The power range nuclear instruments have been adjusted to 100% based on a heat balance calculation. Which one of the following will result in indicated reactor power being higher than actual reactor power?

A. The feedwater temperature used in the heat balance calculation was 20°F higher than actual feedwater temperature.

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

C. The feedwater flow rate used in the heat balance calculation was 10% lower than actual feedwater flow rate.

D. The ambient heat loss term was omitted from the heat balance calculation.

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2785

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being lower than actual reactor power?

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

B. The feed water temperature used in the heat balance calculation was 20°F lower than actual feed water temperature.

C. The reactor vessel pressure used in the heat balance calculation was 30 psia higher than actual reactor vessel pressure.

D. The steam and feed water flow rates used in the heat balance calculation were 10% higher than actual flow rates.

ANSWER: C.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B2884 (P137)

The power range nuclear instruments have been adjusted to 100% based on a calculated heat balance. Which one of the following will result in indicated reactor power being greater than actual reactor power?

A. The operator miscalculated the enthalpy of the feed water to be 10 Btu/lbm higher than actual feed water enthalpy.

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

C. The steam and feed water flow rates used in the heat balance calculation were 10% lower than actual flow rates.

D. The steam pressure used in the heat balance calculation was 50 psi higher than actual steam pressure.

ANSWER: B.

TOPIC: 293007
KNOWLEDGE: K1.13 [2.3/2.9]
QID: B5043

Two of the parameters listed below are used for calculating core thermal power using the standard heat balance method. Which one of the following identifies the two parameters?

	Reactor Core Mass Flow Rate	Feedwater Temperature	Reactor Vessel Pressure	Reactor Vessel Water Level
A.	Yes	No	Yes	No
B.	No	Yes	Yes	No
C.	Yes	No	No	Yes
D.	No	Yes	No	Yes

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B88

The highest rate of heat transfer from the fuel-cladding surface to the coolant channel is provided by...

A. forced convection with subcooled coolant (no boiling).

B. natural convection with subcooled coolant (no boiling).

C. natural convection with bulk boiling of coolant.

D. forced convection with nucleate boiling.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B89

The order of heat-transfer mechanisms occurring in the core (inlet-to-outlet) is...

A. nucleate boiling, single-phase convection, slug flow, annular flow.

B. nucleate boiling, single-phase convection, annular flow, slug flow.

C. single-phase convection, nucleate boiling, slug flow, annular flow.

D. single-phase convection, nucleate boiling, annular flow, slug flow.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B389 (P286)

As heat is transferred to water adjacent to a heating surface, many factors influence steam bubble formation. Select the characteristic below that will enhance steam bubble formation.

A. Chemicals dissolved in the water

B. The absence of ionizing radiation exposure to the water

C A highly polished heat transfer surface with minimal scratches or cavities

D. The presence of gases dissolved in the water

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B885

The dominant heat transfer mechanism that occurs when nucleate boiling is present is...

A. convection.

B. radiation.

C. conduction.

D. induction.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B986

Which one of the following describes convection heat transfer?

A. The flow of heat through a body or between bodies in direct contact

B. The flow of heat between two different fluids not in direct contact

C. The flow of heat from a body by electromagnetic waves across an intervening space

D. The flow of heat between a fluid and surface by circulation of the fluid

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B1183

Refer to the drawing of a pool boiling curve (see figure below). In which region(s) of the curve does a nuclear reactor normally operate to transfer heat from the fuel cladding to the coolant at 100% power?

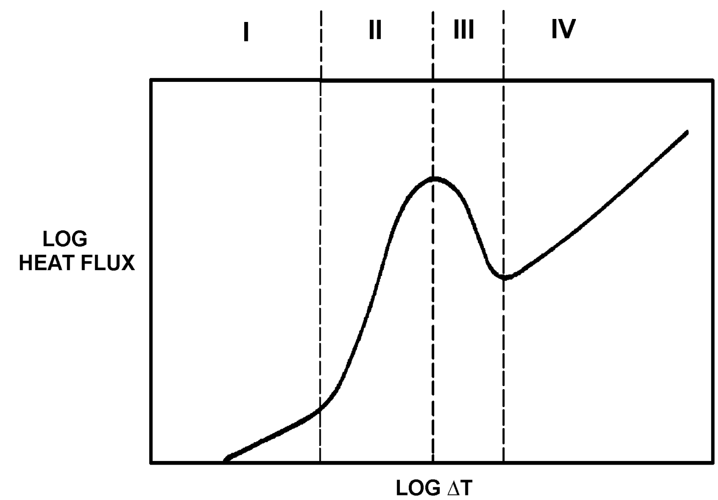
A. Regions II and III

B. Region II only

C. Regions I and II

D. Region I only

ANSWER: C.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B1285 (P2787)

For boiling to occur, the coolant adjacent to the fuel rod must have sufficient heat flux for vapor bubble formation. Select the characteristic below that will aid in bubble formation.

A. Surface scratches or cavities in the fuel clad

B. Subsurface void defect in the fuel clad

C. Increased coolant velocity past the fuel rod

D. Chemically inert material dissolved in the coolant

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.01 [2.6/2.8]
QID: B2784 (P1086)

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel rod if subcooled reactor coolant enters the coolant channel and exits as superheated steam?

A. Increases continuously

B. Increases, then decreases

C. Decreases continuously

D. Decreases, then increases

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B90

Boiling improves heat transfer because the...

A. agitation produced reduces the thickness of the fluid film and the bubble formation removes the latent heat of vaporization from the heated surface.

B. bubbles produced reduce the turbulence in the bulk fluid flow and transfer the latent heat of condensation to the fluid as the steam bubbles collapse in the laminar fluid film.

C. velocity of the laminar fluid film past the heated surface increases causing the ΔT between the heated surface and the fluid film to increase.

D. velocity of the laminar fluid film near the heated surface decreases causing the liquid contact time with the heated surface to increase.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B486

Nucleate boiling occurring at the surface of a fuel rod...

A. increases the convective heat transfer from the fuel rod to the coolant.

B. decreases the convective heat transfer from the fuel rod to the coolant.

C. has no effect on convective heat transfer because it is boiling heat transfer.

D. causes damage to the fuel rod because it disrupts the laminar flow of coolant next to the fuel rod.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B588 (P389)

Core heat transfer is <u>maximized</u> by the presence of...

A. laminar flow with no nucleate boiling.

B. turbulent flow with no nucleate boiling.

C. laminar flow with nucleate boiling.

D. turbulent flow with nucleate boiling.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1086 (P2287)

Which one of the following describes why the core heat transfer rate increases when nucleate boiling begins on the surface of a fuel rod?

A. Steam bubbles have a greater thermal conductivity than water.

B. The formation of steam bubbles increases coolant flow along the fuel rod.

C. Radiative heat transfer begins to supplement convective heat transfer.

D. The motion of the steam bubbles causes rapid mixing of the coolant.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1890 (P487)

Nucleate boiling enhances the convective heat transfer coefficient by ______________ the thermal conductivity of the coolant and ______________ the laminar layer thickness.

A. increasing; decreasing

B. increasing; increasing

C. decreasing; decreasing

D. decreasing; increasing

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B2385 (P2386)

Subcooled water enters the bottom of a fuel assembly in an operating nuclear reactor core. As the water flows upward past the fuel assembly, boiling occurs and the coolant exits the fuel assembly at saturation temperature.

If the coolant had remained subcooled, average fuel temperature would have been ________ because boiling is a ________ efficient method of heat transfer.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B2486 (P2686)

Case 1: Pure subcooled reactor coolant is flowing through a fuel assembly in a reactor core operating at steady-state full power. As the coolant flows upward through the fuel assembly, the water heats up and exits the fuel assembly still subcooled.

Case 2: Same as above except that reactor coolant system pressure is decreased such that the coolant begins to boil halfway up the fuel assembly, which results in a saturated steam-water mixture exiting the fuel assembly.

Assume departure from nucleate boiling is avoided in both cases and that both cores continue to operate at full power. As compared to Case 1, the average fuel temperature for Case 2 will be ________ because boiling is a ________ efficient method of heat transfer.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B2886 (P1086)

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel rod if subcooled reactor coolant enters the coolant channel and exits as superheated steam?

A. Increases continuously

B. Increases, then decreases

C. Decreases continuously

D. Decreases, then increases

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B2986 (P2986)

Subcooled reactor coolant flows into the bottom of a fuel assembly coolant channel and exits the top of the channel as a saturated steam-water mixture with a 98% moisture content. How does the convective heat transfer coefficient in the coolant channel change as the coolant travels upward along the channel?

A. Increases only

B. Increases, then decreases

C. Decreases only

D. Decreases, then increases

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B3785 (P3786)

Subcooled water is flowing into a fuel assembly in an operating nuclear reactor core. As the water flows upward through the fuel assembly, the water begins to boil and exits the fuel assembly as a saturated fluid.

If fuel assembly power is unchanged and system pressure is increased such that all of the water remains subcooled, the average fuel temperature in the fuel assembly would be ________ because boiling is a ________ efficient method of heat transfer.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.06 [2.5/2.6]
QID: B387

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

A. Subcooling of the fluid

B. A phase change in the fluid

C. An enthalpy change in the fluid

D. Radiative heat transfer to the fluid

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.06 [2.5/2.6]
QID: B2386 (P1989)

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

A. Subcooling of the fluid

B. A phase change in the fluid

C. A density change in the fluid

D. Radiative heat transfer to the fluid

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B388 (P387)

What type of boiling is described as follows?

The bulk temperature of the liquid is below saturation, but the temperature of the heat transfer surface is above saturation. Vapor bubbles form at the heat transfer surface, but condense in the cold liquid so that no net generation of vapor is obtained.

A. Bulk boiling

B. Subcooled nucleate boiling

C. Transition boiling

D. Partial film boiling

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B887

Refer to the drawing of a pool-boiling curve (see figure below).

The region in which nucleate boiling is the primary heat transfer mechanism is region...

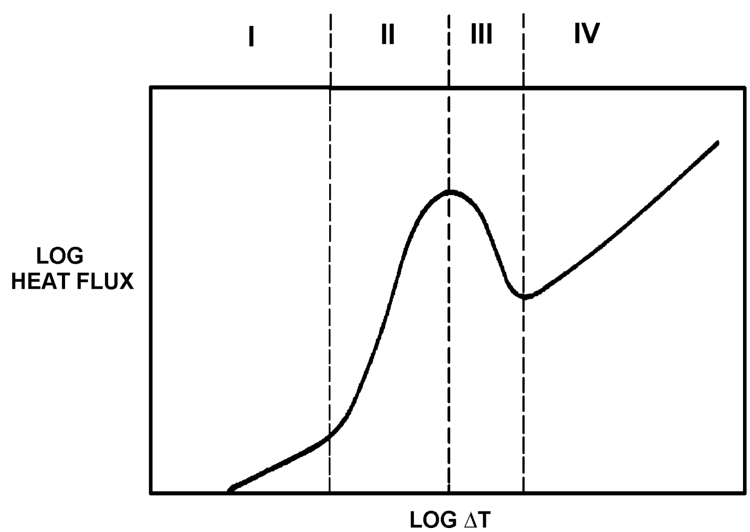
A. I.

B. II.

C. III.

D. IV.

ANSWER: B.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B1087 (P1686)

Which one of the following is a characteristic of subcooled nucleate boiling but not saturated nucleate boiling?

A. T_{Clad} equals T_{Sat}

B. T_{Clad} is greater than T_{Sat}

C. $T_{Bulk\ Coolant}$ equals T_{Sat}

D. $T_{Bulk\ Coolant}$ is less than T_{Sat}

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B1287 (P2687)

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

A. Bulk boiling

B. Subcooled nucleate boiling

C. Saturated nucleate boiling

D. Saturated natural convection

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B1786 (P1888)

Which one of the following is a characteristic of saturated nucleate boiling but not subcooled nucleate boiling?

A. T_{Clad} equals T_{Sat}

B. T_{Clad} is greater than T_{Sat}

C. $T_{Bulk\ Coolant}$ equals T_{Sat}

D. $T_{Bulk\ Coolant}$ is less than T_{Sat}

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B1986 (P1186)

Refer to the drawing of a pool boiling curve (see figure below). Identify the region of the curve where the most efficient form of heat transfer exists.

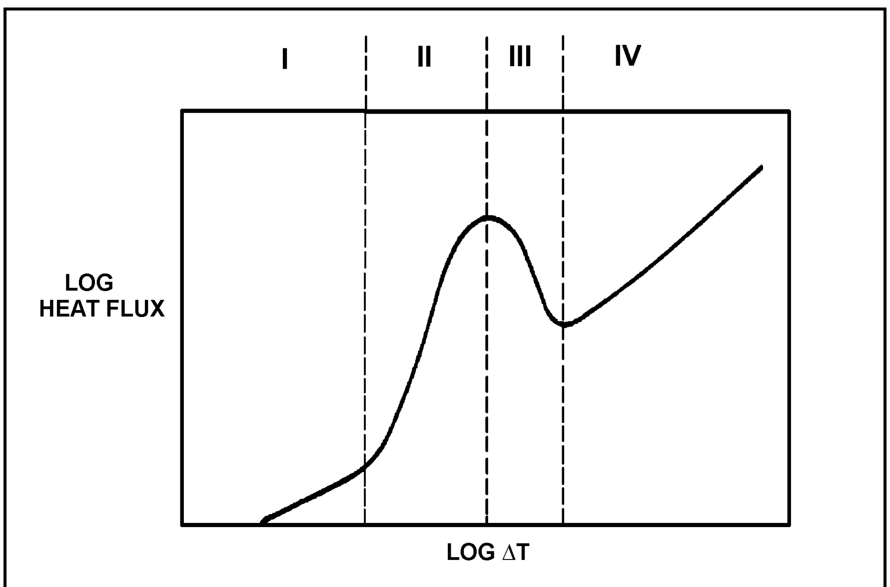
A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B2088 (P1286)

Refer to the drawing of a pool boiling curve (see figure below).

Which region of the curve contains the point at which the hottest locations of a nuclear reactor core normally operate to transfer heat from the cladding to the coolant at 100% power?

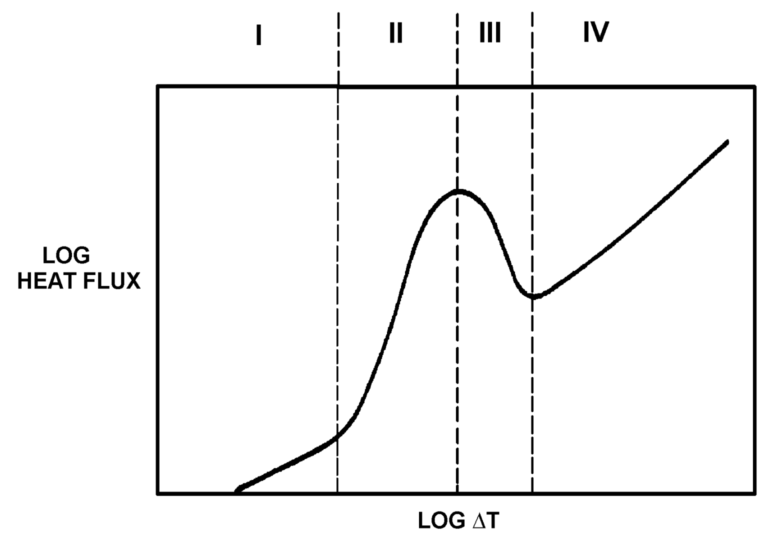
A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.07 [2.8/3.0]
QID: B3685 (P3686)

A nuclear power plant is currently shut down after several months of operation at full power. The shutdown cooling system is in operation, maintaining an average reactor coolant temperature of 280°F. A pressure control malfunction causes RCS pressure to slowly and continuously decrease from 100 psia while reactor coolant temperature remains constant. (Assume a normal reactor coolant flow direction through the core.)

Which one of the following describes where nucleate boiling will first occur?

A. At a scratch on the surface of a fuel rod near the top of a fuel assembly.

B. At a scratch on the surface of a fuel rod near the bottom of a fuel assembly.

C. In the bulk fluid of a coolant channel near the top of a fuel assembly.

D. In the bulk fluid of a coolant channel near the bottom of a fuel assembly.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.08 [2.9/3.1]
QID: B142

Which one of the following describes the onset of transition boiling?

A. Steam bubbles begin to blanket the fuel rod causing a rapid increase in the ΔT 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 ΔT between the fuel rod and the coolant.

D. Steam bubbles break up the laminar layer of coolant on the surface of the fuel rod causing an increase in the heat flux from the fuel rod.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.08 [2.9/3.1]
QID: B287

Departure from nucleate boiling (DNB) occurs when steam bubbles begin to blanket the fuel rod, resulting in a rapid ____________ in heat transfer rate and a rapid ____________ in ΔT (fuel clad minus coolant temperature).

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.08 [2.9/3.1]
QID: B1288 (P3388)

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

A. Bulk boiling is occurring.

B. Departure from nucleate boiling has been reached.

C. Critical heat flux is increasing.

D. Nucleate boiling is occurring.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.08 [2.9/3.1]
QID: B1985 (P1288)

Departure from nucleate boiling should not be allowed to occur in the core because...

A. as steam bubbles begin to blanket the clad, the radiative heat transfer decreases.

B. as steam bubbles in the coolant form and then collapse, water hammer occurs.

C. as steam bubbles begin to blanket the clad, temperature rises sharply.

D. as steam bubbles form in the coolant, voids-induced reactivity changes cause undesirable power changes.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.08 [2.9/3.1]
QID: B2987 (P287)

If ΔT is the temperature difference between the fuel rod clad surface and the bulk coolant, which one of the following describes the heat transfer from a fuel rod experiencing departure from nucleate boiling?

A. Steam bubbles begin to blanket the fuel rod clad, causing a rapid increase in the ΔT for a given heat flux.

B. Steam bubbles completely blanket the fuel rod clad, causing a rapid decrease in the ΔT for a given heat flux.

C. Steam bubbles begin to form on the fuel rod clad, causing a rapid decrease in the heat flux from the fuel rod for a given ΔT.

D. Steam bubbles completely blanket the fuel rod clad, causing a rapid increase in the heat flux from the fuel rod for a given ΔT.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B288

Refer to the drawing of a hypothetical fuel coolant channel (see figure below).

For the hypothetical fuel coolant channel shown below, at what point along its length does transition boiling begin?

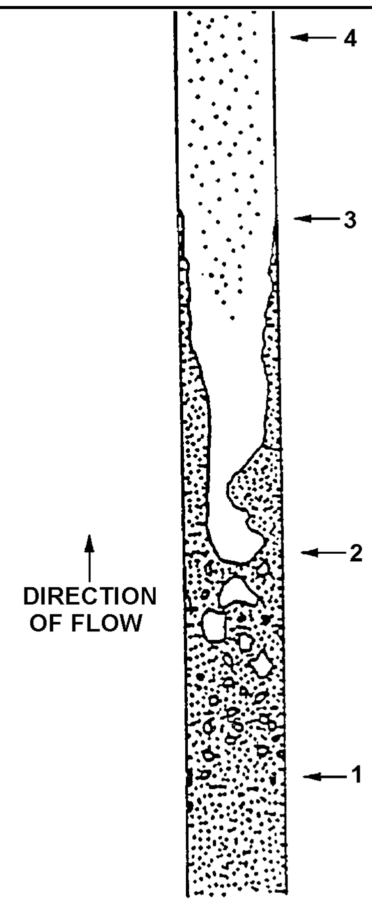
A. 1

B. 2

C. 3

D. 4

ANSWER: C.



HYPOTHETICAL FUEL COOLANT CHANNEL

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B987 (P1891)

Which one of the following describes the conditions in a fuel channel that is experiencing transition boiling?

A. Complete steam blanketing of the fuel rod surface

B. Alternate wetting and drying of the fuel rod surface

C. Saturated nucleate boiling

D. Subcooled nucleate boiling

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B1386 (P1689)

Refer to the drawing of a pool-boiling curve (see figure below).

Which one of the points shown represents the onset of transition boiling?

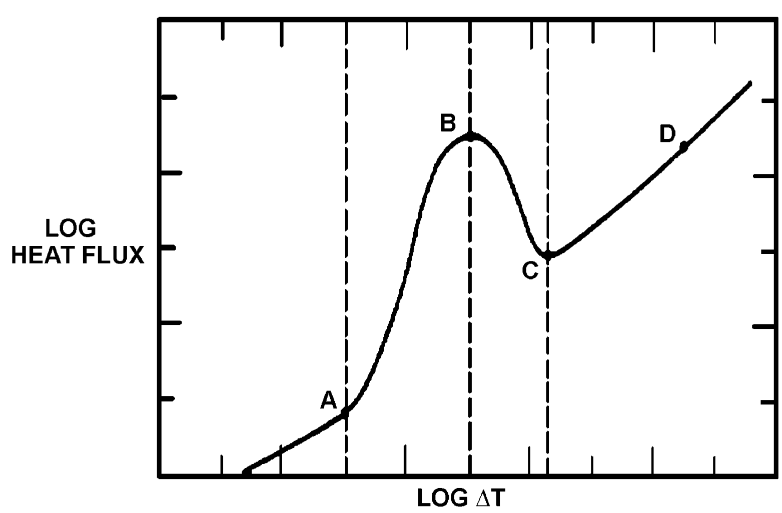
A. A

B. B

C. C

D. D

ANSWER: B.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B1486 (P2688)

Refer to the drawing of a pool-boiling curve (see figure below).

Which one of the following regions represents the most unstable heat transfer?

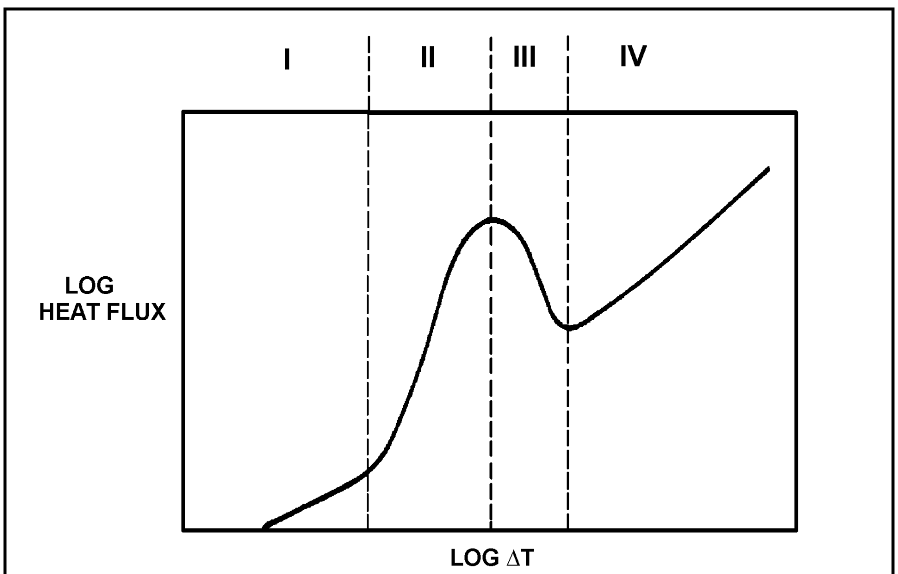
A. I

B. II

C. III

D. IV

ANSWER: C.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B1587 (P1587)

Refer to the drawing of a pool-boiling curve (see figure below).

Which one of the points shown marks the lowest ΔT at which stable film boiling can exist?

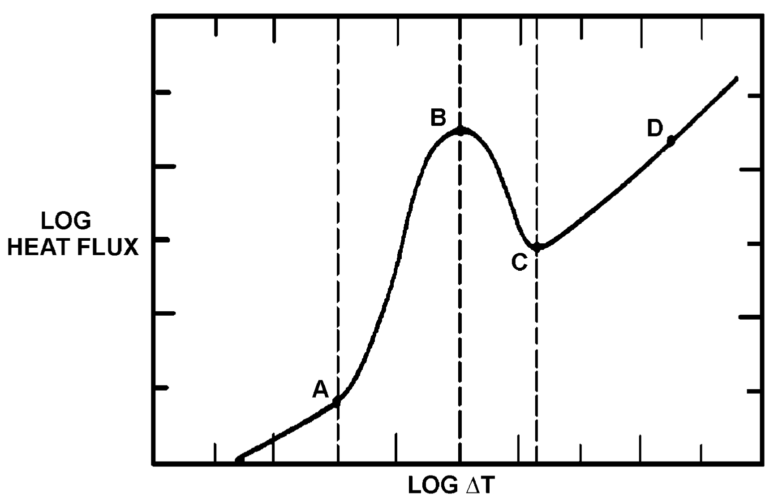
A. A

B. B

C. C

D. D

ANSWER: C.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.09 [3.0/3.2]
QID: B2288 (P1987)

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

A. transition boiling.

B. subcooled nucleate boiling.

C. saturated nucleate boiling.

D. stable film boiling.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.10 [2.9/3.0]
QID: B289 (P2289)

Refer to the drawing of a pool-boiling curve (see figure below).

The point at which heat flux is increasing and the critical heat flux has been reached (point B), marks the beginning of...

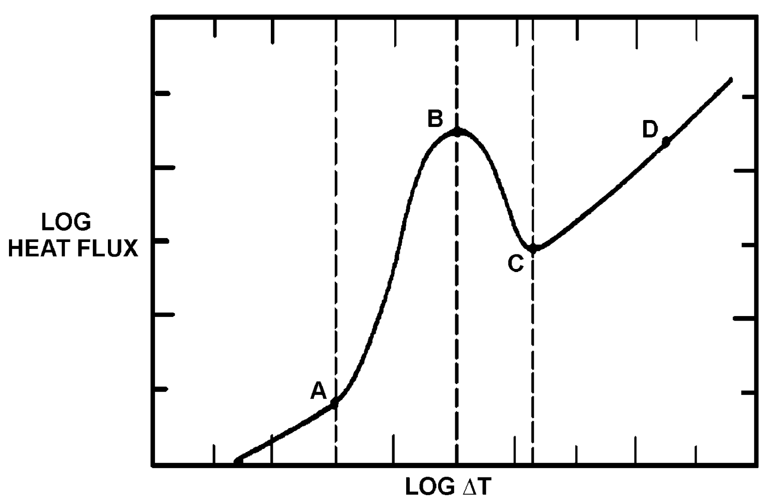
A. nucleate boiling.

B. stable film boiling.

C. partial film boiling.

D. single-phase convection.

ANSWER: C.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.10 [2.9/3.0]
QID: B390

The magnitude of the local fuel pin heat flux that is necessary to cause the onset of transition boiling is...

A. largest at the top of the core and smallest at the bottom of the core.

B. largest at the bottom of the core and smallest at the top of the core.

C. largest at the core midplane and smallest at the top and bottom of the core.

D. largest at the top and bottom of the core and smallest at the core midplane.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.10 [2.9/3.0]
QID: B1687

Which one of the following is the expected mechanism of fuel damage if a fuel rod exceeds the critical heat flux at 100% power?

A. Loss of clad integrity

B. Loss of pellet integrity

C. Pellet-clad interaction

D. Clad creep

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.10 [2.9/3.0]
QID: B1888 (P1087)

How does critical heat flux vary from the bottom to the top of a typical fuel bundle during normal full power operation?

A. Decreases continuously

B. Decreases, then increases

C. Increases continuously

D. Increases, then decreases

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.10 [2.9/3.0]
QID: B2487 (P2487)

A nuclear reactor is shutdown at normal operating temperature and pressure. Which one of the following will decrease the critical heat flux for the reactor fuel? (Assume the reactor remains shutdown.)

A. Fully withdrawing one control rod

B. Increasing reactor vessel water level by 12 inches

C. Increasing reactor recirculation flow rate by 100 gpm

D. Increasing RCS pressure by 10 psig

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.11 [2.7/2.8]
QID: B91

Select the statement that describes transition (partial film) boiling.

A. A small increase in ΔT (at the heat transfer and coolant interface) causes increased steam blanketing and a reduction in heat flux.

B. The temperature of the heat transfer surface is so high that thermal radiative heat transfer becomes significant and heat flux increases.

C. As the ΔT increases, the increasing number of bubbles causes increased agitation and turbulence of the boundary layer consequently increasing heat flux.

D. As the ΔT increases a few vapor bubbles are formed that may collapse when they enter into the bulk of the fluid.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.11
QID: B1289

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

Which of the following causes the first reduction in the local fuel clad heat transfer rate as the coolant flows upward through the coolant channel?

A. Nucleate boiling

B. Stable film boiling

C. Partial film boiling

D. Single-phase convection

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.11 [2.7/2.8]
QID: B1987 (P889)

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

A. transition boiling.

B. subcooled nucleate boiling.

C. saturated nucleate boiling.

D. stable film boiling.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.11 [2.7/2.8]
QID: B2185 (P2188)

Refer to the drawing of a pool boiling curve (see figure below).

Which one of the following describes the conditions in a fuel channel that is experiencing region III heat transfer?

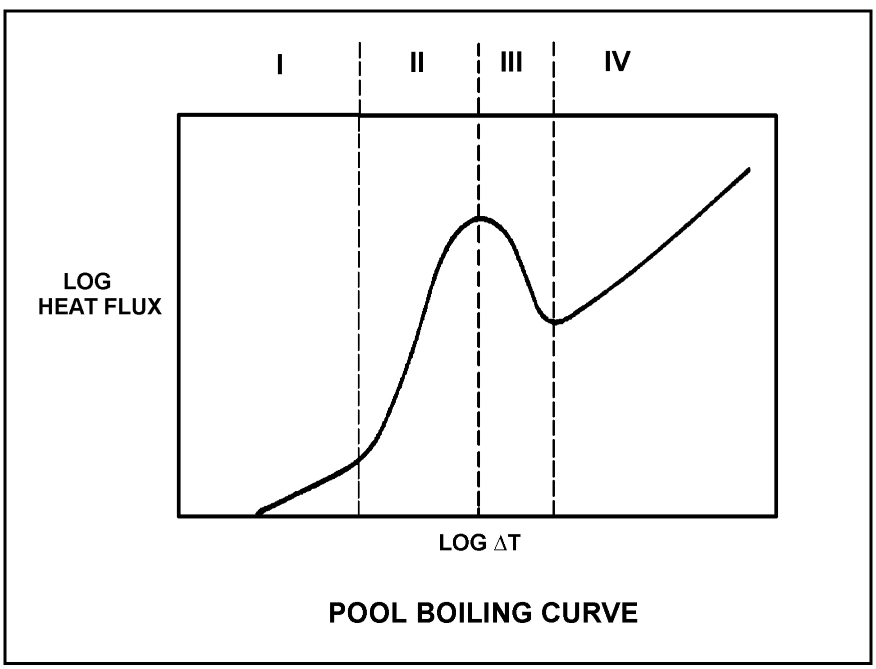
A. Complete steam blanketing of the fuel rod surface

B. Alternate wetting and drying of the fuel rod surface

C. Saturated nucleate boiling

D. Subcooled nucleate boiling

ANSWER: B.



TOPIC: 293008
KNOWLEDGE: K1.11 [2.7/2.8]
QID: B2688 (P2289)

Refer to the drawing of a pool boiling curve (see figure below).

The point at which heat flux stops increasing and the critical heat flux has been reached (point B), marks the beginning of...

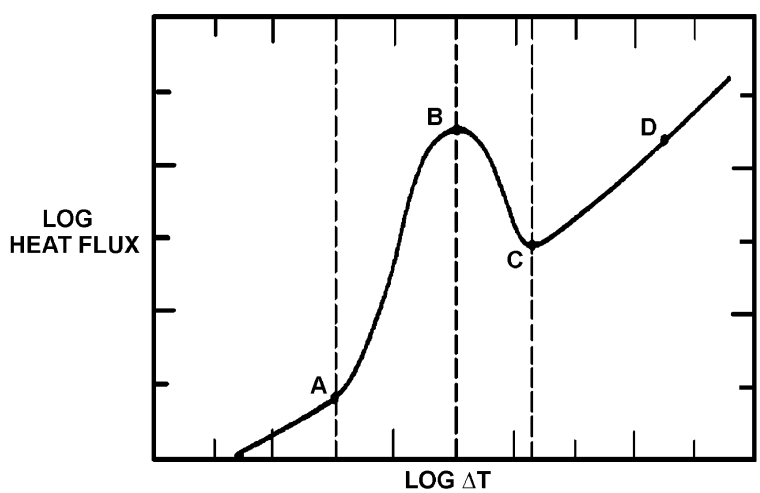
A. nucleate boiling.

B. stable film boiling.

C. partial film boiling.

D. single-phase convection.

ANSWER: C.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.12 [2.7/2.8]
QID: B687 (P2189)

Which one of the following describes the relative contributions of the convective and radiative modes of heat transfer, and the relationship of ΔT (T_{wall} - $T_{bulk\ coolant}$) to heat flux, during stable film boiling heat transfer in the core?

A. Only radiative heat transfer is significant, and heat flux increases in direct proportion to ΔT squared.

B. Both heat transfer modes are significant, and heat flux increases in direct proportion to ΔT squared.

C. Only radiative heat transfer is significant, and a significant increase in heat flux requires a large ΔT increase.

D. Both heat transfer modes are significant, and a significant increase in heat flux requires a large ΔT increase.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.12 [2.7/2.8]
QID: B2588 (P2588)

Refer to the drawing of a pool boiling curve (see figure below).

Which one of the following describes the conditions in a fuel channel that is experiencing region IV heat transfer?

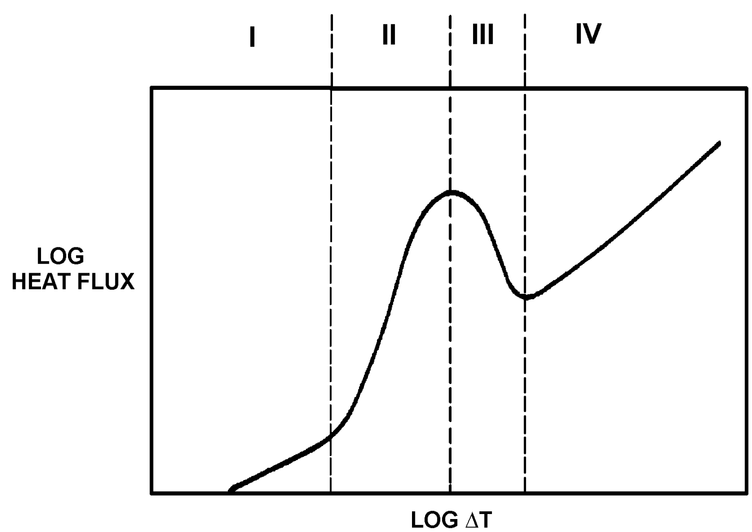
A. Complete steam blanketing of the fuel rod surface

B. Alternate wetting and drying of the fuel rod surface

C. Saturated nucleate boiling

D. Subcooled nucleate boiling

ANSWER: A.



POOL BOILING CURVE

TOPIC: 293008
KNOWLEDGE: K1.12 [2.7/2.8]
QID: B3485 (P3488)

During a loss of coolant accident, the reactor fuel may experience stable film boiling. Which one of the following types of heat transfer from the fuel cladding will increase significantly when stable film boiling begins?

A. Forced convection

B. Natural convection

C. Conduction

D. Radiation

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B788 (P789)

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

A. annular; slug

B. annular; vapor

C. bubbly; slug

D. bubbly; vapor

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B1588

A nuclear reactor is operating at steady state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become closer to the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Reactor pressure increases.

B. Recirculation flow rate increases.

C. Feedwater temperature decreases.

D. Associated bundle power decreases.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B1891

A nuclear reactor is operating at steady state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become closer to the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow rate decreases.

B. Reactor pressure decreases.

C. Feedwater temperature decreases.

D. Associated bundle power decreases.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B2089

A nuclear reactor is operating at steady state 70% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become farther from the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow rate increases.

B. Reactor pressure increases.

C. Feedwater temperature increases.

D. Associated bundle power increases.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B2589

A nuclear reactor is operating at steady state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become farther from the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow decreases.

B. Reactor pressure increases.

C. Feedwater temperature decreases.

D. Associated bundle power increases.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B2789

A nuclear reactor is operating at steady-state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel bundle to become closer to the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow increases.

B. Reactor pressure decreases.

C. Feed water temperature increases.

D. Associated bundle power decreases.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.17 [2.5/2.8]
QID: B2888

A nuclear reactor is operating at steady state 90% power. Which one of the following will cause the two-phase coolant flowing upward in a fuel channel to become closer to the onset of transition boiling? (Assume reactor power does not change unless stated.)

A. Recirculation flow is slowly increased.

B. Feed water temperature slowly increases.

C. Reactor operating pressure is slowly decreased.

D. Associated bundle power slowly decreases.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.19 [2.6/2.8]
QID: B789

Core inlet subcooling is defined as the difference between the temperature of the fluid __________ and the saturation temperature of the fluid in the core inlet plenum.

A. in the core inlet plenum

B. at the feedwater pump discharge

C. in the downcomer area

D. in the lower fuel channel area

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.20 [2.4/2.6]
QID: B790

Carry-under is most damaging to which one of the following components?

A. Main turbine

B. Moisture separator (turbine)

C. Recirculation pump

D. Moisture separator (reactor vessel)

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.20 [2.4/2.6]
QID: B989

Which one of the following will directly <u>reduce</u> core inlet subcooling?

A. Raise reactor vessel downcomer level until carryover occurs

B. Lower reactor vessel downcomer level until carryunder occurs

C. Increase core recirculation flow

D. Isolate steam to one feed-water heater

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.21 [3.0/3.0]
QID: B290

Void fraction is the ratio of the ________________ of steam to the ________________ of steam/water mixture at a given elevation in the fuel channel.

A. volume; mass

B. mass; mass

C. volume; volume

D. mass; volume

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.21 [3.0/3.0]
QID: B1487

Given the following conditions:

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

Which one of the following is the approximate void fraction?

A. 42%

B. 48%

C. 84%

D. 96%

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.21 [3.0/3.0]
QID: B1689

Given the following conditions:

10 lbm mixture of vapor and liquid
Steam quality = 30%
Pressure = 1,000 psia

Which one of the following approximates the void fraction?

A. 10.1%

B. 11.3%

C. 88.7%

D. 89.9%

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.21 [3.0/3.0]
QID: B2389

Given the following conditions:

10 lbm mixture of vapor and liquid
Steam quality = 40%
Pressure = 1,000 psia

Which one of the following approximates the void fraction?

A. 93.2%

B. 89.9%

C. 10.1%

D. 6.8%

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.21 [3.0/3.0]
QID: B2690

Which one of the following ratios can be used to calculate the core void fraction?

A. $\dfrac{\text{Steam Volume}}{\text{Water Volume}}$

B. $\dfrac{\text{Steam Volume}}{\text{Steam Volume + Water Volume}}$

C. $\dfrac{\text{Steam Volume + Water Volume}}{\text{Steam Volume - Water Volume}}$

D. $\dfrac{\text{Steam Volume + Water Volume}}{\text{Steam Volume x Water Volume}}$

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.22 [2.9/3.0]
QID: B587

A nuclear power plant is operating at steady state 80% power. Reactor recirculation flow rate is then decreased from 100% to 80%.

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

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

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

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

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

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.22 [2.9/3.0]
QID: B2091

A nuclear reactor is operating at steady-state 70% power. Recirculation flow rate is increased by 5%.

Which one of the following statements describes the <u>initial</u> response of the boiling boundary within the core?

A. It physically moves upward, because each pound mass of coolant must travel farther through a fuel bundle before vaporizing.

B. It physically moves upward, because each pound mass of coolant enters the core with a larger subcooled margin.

C. It physically moves downward, because each pound mass of coolant will vaporize sooner as it travels through a fuel bundle.

D. It physically moves downward, because each pound mass of coolant enters the core with a smaller subcooled margin.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.23 [2.5/2.7]
QID: B688

Which one of the following is the quality of the steam leaving a cyclone separator at 985 psig and 1171 Btu/lbm? (Answer should be rounded to the nearest whole number.)

A. 95%

B. 96%

C. 97%

D. 98%

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.23 [2.5/2.7]
QID: B1387

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

A. 96%

B. 97%

C. 98%

D. 99%

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.23 [2.5/2.7]
QID: B1788

Which one of the following values approximates the quality of the saturated steam/water mixture leaving the core at 948 psig and 905 Btu/lbm?

A. 27%

B. 44%

C. 56%

D. 73%

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.24 [2.4/2.5]
QID: B391

Consider the temperature profile from the centerline of a fuel pellet to the centerline of the flow channel under 100% power conditions and single-phase cooling. Which one of the following portions of the temperature profile will have the greatest temperature difference across it at the beginning of a fuel cycle?

A. Flow channel boundary layer

B. Cladding corrosion film

C. Zircaloy cladding

D. Pellet-to-clad gap

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.24 [2.4/2.5]
QID: B1989 (P391)

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

At 100% reactor power, the greatest temperature difference in a fuel channel radial temperature profile will occur across the: (Assume the temperature profile begins at the fuel centerline.)

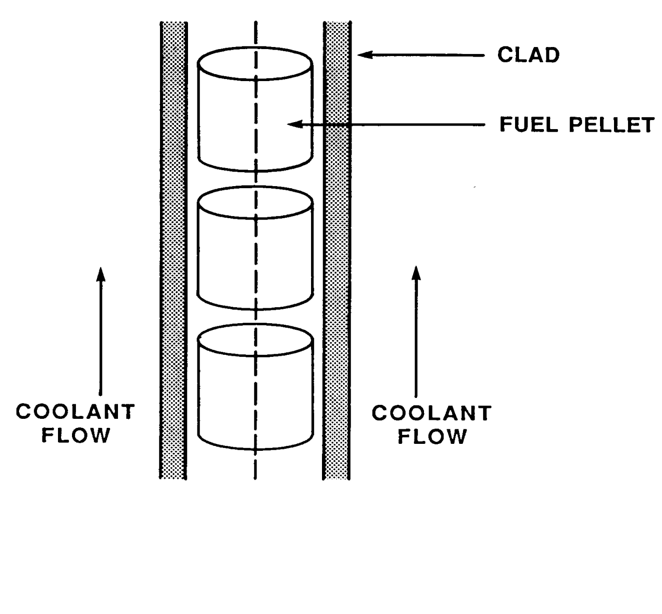
A. fuel pellet centerline to pellet surface.

B. fuel pellet surface-to-clad gap.

C. zircaloy cladding.

D. flow channel boundary (laminar) layer.

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293008
KNOWLEDGE: K1.25 [3.2/3.2]
QID: B292

A nuclear reactor is at 100% power when a trip of the recirculation pumps occurs. Void fraction percentage will...

A. stay the same due to minimal changes in reactor pressure.

B. decrease because the reactor power decrease reduces the steam bubbles being generated.

C. increase because steam bubbles are no longer being swept away.

D. decrease initially due to reactor pressure increase, then return to initial value.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.25 [3.2/3.2]
QID: B1189

Forced circulation through a reactor core is required at all times during power operation to prevent...

A. the core from becoming prompt critical due to high fuel and coolant temperatures.

B. exceeding reactor vessel and core design steaming rates.

C. high fuel clad surface temperatures that would result in a crack or leak in the clad.

D. jet pump cavitation which would reduce the power generated by the core.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.25 [3.2/3.2]
QID: B3789

Which one of the following describes the relationship between the feedwater mass flow rate entering the reactor vessel and the core mass flow rate at steady-state 100% reactor power?

A. The mass flow rates are about the same as long as the reactor vessel downcomer level is constant.

B. The mass flow rates are about the same as long as the reactor recirculation mass flow rate is constant.

C. The feedwater mass flow rate is much smaller than the core mass flow rate because most of the core mass flow is returned to the reactor vessel downcomer by the steam separators.

D. The feedwater mass flow rate is much larger than the core mass flow rate because the feedwater pump differential pressure is much larger than the core differential pressure.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.26 [2.9/3.1]
QID: B137

Which one of the following statements describes the principle of jet pump operation?

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

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

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

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

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.26 [2.9/3.1]
QID: B1389

Refer to the drawing of a core recirculation jet pump (see figure below).

The highest pressure will exist at point ______, and the highest velocity will occur at point ______.

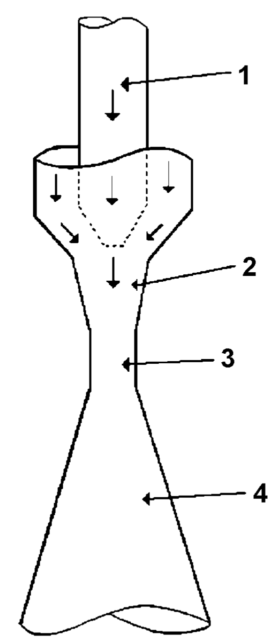
A. 1; 4

B. 2; 4

C. 1; 3

D. 2; 3

ANSWER: C.



JET PUMP

TOPIC: 293008
KNOWLEDGE: K1.26 [2.9/3.1]
QID: B2791

Refer to the drawing of a core recirculation jet pump (see figure below).

During normal operation, the lowest pressure will exist at point ______; and the highest velocity will occur at point ______.

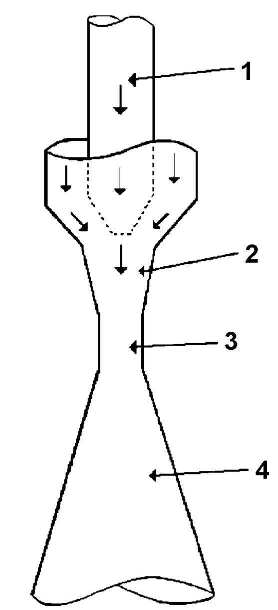
A. 3; 3

B. 3; 4

C. 4; 3

D. 4; 4

ANSWER: A.



JET PUMP

TOPIC: 293008
KNOWLEDGE: K1.28 [2.3/2.5]
QID: B490

A nuclear reactor is operating at 100% power. Recirculation flow is decreased from 100% to 80%. During the flow reduction, the boiling boundary will move ____________ in the core because each pound-mass (lbm) of water flowing through the core is required to remove ____________ heat from the fuel rods.

A. upward; less

B. upward; more

C. downward; less

D. downward; more

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.28 [2.3/2.5]
QID: B1789 (P1790)

Single-phase coolant flow resistance (head loss) in a reactor core is directly proportional to the square of coolant __________ and inversely proportional to __________.

A. velocity; fuel assembly length

B. temperature; fuel assembly length

C. velocity; coolant channel cross-sectional area

D. temperature; coolant channel cross-sectional area

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.28 [2.3/2.5]
QID: B5445 (P5446)

Refer to the drawing of a section of pipe that contains flowing water (see figure below).

Given:

Pressure at P_1 is 24 psig.
Pressure at P_2 is 16 psig.
Pressure change due to change in velocity is 2 psig.
Pressure change due to change in elevation is 10 psig.

The pressure decrease due to friction head loss between P_1 and P_2 is ____________; and the direction of flow is from ______________.

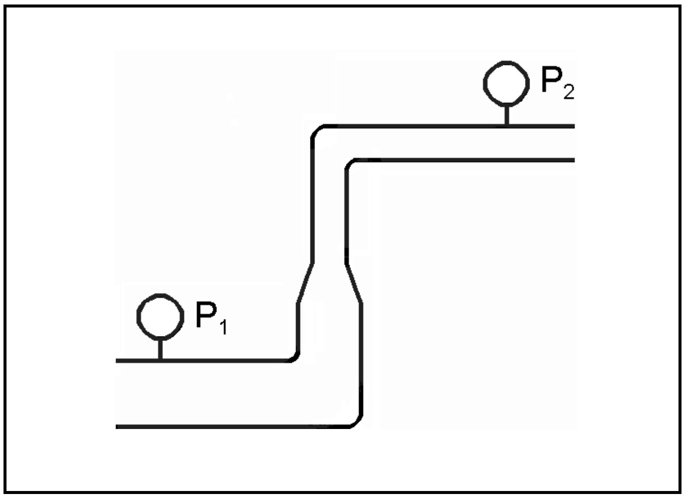
A. 2 psig; left to right

B. 2 psig; right to left

C. 4 psig; left to right

D. 4 psig; right to left

ANSWER: D.



TOPIC: 293008
KNOWLEDGE: K1.29 [2.8/3.0]
QID: B93

Which one of the following statements describes the effect of an increase in bundle power on bundle flow in a centrally located fuel bundle? (Assume total recirculation flow remains constant.)

A. Bundle flow increases because the increased boiling causes average coolant density to decrease, thereby reducing flow resistance.

B. Bundle flow decreases because the increased boiling increases backpressure due to increased reactor steam dome pressure, thereby increasing flow resistance.

C. Bundle flow increases because the increased boiling causes acceleration of coolant due to rapid expansion, thereby reducing flow resistance.

D. Bundle flow decreases because the increased boiling increases backpressure due to increased turbulence, thereby increasing flow resistance.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.29 [2.8/3.0]
QID: B2090

Nuclear reactors A and B are identical. Reactor A is operating at 75% power and reactor B is operating at 50% power with neutron flux radially and axially peaked in the center of each core. Recirculation mass flow rate through each core is the same.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B has the __________ critical power and the __________ coolant flow rate.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.29 [2.8/3.0]
QID: B2390

Nuclear reactors A and B are identical. Reactor A is operating at 50% power and reactor B is operating at 75% power. Neutron flux is radially and axially peaked in the center of each core. Recirculation mass flow rate through each core is the same.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B has the __________ critical power and the __________ coolant flow rate.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.29 [2.8/3.0]
QID: B5646

Two nuclear reactors, A and B, are operating at rated power with thermal neutron flux radially peaked in the center of each core. The reactors are identical except that reactor A has core orificing and reactor B does not. Both reactors have the same control rod pattern and density.

Compared to the center fuel bundle in reactor B, the center fuel bundle in reactor A will have the __________ exit steam quality and the __________ critical power.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B590

Without core orifices, the coolant flow rate through a high-power bundle will be less than the flow rate through a low-power bundle because the...

A two-phase flow-friction multiplier will be greater in the low-power bundle.

B. channel quality will be greater in the high-power bundle.

C. bypass flow will be greater in the high-power bundle.

D. thermal expansion of the fuel rods will be greater in the high-power bundle.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B890

With a nuclear reactor operating at rated power, if core orificing was not used, the highest core flow rates would exist in...

A. low-power bundles because of decreased flow resistance.

B. low-power bundles because of reduced control rod obstruction.

C. high-power bundles because of decreased flow resistance.

D. high-power bundles because of reduced control rod obstruction.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B990

Nuclear reactors A and B are operating at 100% power with neutron flux radially peaked in the center of each core. The reactors are identical except that reactor A has core orificing and reactor B does not.

Compared to the center fuel bundle in reactor B, the center fuel bundle in reactor A will have the __________ critical power and the __________ coolant flow rate.

A. lowest; lowest

B. lowest; highest

C. highest; lowest

D. highest; highest

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B1190

A nuclear reactor is operating at the point of adding heat during a reactor heatup. With only single-phase flow in the reactor, core orificing causes core flow to be...

A. highest in the periphery bundles.

B. highest in the central bundles.

C. the same for all bundles.

D. unpredictable.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B1590

Two nuclear reactors have the same rated power level and are currently operating at 50% power with the same power distribution in each core. The reactors are identical except that one reactor has core orifices and the other core does not. Each reactor has the same core mass flow rate.

The orificed core will have the ____________ critical power and the ____________ core differential pressure.

A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B1691

A nuclear reactor is operating at rated power at the beginning of core life. If core orificing is <u>not</u> used, the lowest bundle flow rate will exist in...

A. peripheral bundles that have control rods partially inserted.

B. central bundles that have control rods partially inserted.

C. peripheral bundles that have control rods completely withdrawn.

D. central bundles that have control rods completely withdrawn.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B1790

Two nuclear reactors, A and B, are operating at the same rated power with neutron flux radially peaked in the center of each core. Reactors A and B are identical except that reactor A has core orificing and reactor B does not. Both reactors have the same control rod pattern and density.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B will have the __________ critical power and the __________ coolant flow rate.

A. lowest; lowest

B. lowest; highest

C. highest; lowest

D. highest; highest

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B2187

Nuclear reactors A and B are currently operating at 50% power with a normal neutron flux distribution in each core. The reactors are identical except that reactor A has core orifices and reactor B does not. Each reactor has the same core mass flow rate.

Reactor B will have the ____________ critical power and the ____________ core differential pressure.

A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B2591

Two nuclear reactors, A and B, are operating at rated power with neutron flux radially peaked in the center of each core. Reactors A and B are identical except that reactor A has core orificing and reactor B does not. Both reactors have the same control rod pattern and density.

Compared to the outer fuel bundles in reactor B, the outer fuel bundles in reactor A will have the __________ critical power and the __________ coolant flow rate.

A. lowest; lowest

B. lowest; highest

C. highest; lowest

D. highest; highest

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.30 [2.7/2.7]
QID: B2890

Two nuclear reactors, A and B, are operating at rated power with neutron flux radially peaked in the center of each core. The reactors are identical except that reactor A has core orificing and reactor B does not. Both reactors have the same control rod pattern and density.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B will have the __________ exit steam quality and the __________ critical power.

A. lower; lower

B. lower; higher

C. higher; lower

D. higher; higher

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.31 [2.9/3.0]
QID: B291

Core orificing is used in the reactor core because the orifices...

A. counteract the buoyant force of the bubbles accelerating flow in the high-powered bundles.

B. improve the distribution of core flow to offset the effect of increasing quality on bundle flow.

C. increase core ΔP so that minor crud buildup on fuel bundles will not adversely affect flow.

D. decrease flow during periods of natural circulation to increase the void coefficient.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.31 [2.9/3.0]
QID: B1388

Which one of the following occurs as a result of reactor core orifices?

A. The core differential pressure is minimized at all power levels.

B. The total core coolant flow rate remains the same at all power levels.

C. The total core coolant flow rate is divided equally through all bundles at all power levels.

D. The highest bundle coolant flow rates exist in core interior bundles at all power levels.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.31 [2.9/3.0]
QID: B3890

Given:

- Nuclear reactors A and B are identical except that reactor A has no core orificing while reactor B is equipped with orifices.
- Both reactors always operate with identical recirculation system flow rates.
- Both reactors are currently operating at 80% of full power with the thermal neutron flux radially peaked in the center of both cores.

Compared to identical locations in the core of reactor A, the critical power ratio (CPR) in the central fuel bundles of reactor B is ________; and the peak power in the peripheral fuel bundles of reactor B is ________.

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.32 [2.5/2.6]
QID: B690

Core bypass flow is...

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

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

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

D. desirable because it provides cooling for incore instrumentation.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.32 [2.5/2.6]
QID: B2991

Which one of the following is the approximate percentage of total core flow that bypasses the fuel coolant channels in a nuclear reactor operating at 100% power with 100% recirculation flow?

A. 0.01%

B. 0.1%

C. 1 %

D. 10 %

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.32 [2.5/2.6]
QID: B3191

A nuclear reactor is operating at 100% power with 100% core flow rate. Reactor power is decreased and stabilized at 75% using only control rods for reactivity control. Core flow rate is maintained at 100%.

During the power decrease, core bypass flow rate ________ because core pressure drop __________.

A. decreased; increased

B. decreased; decreased

C. increased; increased

D. increased; decreased

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.32 [2.5/2.6]
QID: B3290

A nuclear reactor is operating at equilibrium 100% power. Assuming reactor coolant flow rate into the core region does not change, how will core bypass flow rate be affected during a reactor power decrease to 80%?

A. Increase because greater two-phase flow resistance exists in the core at 80% power.

B. Decrease because less two-phase flow resistance exists in the core at 80% power.

C. Remain the same because core bypass flow rate is dependent only on reactor core flow rate.

D. Remain the same because core bypass flow rate is unaffected by changes in reactor power.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.33 [2.4/2.6]
QID: B384

What is the purpose of the coolant flow that bypasses the fuel assemblies and enters the core interstitial region?

A. Removes the heat that is generated in the control rods and the local power range monitors.

B. Equalizes core differential pressure between the inlet and outlet plenums.

C. Offsets the decrease in heat removal from the fuel bundle due to decreased flow as two phase flow resistance increases.

D. Lubricates the interfacing surfaces of control rods and fuel channels to reduce sliding friction and wear.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.33 [2.4/2.6]
QID: B1390

Reactor coolant flow that bypasses the core is necessary to...

A. provide a source of water to the incore thermocouples to ensure they measure a representative coolant temperature.

B. act as a neutron reflector to minimize fast neutron leakage.

C. ensure that recirculation pump flow rate is adequate to prevent pump overheating.

D. provide cooling to prevent excessive boiling in the bypass region.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.34 [2.9/3.1]
QID: B192

Natural circulation is inherent in a boiling water nuclear reactor. Which one of the following statements describes natural circulation after a loss of offsite power?

A. Liquid density in the downcomer and reduction of density in the core region support the cycle.

B. Two-phase flow in the separators allows steam to be removed and liquid to return to the downcomer region.

C. Relief and safety valves provide a heat sink for decay heat; in spite of leakage, control rod drives are adequate to maintain inventory.

D. Density of liquid in the core region increases, thereby allowing liquid in the downcomer to enter the core.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.34 [2.9/3.1]
QID: B691

Which one of the following statements describes natural circulation in a shut down nuclear reactor? (Assume no isolation condenser.)

A. The moisture separators return the liquid portion of the coolant mixture exiting the core to the downcomer where it cools and increases in density.

B. The jet pump diffusers establish a thermal driving head by increasing the velocity of the coolant as it flows downward through the diffuser.

C. Coolant flows from the downcomer into a reactor recirculation loop and is returned to the core.

D. Emergency coolant injection establishes a thermal driving head by providing cold coolant to the downcomer.

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.35 [3.1/3.3]
QID: B293

A nuclear reactor is shut down with all reactor recirculating pumps stopped. Which one of the following explains why it is important to monitor reactor vessel skin temperatures?

A. Significant differential temperature between the top and bottom reactor vessel heads will result in excessive thermal stresses in the reactor vessel wall.

B. Significant differential temperature between the upper and lower elevation reactor vessel skin indicates that thermal stratification is occurring.

C. These temperatures provide a backup indication of reactor water level because the skin temperatures detected above vessel water level will be lower than those below vessel water level.

D. These temperatures provide the best indication of the accuracy of the shutdown reactor water level instruments due to the temperature variance from instrument calibration conditions.

ANSWER: B.

TOPIC: 293008
KNOWLEDGE: K1.35 [3.1/3.3]
QID: B3490

Given:

- A nuclear reactor was shutdown 1 week ago from long term operation at 100% power.
- All reactor recirculation pumps are off.
- All reactor head vents are open.
- A shutdown core cooling system is currently in use, maintaining reactor coolant temperature stable at 170°F.
- Reactor coolant temperature is monitored by a detector at the inlet to the in-service shutdown core cooling heat exchanger.

The flow rate from the shutdown core cooling system to the core is inadvertently throttled, resulting in thermal stratification of the reactor coolant in the core. Which one of the following combinations will occur if this thermal stratification is permitted to exist for up to 24 hours?

A. Water in the core will begin to boil, and the in-service shutdown cooling pump will cavitate.

B. The in-service shutdown cooling pump will cavitate, and the jet pumps will cavitate.

C. The jet pumps will cavitate, and reactor coolant temperature will indicate lower than actual core water temperature.

D. Reactor coolant temperature will indicate lower than actual core water temperature, and water in the core will begin to boil.

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.36 [3.1/3.3]
QID: B1491

A nuclear reactor is operating at full power when a loss of offsite power results in a reactor scram and a loss of forced core coolant flow. Several minutes later, the development of natural circulation flow will be indicated by differential ____________ across the core plate and flow through the ____________ pumps.

A. temperature; recirculation

B. temperature; jet

C. pressure; recirculation

D. pressure; jet

ANSWER: D.

TOPIC: 293008
KNOWLEDGE: K1.36 [3.1/3.3]
QID: B3891

A nuclear reactor was shutdown from long-term 100% power operation 10 days ago. Five minutes ago, a station blackout occurred that caused the complete loss of forced coolant circulation through the core. The following conditions currently exist:

- Reactor pressure vessel (RPV) pressure indicates 0 psig.
- Main steam isolation valves are closed.
- Reactor head vents are open with no steam issuing.
- Average reactor coolant temperature is 150°F.
- Differential temperature between the upper and lower RPV heads is 20°F and increasing.

Over the next hour or so, with no operator action, which one of the following will occur as natural circulation becomes established in the RPV?

A. RPV pressure will slowly increase and stabilize at about 10 psig, and the differential temperature between the upper and lower RPV heads will stabilize at a value greater than 0°F.

B. RPV pressure will slowly increase and stabilize at about 10 psig, and the differential temperature between the upper and lower RPV heads will stabilize at 0°F.

C. RPV pressure will remain near 0 psig, and the differential temperature between the upper and lower RPV heads will stabilize at a value greater than 0°F.

D. RPV pressure will remain near 0 psig, and the differential temperature between the upper and lower RPV heads will stabilize at 0°F.

ANSWER: C.

TOPIC: 293008
KNOWLEDGE: K1.37 [3.2/3.4]
QID: B891

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

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

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

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

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

ANSWER: A.

TOPIC: 293008
KNOWLEDGE: K1.37 [3.2/3.4]
QID: B3086

After operating at high power for several weeks, a nuclear reactor was shut down yesterday and cooled down to repair a steam line leak. Shutdown cooling water pumps are being used to maintain reactor temperature and pressure. The pumps will be stopped in 30 minutes to commence a 4-hour test.

What action, if any, should be taken to enhance natural circulation cooling during the test, and why?

A. No action necessary; the increase of density in the downcomer and the reduction of density in the core region will easily support circulation.

B. No action necessary; the density of the mixture in the core region increases, thereby allowing liquid in the downcomer to enter the core.

C. Raise vessel pressure to allow vessel relief valves to lift and create a heat sink for decay heat while control rod drive flow maintains inventory.

D. Raise vessel water level above the bottom of the steam separators to provide a liquid flow path from the inside to the outside of the core shroud.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
QID: B1092

In a nuclear reactor operating at full power, the fuel bundle with the highest power always has the...

A. greatest critical power ratio.

B. greatest radial peaking factor.

C. smallest linear heat generation rate.

D. smallest maximum average planar linear heat generation rate.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
QID: B1592

The radial peaking factor of a bundle is defined as...

A. $\dfrac{\text{core average bundle power}}{\text{individual bundle power}}$

B. $\dfrac{\text{peak nodal power}}{\text{core average nodal power}}$

C. $\dfrac{\text{core average nodal power}}{\text{peak nodal power}}$

D. $\dfrac{\text{individual bundle power}}{\text{core average bundle power}}$

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
QID: B2392

In a nuclear reactor operating at full power, the fuel bundle with the lowest power always has the smallest...

A. critical power ratio.

B. radial peaking factor.

C. axial peaking factor.

D. critical heat flux.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
K1.02 [2.2/2.6]
QID: B2592

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

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

A. increase; decrease

B. increase; increase

C. decrease; decrease

D. decrease; increase

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
QID: B2892

In a nuclear reactor operating at full power, the fuel bundle with the greatest radial peaking factor always has the...

A. greatest power.

B. greatest critical power ratio.

C. smallest axial peaking factor.

D. smallest linear heat generation rate.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
K1.02 [2.2/2.6]
QID: B2992

A nuclear reactor is operating at 40% of rated thermal power with power distribution peaked both radially and axially in the center of the core. Reactor power is then increased to 70% over the next two hours using only reactor recirculation flow rate adjustments for reactivity control.

Neglecting any effect from reactor poisons, when power is stabilized at 70% the location of the maximum core radial peaking factor will ___________ of the core and the location of the maximum core axial peaking factor will ____________ of the core.

A. move away from the center; move toward the bottom

B. move away from the center; move toward the top

C. remain near the center; move toward the bottom

D. remain near the center; move toward the top

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.01 [2.1/2.5]
QID: B3492

A nuclear reactor is operating at 80% of rated thermal power with the radial power distribution peaked in the center of the core. Reactor power is then decreased to 60% over the next two hours by:

- reducing reactor recirculation flow rate by 10%, and
- partially inserting a group of centrally-located deep control rods.

Compared with the previous operation at 80%, when power is stabilized at 60%, the value of the core maximum radial peaking factor will be __________; and the primary contributor to the change in the value of the core maximum radial peaking factor will be the change in __________.

A. smaller; recirculation flow

B. smaller; control rod position

C. larger; recirculation flow

D. larger; control rod position

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.02 [2.2/2.6]
QID: B892

The axial peaking factor for a node of a fuel bundle is defined as...

A. $\dfrac{\text{core average bundle power}}{\text{peak nodal power}}$

B. $\dfrac{\text{peak nodal power}}{\text{core average bundle power}}$

C. $\dfrac{\text{bundle average nodal power}}{\text{nodal power}}$

D. $\dfrac{\text{nodal power}}{\text{bundle average nodal power}}$

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.03 [2.1/2.5]
QID: B1492

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

A. local

B. radial

C. axial

D. total

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.04 [2.2/2.6]
QID: B3294

A BWR core consists of 30,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal power. If the total peaking factor for a node is 2.0, what is the maximum local linear power density being produced in the node?

A. 4.0 kW/ft

B. 6.0 kW/ft

C. 8.0 kW/ft

D. 10.0 kW/ft

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.04 [2.2/2.6]
QID: B3793

A BWR core consists of 30,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,800 MW of thermal power. If the total peaking factor for a node is 1.6, what is the maximum local linear power density being produced in the node?

A. 4.0 kW/ft

B. 6.0 kW/ft

C. 8.0 kW/ft

D. 10.0 kW/ft

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.04 [2.2/2.6]
QID: B4447

A nuclear reactor is operating at its licensed limit of 2,200 MWt. The linear heat generation rate (LHGR) limit is 13.0 kW/ft.

Given:

- The reactor core contains 560 fuel bundles.
- Each bundle contains 62 fuel rods, each with an active length of 12.5 feet
- The highest total peaking factors are at the following core locations:

  Location A: 2.9
  Location B: 2.7
  Location C: 2.5
  Location D: 2.3

Which one of the following describes the operating condition of the core relative to the LHGR limit?

A. All locations in the core are operating below the LHGR limit.

B. Only location A has exceeded the LHGR limit while the remainder of the core is operating below the limit.

C. Locations A and B have exceeded the LHGR limit while the remainder of the core is operating below the limit.

D. Locations A, B, and C have exceeded the LHGR limit while the remainder of the core is operating below the limit.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.04 [2.2/2.6]
QID: B4948

A BWR core consists of 30,000 fuel rods; each fuel rod has an active length of 12 feet. The core is producing 1,350 MW of thermal power. If the total peaking factor for a node is 1.6, what is the maximum local linear power density being produced in the node?

A. 4.0 kW/ft

B. 6.0 kW/ft

C. 8.0 kW/ft

D. 10.0 kW/ft

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.04 [2.2/2.6]
QID: B5247

A nuclear reactor is operating at 3,400 MW thermal power. The linear heat generation rate (LHGR) limit is 14.7 kW/ft.

Given:

- The reactor core contains 640 fuel bundles.
- Each bundle contains 62 fuel rods, each with an active length of 12.5 feet
- The highest total peaking factors are at the following core locations:

  Location A: 2.4
  Location B: 2.3
  Location C: 2.2
  Location D: 2.1

Which one of the following describes the operating conditions in the core relative to the LHGR limit?

A. All locations in the core are operating below the LHGR limit.

B. Location A has exceeded the LHGR limit while the remainder of the core is operating below the limit.

C. Locations A and B have exceeded the LHGR limit while the remainder of the core is operating below the limit.

D. Locations A, B, and C have exceeded the LHGR limit while the remainder of the core is operating below the limit.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.05 [3.3/3.5]
QID: B1893 (P1395)

Thermal limits are established to protect the nuclear reactor core, and thereby protect the public during nuclear power plant operations which include...

A. normal operations only.

B. normal and abnormal operations only.

C. normal, abnormal, and postulated accident operations only.

D. normal, abnormal, postulated and unpostulated accident operations.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.05 [3.3/3.5]
QID: B2693 (P2696)

A nuclear reactor has experienced a loss of coolant accident. Inadequate core cooling has resulted in the following core temperatures one hour into the accident:

- 90% of the fuel clad has remained below 1,800°F.
- 10% of the fuel clad has exceeded 1,800°F.
- 5% of the fuel clad has exceeded 2,000°F.
- 0.5% of the fuel clad has reached 2,200°F.
- 0.0% of the fuel clad has exceeded 2,200°F.
- Peak centerline fuel temperature is 4,650°F.

Which one of the following is an adverse consequence that will occur if the above fuel and clad temperature conditions remain constant for 24 additional hours followed by the injection of emergency cooling water directly to the top of the core?

A. Release of radioactive fission products due to rupture of the fuel clad

B. Release of radioactive fission products due to melting of the fuel pellets and fuel clad

C. Explosive hydrogen concentration inside the reactor vessel

D. Explosive hydrogen concentration inside the reactor containment building

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.06 [3.4/3.8]
QID: B94

Linear heat generation rate is the...

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

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

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

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

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.06 [3.4/3.8]
QID: B296

The linear heat generation rate (LHGR) for a nuclear reactor core is acceptable if _______________ is being maintained at _______________.

A. $LHGR_{limit}/LHGR_{measured}$; 0.95

B. $LHGR_{measured}/LHGR_{limit}$; 1.05

C. $LHGR_{limit}/LHGR_{measured}$; 1.10

D. $LHGR_{measured}/LHGR_{limit}$; 1.15

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.07 [2.8/3.6]
QID: B295

Operating a nuclear reactor below the linear heat generation rate thermal limit prevents...

A. cracking of the fuel cladding due to high stress from fuel pellet expansion.

B. melting of the fuel cladding due to cladding temperature exceeding 2,200°F during an anticipated transient without a scram.

C. cracking of the fuel cladding due to a lack of cooling caused by departure from nucleate boiling.

D. melting of the fuel cladding due to a lack of cooling following a loss of coolant accident.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.07 [2.8/3.6]
QID: B392

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

A. Average gain adjustment factor

B. Maximum linear heat generation rate

C. Rated thermal power

D. Minimum critical power ratio

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.07 [2.8/3.6]
QID: B894

Which one of the following must be maintained within the technical specification limit to ensure that fuel cladding plastic strain (deformation) is limited to 1%?

A. Average planar linear heat generation rate

B. Linear heat generation rate

C. Minimum critical power ratio safety limit

D. Minimum critical power ratio operating limit

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.07 [2.8/3.6]
QID: B1093

Which one of the following is responsible for the clad failure caused by operating the nuclear reactor above the limit for linear heat generation rate?

A. Fission product gas expansion causes clad internal design pressure to be exceeded.

B. Corrosion buildup on the fuel clad surface reduces heat transfer and promotes transition boiling.

C. The zircaloy-steam reaction causes accelerated oxidation of the clad at high temperatures.

D. The difference between thermal expansion rates of the fuel pellets and the clad causes severe clad stress.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.07 [2.8/3.6]
QID: B1692

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

A. peak cladding temperature after the design basis loss of coolant accident will not exceed 2,200°F.

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

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

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

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.08 [3.0/3.4]
QID: B592

If the linear heat generation rate (LHGR) limiting condition for operation is exceeded, the most probable type of fuel cladding failure is...

A. cracking due to high stress.

B. gross failure due to a lack of cooling.

C. embrittlement due to excessive oxidation.

D. distortion due to inadequate cooling.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.10 [3.3/3.7]
QID: B297

The amount of heat stored in the fuel, resulting from the operating kW/foot existing in the fuel prior to a scram, is measured by the...

A. average planar linear heat generation rate (APLHGR).

B. linear heat generation rate (LHGR) multiplied by the total peaking factor.

C. core fraction of limiting power density.

D. APLHGR-to-MAPLHGR ratio.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.11 [2.8/3.6]
QID: B195

Which one of the following must be maintained within limits to ensure that peak cladding temperature will not exceed 2,200°F after a design basis loss of coolant accident?

A. Linear heat generation rate

B. Average planar linear heat generation rate

C. Minimum critical power ratio

D. Maximum fraction of limiting critical power ratio

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.11 [2.8/3.6]
QID: B1393

Maintaining the average planar linear heat generation rate (APLHGR) below the technical specification limiting condition for operation (LCO) ensures that...

A. peak clad temperature after the design basis loss of coolant accident will not exceed 2,200°F.

B. during transients, more than 99.9% of the fuel rods are expected to avoid transition boiling.

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

D. axial peaking factors will not exceed those assumed in the safety analyses.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.11 [2.8/3.6]
QID: B1793 (P396)

The 2,200°F maximum peak fuel cladding temperature limit is imposed because...

A. 2,200°F is approximately 500°F below the fuel cladding melting temperature.

B. the rate of the zircaloy-steam reaction increases significantly at temperatures above 2,200°F.

C. any cladding temperature higher than 2,200°F correlates to a fuel centerline temperature above the fuel melting point.

D. the thermal conductivity of zircaloy decreases rapidly at temperatures above 2,200°F.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.11 [2.8/3.6]
QID: B2194 (P2194)

Which one of the following describes the basis for the 2,200°F maximum fuel clad temperature limit?

A. The material strength of zircaloy decreases rapidly at temperatures above 2,200°F.

B. At the normal operating pressure of the reactor vessel a clad temperature above 2,200°F indicates that the critical heat flux has been exceeded.

C. The rate of the zircaloy-water reaction becomes significant at temperatures above 2,200°F.

D. 2,200°F is approximately 500°F below the fuel clad melting temperature.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.11 [2.8/3.6]
QID: B2292 (P2995)

Which one of the following describes the basis for the 2,200°F maximum fuel clad temperature limit?

A. 2,200°F is approximately 500°F below the fuel clad melting temperature.

B. The rate of the zircaloy-steam reaction increases significantly above 2,200°F.

C. If fuel clad temperature reaches 2,200°F, the onset of transition boiling is imminent.

D. The differential expansion between the fuel pellets and the fuel clad becomes excessive above 2,200°F.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.13 [3.1/3.6]
QID: B97

Operating a nuclear reactor within the limits defined by the maximum average planar linear heat generation rate (MAPLHGR) prevents...

A. exceeding 1% plastic strain in the cladding.

B. exceeding a peak fuel temperature of 2,200°F.

C. the onset of transition boiling in the upper core.

D. exceeding a peak clad temperature of 2,200°F.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.13 [3.1/3.6]
QID: B896

Which of the following is indicated when the average planar linear heat generation rate (APLHGR)-to-maximum APLHGR ratio is less than 1?

A. Linear heat generation rate (LHGR) limit has not been exceeded.

B. LHGR limit has been exceeded.

C. APLGHR limit has not been exceeded.

D. APLGHR limit has been exceeded.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.13 [3.1/3.6]
QID: B1595

Which one of the following is indicated when the maximum average power ratio (MAPRAT) is greater than 1.0?

A. The linear heat generation rate (LHGR) limit has not been exceeded.

B. The average planar linear heat generation rate (APLHGR) limit has not been exceeded.

C. The LHGR limit has been exceeded.

D. The APLHGR limit has been exceeded.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.13 [3.1/3.6]
QID: B1795

Which one of the following is indicated when the maximum average power ratio (MAPRAT) is less than 1.0?

A. The linear heat generation rate (LHGR) limit has been exceeded.

B. The average planar linear heat generation rate (APLHGR) limit has been exceeded.

C. The APLHGR limit has not been exceeded.

D. The LHGR limit has not been exceeded.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.13 [3.1/3.6]
QID: B2595

If a nuclear reactor is operating above its Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) prior to a loss of coolant accident, fuel pellet centerline temperature may reach 4200°F and fuel cladding temperature may reach 2300°F during the accident.

Which one of the following describes the likely clad rupture mechanism?

A. Excessive fuel pellet expansion

B. Excessive plastic strain in the clad

C. Excessive embrittlement of the clad

D. Excessive cadmium and iodine attack on the clad

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.14 [2.2/2.7]
QID: B393

At high core exposures, the maximum average planar linear heat generation rate (MAPLHGR) limit decreases with increasing core exposure. What is the reason for this decrease?

A. Cracking of fuel pellets at higher core exposures permits additional volume for fission product gases.

B. Zirconium-steam chemical reaction in cladding requires higher temperatures at higher core exposures.

C. Fission product decay heat level decreases at higher core exposures.

D. Fission product gases lower the overall heat transfer coefficient of the fuel rod fill gas.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.15 [2.6/3.1]
QID: B792

During a loss-of-coolant accident, which one of the following heat transfer mechanisms provides the most core cooling when fuel elements are not in contact with the coolant?

A. Radiation

B. Emission

C. Convection

D. Conduction

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B394 (P383)

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

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 3,000°F

Which one of the following would be the fuel centerline temperature if, over core life, the total fuel-to-coolant thermal conductivity were doubled? (Assume reactor power is constant.)

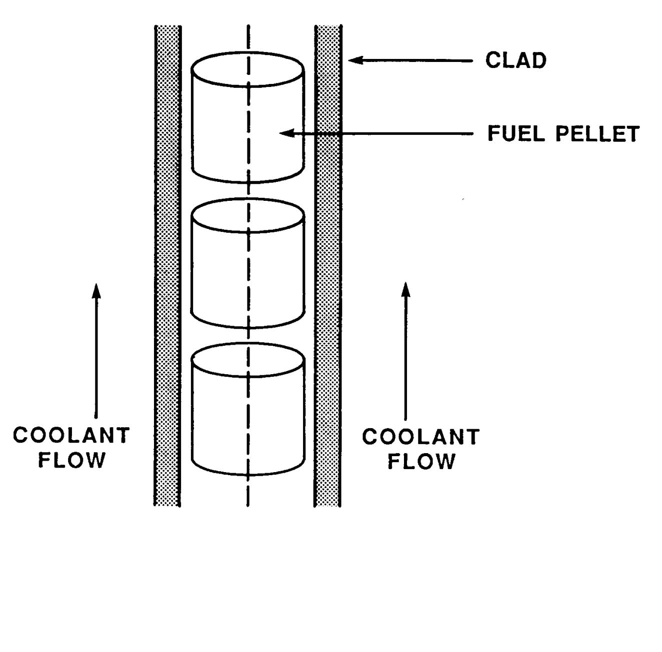
A. 1,000°F

B. 1,250°F

C. 1,500°F

D. 1,750°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B495 (P495)

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

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,500°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled? (Assume reactor power is constant.)

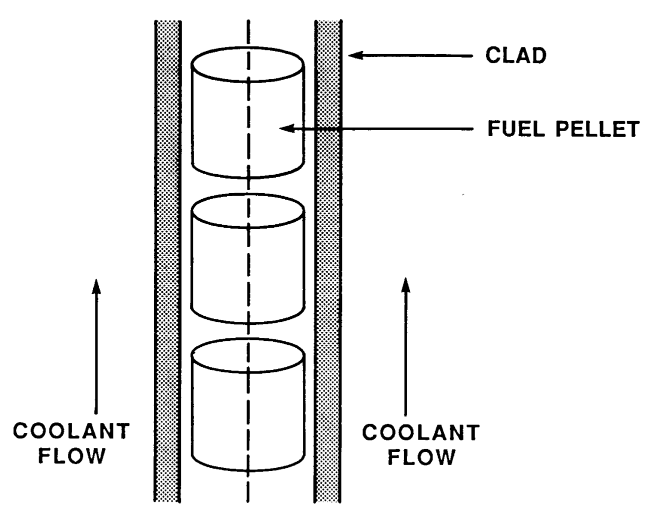
A. 1,250°F

B. 1,300°F

C. 1,400°F

D. 1,500°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B1395 (P1894)

Which one of the following describes the fuel-to-coolant thermal conductivity at the end of core life (EOL) as compared to the beginning of core life (BOL)?

A. Smaller at EOL due to fuel pellet densification.

B. Smaller at EOL due to contamination of fill gas with fission product gases.

C. Larger at EOL due to reduction in gap between fuel pellets and clad.

D. Larger at EOL due to greater temperature difference between fuel pellets and coolant.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B1594 (P1594)

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

Given the following initial core parameters:

Reactor power = 100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,700°F

What would be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power is constant.)

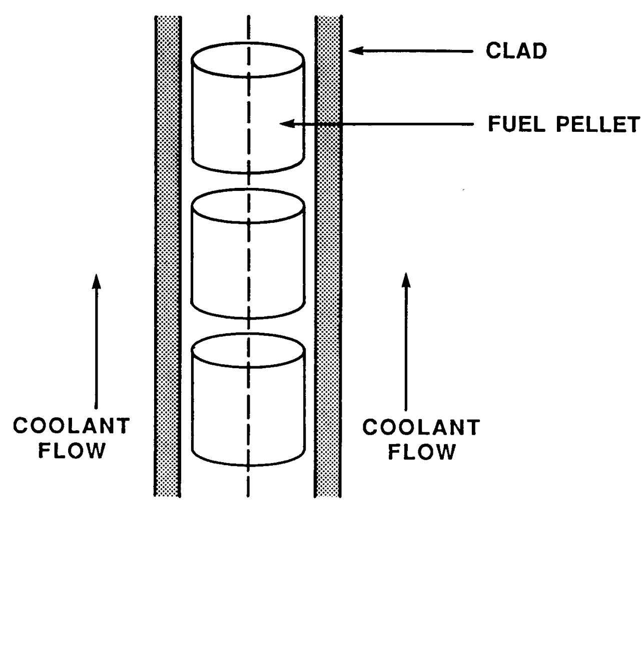
A. 1,100°F

B. 1,350°F

C. 1,600°F

D. 1,850°F

ANSWER: C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B1697 (P3395)

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

Given the following initial core parameters:

Reactor power = 50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,750°F

What will the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

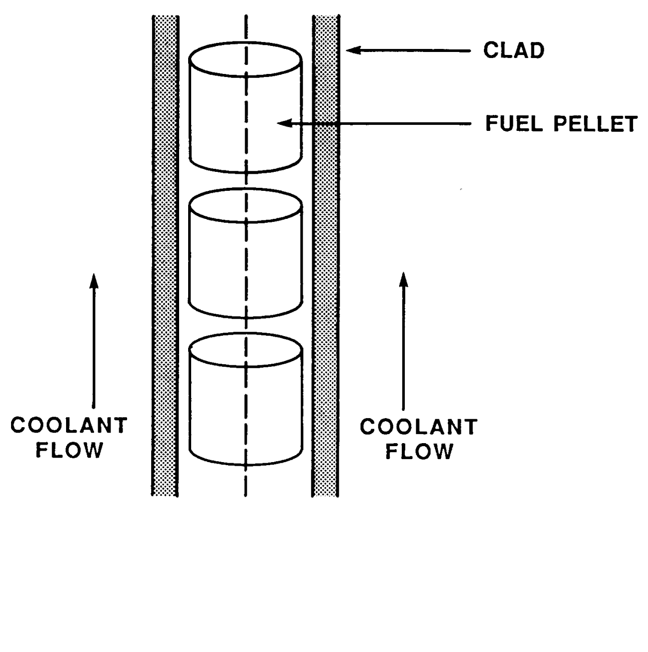
A. 1,100°F

B. 1,375°F

C. 1,525°F

D. 1,650°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B1995 (P1994)

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

Given the following initial core parameters:

Reactor power	= 80%
$T_{coolant}$	= 540°F
$T_{fuel\ centerline}$	= 2,540°F

What would the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity were doubled? (Assume reactor power is constant.)

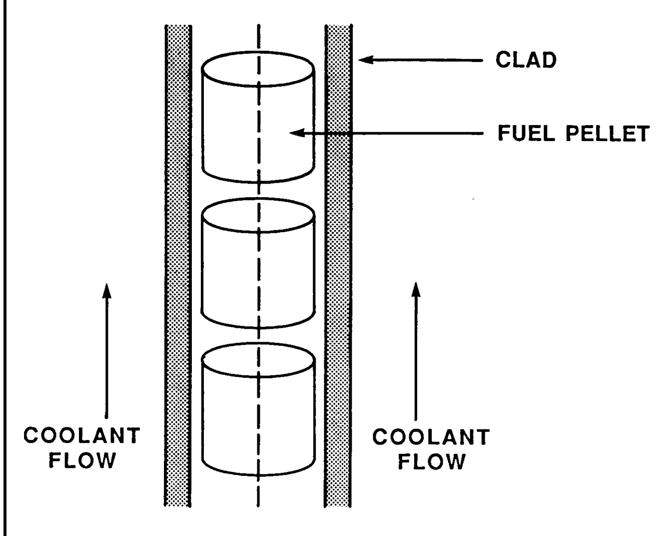
A. 1,270°F

B. 1,370°F

C. 1,440°F

D. 1,540°F

ANSWER: D.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B2192 (P2195)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel assembly at the beginning of a fuel cycle (BOC) as compared to the end of a fuel cycle (EOC)?

A. Larger at BOC due to a higher fuel pellet density.

B. Larger at BOC due to lower contamination of fuel rod fill gas with fission product gases.

C. Smaller at BOC due to a larger gap between the fuel pellets and clad.

D. Smaller at BOC due to a smaller corrosion film on the surface of the fuel rods.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B2394 (P2395)

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

The reactor is shut down with the following parameter values:

$T_{coolant}$ = 320°F
$T_{fuel\ centerline}$ = 780°F

What would the fuel centerline temperature be under these same conditions at the end of core life if the total fuel-to-coolant thermal conductivity were doubled?

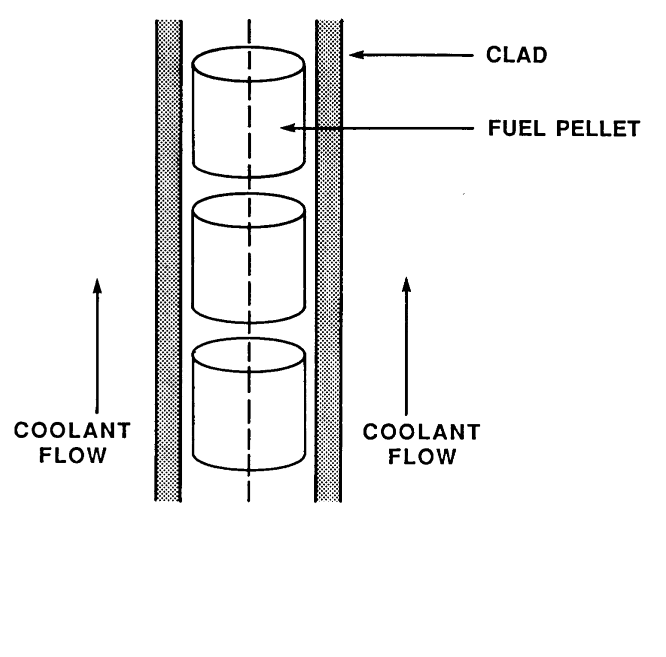
A. 550°F

B. 500°F

C. 450°F

D. 400°F

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B2696 (P2296)

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

Given the following initial core parameters:

Reactor power = 60%
$T_{coolant}$ = 560°F
$T_{fuel\ centerline}$ = 2,500°F

Which one of the following will be the fuel centerline temperature at the end of the fuel cycle if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

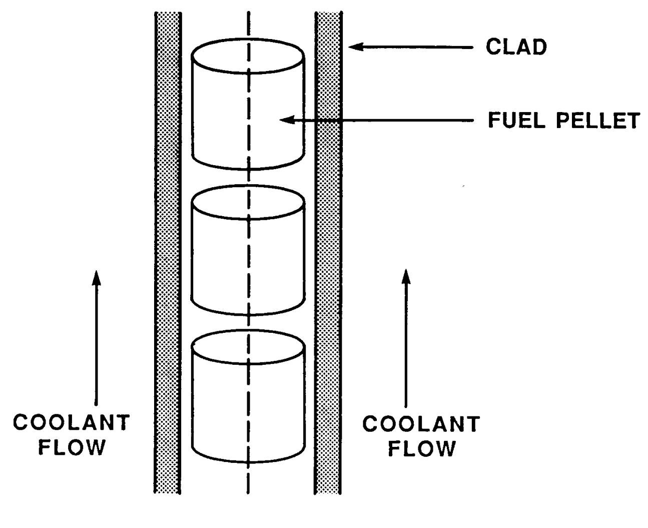
A. 1,080°F

B. 1,250°F

C. 1,530°F

D. 1,810°F

ANSWER: C.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B2794

Given the following initial core parameters for a segment of a fuel rod:

Power density = 2 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 1,200°F

Reactor power is increased such that the following core parameters now exist for the fuel rod segment:

Power density = 3 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = ?

Assuming void fraction surrounding the fuel rod segment does not change, what will be the new stable $T_{fuel\ centerline}$?

A. 1,380°F

B. 1,530°F

C. 1,670°F

D. 1,820°F

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B2896

Given the following initial core parameters for a segment of a fuel rod:

Power density = 2 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 1,800°F

Reactor power is increased such that the following core parameters now exist for the fuel rod segment:

Power density = 4 kW/ft
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = ?

Assuming void fraction surrounding the fuel rod segment does not change, what will be the new stable $T_{fuel\ centerline}$?

A. 2,520°F

B. 2,780°F

C. 3,060°F

D. 3,600°F

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B3193 (P3195)

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

The reactor is shut down at the beginning of a fuel cycle with the following average parameter values:

$T_{coolant}$ = 440°F
$T_{fuel\ centerline}$ = 780°F

If the total fuel-to-coolant thermal conductivity doubles over core life, what will the fuel centerline temperature be with the same coolant temperature and reactor decay heat conditions at the end of the fuel cycle?

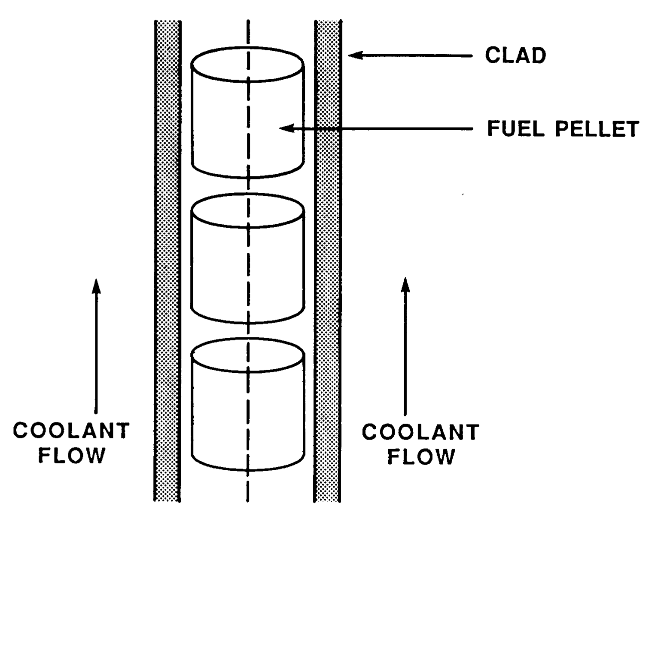
A. 610°F

B. 580°F

C. 550°F

D. 520°F

ANSWER: A.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.16 [2.4/2.8]
QID: B3893

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

Given the following initial stable core parameters:

Reactor power = 50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 1,250°F

Assume that the total heat transfer coefficient and the reactor coolant temperature do <u>not</u> change. What will the approximate stable fuel centerline temperature be if reactor power is increased to 75%?

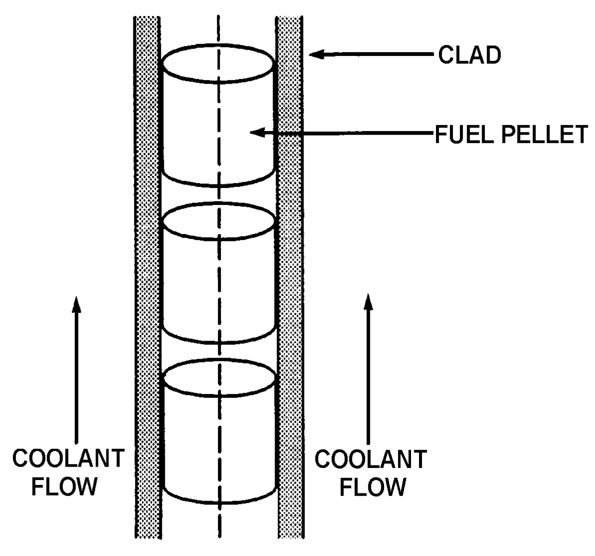
A. 1,425°F

B. 1,600°F

C. 1,750°F

D. 1,875°F

ANSWER: B.



FUEL ROD AND COOLANT FLOW CHANNEL

TOPIC: 293009
KNOWLEDGE: K1.17 [3.3/3.7]
QID: B145

The fuel bundle power that will cause the onset of transition boiling at some point in the fuel bundle is the...

A. technical specification limit.

B. critical power.

C. maximum fraction of limiting power density.

D. maximum power density.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.17 [3.3/3.7]
QID: B1997 (P3587)

Which one of the following is most likely to result in fuel clad damage?

A. Operating at 110% of reactor vessel design pressure.

B. An inadvertent reactor scram from 100% power.

C. Operating with fuel bundle power greater than critical power.

D. Operating with saturated nucleate boiling occurring in a fuel bundle.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.18 [3.2/3.7]
QID: B298

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

A. Critical power/actual bundle power

B. Actual bundle power/critical power

C. Average bundle power/critical power

D. Critical power/average bundle power

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.19 [2.8/3.6]
QID: B597

Which one of the following adverse conditions is avoided primarily by maintaining the minimum critical power ratio within specified values (limits)?

A. Excessive plastic strain on cladding

B. Excessive cladding creep

C. Excessive decay heat in the fuel

D. Excessive cladding temperatures

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.19 [2.8/3.6]
QID: B694

The purpose of maintaining the critical power ratio greater than 1.0 is to...

A. prevent fuel clad cracking during analyzed accident conditions.

B. avoid the onset of transition boiling during expected operating transients.

C. limit peak cladding temperatures to less than 2,200°F during analyzed accident conditions.

D. prevent melting at the fuel pellet centerline during expected operating transients.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.19 [2.8/3.6]
QID: B798

Which thermal limit is maintained to ensure the core does <u>not</u> experience transition boiling?

A. Minimum critical power ratio

B. Maximum average planar linear heat generation ratio (APLHGR)

C. Maximum fraction of limiting power density

D. APLHGR-to-maximum APLHGR ratio

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.19 [2.8/3.6]
QID: B2796

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

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

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

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

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

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.20 [3.1/3.6]
QID: B1196

Bundle critical power ratio must be maintained __________ 1.0 to prevent fuel damage caused by a rapid increase in the temperature of the _____________.

A. greater than; fuel pellets

B. less than; fuel pellets

C. greater than; fuel clad

D. less than; fuel clad

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.23 [2.8/3.2]
QID: B96

Which one of the following parameter changes will cause an increase in the critical power of a fuel bundle?

A. The subcooling of the coolant entering the bundle decreases.

B. The local peaking factor increases.

C. The coolant flow through the bundle increases.

D. The axial power peak shifts from the bottom to the top of the bundle.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.23 [2.8/3.2]
QID: B2498

A nuclear power plant is operating at 90% power near the end of a fuel cycle when reactor recirculation flow rate suddenly decreases by 10%. Assuming the reactor does <u>not</u> scram immediately, critical power will initially __________ and reactor power will initially ___________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.24 [2.7/3.2]
QID: B995

During normal power operation a reactor pressure increase causes critical power to ____________ because the latent heat of vaporization for the reactor coolant ____________.

A. increase; decreases

B. decrease; decreases

C. increase; increases

D. decrease; increases

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.24 [2.7/3.2]
QID: B1297

A nuclear power plant is operating at 100% load when a turbine trip occurs with no bypass valve actuation. Assuming the reactor does not scram immediately, critical power ratio will initially...

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

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

C. increase due to an increased reactor power.

D. decrease due to a decreased reactor power.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.24 [2.7/3.2]
QID: B2398

A nuclear power plant is operating at 90% power near the end of a fuel cycle when the turbine control system opens the turbine control valves an additional 5 percent. Assuming the reactor does not scram immediately, critical power ratio will initially __________ due to a(n) ___________ latent heat of vaporization.

A. increase; increased

B. increase; decreased

C. decrease; increased

D. decrease; decreased

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.24 [2.7/3.2]
QID: B2998

A nuclear power plant is operating at 90% power at the end of core life when a signal error causes the turbine control system to throttle the turbine control valves 5 percent in the closed direction. Assuming the turbine control valves stabilize in their new position and the reactor does <u>not</u> scram, the critical power ratio will initially...

A. increase because reactor power initially increases.

B. decrease because reactor power initially decreases.

C. increase because the reactor coolant latent heat of vaporization initially increases.

D. decrease because the reactor coolant latent heat of vaporization initially decreases.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.24 [2.7/3.2]
QID: B4749

A nuclear power plant is operating at 90% power at the end of core life when a signal error causes the turbine control system to open the turbine control valves an additional 5 percent. Assuming the reactor does not scram, the critical power ratio will initially...

A. increase, because reactor power initially increases.

B. decrease, because reactor power initially decreases.

C. increase, because the reactor coolant latent heat of vaporization initially increases.

D. decrease, because the reactor coolant latent heat of vaporization initially decreases.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.26 [2.6/3.1]
QID: B897

For a nuclear reactor operating at 100% power, which one of the following combinations of axial power distribution and recirculation system flow rate will result in the smallest critical power ratio in a given fuel bundle? (Assume the maximum linear heat generation rate in the fuel bundle is the same for all cases.)

	AXIAL POWER DISTRIBUTION	RECIRCULATION SYSTEM FLOW RATE
A.	Top-peaked	Low
B.	Top-peaked	High
C.	Bottom-peaked	Low
D.	Bottom-peaked	High

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.26 [2.6/3.1]
QID: B1396

How is critical power affected when the axial power distribution in a fuel bundle shifts from bottom-peaked to top-peaked?

A. Critical power increases to a new, higher value.

B. Critical power increases temporarily, then returns to its initial value.

C. Critical power decreases to a new, lower value.

D. Critical power decreases temporarily, then returns to its initial value.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.27 [2.7/3.3]
QID: B795

For what operational condition does the flow biasing correction factor (K_f) adjust the minimum critical power ratio?

A. Operation at less than rated steam flow.

B. Operation at greater than rated steam flow.

C. Operation at less than rated core flow.

D. Operation at greater than rated core flow.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.29 [2.4/2.7]
QID: B996

The fuel thermal time constant describes the amount of time required for...

A. the fuel to change its rate of heat generation by 63%.

B. the fuel centerline temperature to undergo 63% of its total change resulting from a given power change.

C. the fuel cladding temperature to undergo 63% of its total change resulting from a given change in fuel temperature.

D. reactor power to undergo 63% of its total change resulting from a given reactivity insertion.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.29 [2.4/2.7]
QID: B2496

The fuel thermal time constant specifies the amount of time required for...

A. a fuel bundle to achieve equilibrium temperature following a power change.

B. a fuel pellet to achieve equilibrium temperature following a power change.

C. the fuel centerline temperature to undergo most of its total change following a power change.

D. the fuel cladding temperature to undergo most of its total change following a power change.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.30 [2.3/2.7]
QID: B1596

A step increase in reactor power results in a fuel cladding surface temperature increase from 550°F to 580°F at steady-state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel cladding surface temperature 6 seconds after the power change?

A. 571°F

B. 569°F

C. 565°F

D. 561°F

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.30 [2.3/2.7]
QID: B2095

A step increase in reactor power results in a fuel cladding surface temperature increase from 560°F to 590°F. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel cladding surface temperature 6 seconds after the power change?

A. 579°F

B. 575°F

C. 570°F

D. 567°F

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.30 [2.3/2.7]
QID: B2193

A step increase in reactor power results in a fuel rod surface temperature increase from 555°F to 585°F at steady state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel rod surface temperature 6 seconds after the power change?

A. 574°F

B. 570°F

C. 567°F

D. 563°F

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.30 [2.3/2.7]
QID: B2297

A step increase in reactor power will result in a fuel rod surface temperature increase from 570°F to 590°F at steady state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel rod surface temperature 6 seconds after the power change?

A. 574°F

B. 577°F

C. 580°F

D. 583°F

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.31 [3.0/3.4]
QID: B396 (P394)

The pellet-to-clad gap in fuel rod construction is designed to...

A. decrease fuel pellet densification and elongation.

B. reduce fission product gas pressure buildup.

C. increase heat transfer.

D. reduce internal clad strain.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.32 [2.9/3.3]
QID: B99

Why does the threshold power for pellet-clad interaction decrease as fuel burnup increases?

A. The fuel pellet thermal conductivity is reduced significantly by irradiation.

B. The buildup of certain fission product gases causes chemical embrittlement of the cladding.

C. Fuel pellet densification causes the center of the pellet to expand against the cladding as the pellet length shrinks.

D. Zirconium hydriding increases significantly as the zirconium oxide layer builds up on the clad.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.32 [2.9/3.3]
QID: B497

The presence of embrittling isotopes is one of the initiating factors of pellet-clad interaction. Which one of the following describes the primary source of the embrittling isotopes?

A. Created during fission of the reactor fuel

B. Introduced during the fuel manufacturing process

C. Migrate from reactor coolant through cladding

D. Produced as corrosion products inside fuel rod

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.32 [2.9/3.3]
QID: B2195

Which one of the following is most likely to result in fuel failure due to pellet-clad interaction?

A. Increasing reactor power from 20% to 50% near the beginning of a fuel cycle.

B. Increasing reactor power from 20% to 50% near the end of a fuel cycle.

C. Increasing reactor power from 70% to 100% near the beginning of a fuel cycle.

D. Increasing reactor power from 70% to 100% near the end of a fuel cycle.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.33 [2.4/2.8]
QID: B796

Select the purpose of the gap between the fuel pellet and the clad.

A. Prevent contact between the fuel pellets and the clad

B. Increase heat transfer from the fuel pellet to the clad

C. Accommodate differential expansion between the fuel pellets and the clad

D. Reduce diffusion of fission product gases through the clad and into the reactor coolant system

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.33 [2.4/2.8]
QID: B1696

What is the primary purpose of the gap between a fuel pellet and the surrounding cladding?

A. To allow insertion of fuel pellets into the fuel rods.

B. To provide a collection volume for fission product gases.

C. To maintain the design fuel thermal conductivity throughout the fuel cycle.

D. To accommodate different expansion rates of the fuel pellets and cladding.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.34 [2.3/2.6]
QID: B797

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

A. Contraction of the clad due to zirconium hydriding

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

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

D. Expansion of the fuel pellets due to densification

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.35 [2.2/2.6]
QID: B397

Studies of nuclear fuel rod damage revealed that two essential criteria for pellet-clad interaction fuel damage are cladding stress and a chemical embrittling fission product interaction between two chemical agents and the zircaloy cladding.

What are the two (2) chemical agents?

A. Iodine and cadmium

B. Cadmium and bromine

C. Bromine and ruthenium

D. Ruthenium and iodine

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.40 [2.8/3.3]
QID: B696

Gross cladding failure is precluded during a design basis loss of coolant accident by operation below the limit for...

A. total peaking factor.

B. linear heat generation rate.

C. operating critical power ratio.

D. average planar linear heat generation rate.

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.40 [2.8/3.3]
QID: B1497

Gross fuel cladding failure during a design basis loss of coolant accident is prevented by adhering to the...

A. linear heat generation rate limit.

B. maximum average planar linear heat generation rate limit.

C. minimum critical power ratio limit.

D. preconditioning interim operating management recommendations.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.41 [2.8/3.3]
QID: B697

During a rapid increase in core flow, the most limiting thermal limit is...

A. total peaking factor.

B. critical power ratio.

C. average planar linear heat generation rate.

D. linear heat generation rate.

ANSWER: B.

TOPIC: 293009
KNOWLEDGE: K1.41 [2.8/3.3]
QID: B1098

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

A. 25% power increase using only recirculation flow

B. 25% power increase using only control rods

C. 25% power decrease using only recirculation flow

D. 25% power decrease using only control rods

ANSWER: D.

TOPIC: 293009
KNOWLEDGE: K1.41 [2.8/3.3]
QID: B1598

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

A. 25% power increase using only control rods.

B. 25% power decrease using only control rods.

C. 25% power increase using only recirculation flow.

D. 25% power decrease using only recirculation flow.

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.42 [2.8/3.3]
QID: B498

With a nuclear reactor at 100% power, reactor pressure suddenly increases, causing a decrease in the latent heat of vaporization. Which one of the following is the limiting thermal limit for these conditions?

A. Linear heat generation rate

B. Average planar linear heat generation rate

C. Critical power ratio

D Preconditioning interim operating management recommendations

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.43 [2.9/3.4]
QID: B698

If cold water is suddenly injected into the reactor vessel while operating at 50% power, critical power will __________ and bundle power will __________.

A. increase; increase

B. decrease; increase

C. increase; decrease

D. decrease; decrease

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.43 [2.9/3.4]
QID: B1298

If reactor feedwater temperature suddenly decreases by 10°F during operation at 75% power, critical power will ____________ and bundle power will ____________. (Assume the reactor does not scram.)

A. increase; increase

B. decrease; increase

C. increase; decrease

D. decrease; decrease

ANSWER: A.

TOPIC: 293009
KNOWLEDGE: K1.43 [2.9/3.4]
QID: B1498

The most limiting thermal limit for a loss of feedwater heating transient is...

A. average planar linear heat generation rate.

B. linear heat generation rate.

C. critical power ratio.

D. core thermal power.

ANSWER: C.

TOPIC: 293009
KNOWLEDGE: K1.43 [2.9/3.4]
QID: B2298

If reactor feedwater temperature suddenly increases by 10°F during operation at 75% power, critical power will _____________ and bundle power will _____________. (Assume the reactor does not scram.)

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.01 [2.4/2.8]
QID: B499 (P497)

Which one of the following comparisons will result in a higher probability of brittle fracture of the reactor vessel?

A. A high reactor gamma flux rather than a high neutron flux.

B. A high reactor vessel material strength rather than a high material ductility.

C. A high reactor coolant oxygen content rather than a low oxygen content.

D. A rapid 100°F reactor cooldown at a high temperature rather than a low temperature.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.01 [2.4/2.8]
QID: B2499 (P2496)

Brittle fracture of a low-carbon steel is more likely to occur when the temperature of the steel is __________ the nil ductility temperature, and will normally occur when the applied stress is __________ the steel's yield strength (or yield stress).

A. greater than; greater than

B. greater than; less than

C. less than; greater than

D. less than; less than

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B1299 (P1896)

Brittle fracture of the reactor vessel (RV) is most likely to occur during a ____________ of the reactor coolant system (RCS) when RCS temperature is ____________ the RV reference temperature for nil-ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B1500 (P697)

The reference temperature for nil-ductility transition (RT_{NDT}) is the temperature above which...

A. a large compressive stress can result in brittle fracture.

B. a metal exhibits more ductile tendencies.

C. the probability of brittle fracture increases.

D. no appreciable deformation occurs prior to failure.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2099 (P2096)

Which one of the following will prevent brittle fracture failure of a reactor vessel?

A. Manufacturing the reactor vessel from low carbon steel.

B. Maintaining reactor vessel pressure below the maximum design limit.

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

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

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2199 (P2295)

Brittle fracture of the reactor vessel (RV) is <u>least</u> likely to occur during a _____________ of the RV when RV temperature is _____________ the reference temperature for nil-ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2299 (P996)

The nil-ductility transition temperature is that temperature...

A. below which vessel failure is imminent.

B. above which vessel failure is imminent.

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

D. above which the probability of brittle fracture significantly increases.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2699 (P597)

The nil-ductility transition temperature of the reactor vessel (RV) is the temperature...

A. above which the RV metal will elastically deform as RCS pressure decreases.

B. above which the RV metal loses its ability to elastically deform as RCS pressure increases.

C. below which the RV metal will elastically deform as reactor coolant system (RCS) pressure decreases.

D. below which the RV metal loses its ability to elastically deform as RCS pressure increases.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B100 (P96)

The likelihood of brittle fracture failure of the reactor vessel is reduced by...

A. reducing gamma flux exposure.

B. reducing vessel temperature.

C. reducing vessel pressure.

D. increasing vessel age.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B300 (P1897)

Which one of the following will apply a compressive stress to the outside wall of the reactor vessel?

A. Neutron embrittlement of the reactor vessel

B. Increasing reactor coolant system (RCS) pressure

C. Performing an RCS cooldown

D. Performing an RCS heatup

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B398 (P397)

Brittle fracture of the reactor coolant pressure boundary is most likely to occur at...

A. 400°F, 10 psig.

B. 400°F, 400 psig.

C. 120°F, 10 psig.

D. 120°F, 400 psig.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B399 (P399)

The total stress on the reactor vessel inner wall is greater during cooldown than heatup because...

A. thermal heatup stress totally offsets pressure stress at the inner wall.

B. both pressure stress and thermal cooldown stress are tensile at the inner wall.

C. the tensile thermal cooldown stress at the inner wall is greater in magnitude than the compressive pressure stress at the same location.

D. thermal cooldown stress and thermal heatup stress are both tensile at the inner wall, but cooldown stress is greater in magnitude.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B400 (P398)

The probability of reactor vessel brittle fracture is <u>decreased</u> by minimizing...

A. oxygen content in the reactor coolant.

B. operation at high temperatures.

C. the time taken to cool down the reactor coolant system.

D. the amount of copper manufactured into the reactor vessel.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B899 (P97)

Pressure stress on the reactor vessel wall is...

A. compressive across the entire wall.

B. tensile across the entire wall.

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

D. compressive on the inner wall, tensile on the outer wall.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B1899 (P1597)

Which one of the following comparisons increases the probability of brittle fracture for a reactor pressure vessel wall?

A. Using materials fabricated from stainless steel rather than carbon steel.

B. A compressive stress rather than a tensile stress.

C. A high reactor coolant temperature rather than a low reactor coolant temperature.

D. Performing a 100°F/hr cooldown rather than a 100°F/hr heatup.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2300

A reactor plant heatup is in progress. The thermal stress applied to the reactor vessel is...

A. tensile across the entire wall.

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

C. compressive across the entire wall.

D. compressive at the inner wall and tensile at the outer wall.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2399 (P2397)

Reactor coolant system pressure-temperature limit curves are derived by using a conservative value for the reactor vessel reference temperature for nil ductility transition (RT_{NDT}).

Early in core life, the assumed value of RT_{NDT} is ___________ than actual RT_{NDT}; and actual RT_{NDT} is verified periodically over core life by _______________.

A. higher; removing and testing irradiated specimens of reactor vessel material

B. higher; inservice inspection and analysis of the reactor vessel wall

C. lower; removing and testing irradiated specimens of reactor vessel material

D. lower; inservice inspection and analysis of the reactor vessel wall

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2500 (P2497)

Which one of the following comparisons will result in a higher probability of brittle fracture failure of the reactor vessel?

A. A feedwater pH of 8.5 rather than 9.0

B. A high feedwater oxygen content rather than a low oxygen content

C. A 50°F/hr reactor cooldown rather than a 100°F/hr heatup

D. A high gamma flux rather than a high neutron flux

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2700 (P1696)

Which one of the following comparisons increases the probability of brittle fracture of a reactor pressure vessel wall?

A. Performing a 50°F/hr cooldown at 1600 psia rather than a 50°F/hr cooldown at 1200 psia.

B. A compressive stress rather than a tensile stress across the vessel wall.

C. A high reactor coolant temperature rather than a low reactor coolant temperature.

D. Changing wall design to increase toughness while maintaining the same strength.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2999

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel?

A. Maximum setpoint for main steam safety valves

B. Maximum chloride concentration in the reactor coolant

C. Maximum reactor pressure versus vessel temperature during heatup

D. Maximum differential temperature between the vessel steam dome and the bottom head

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B3700 (P3698)

A nuclear reactor is shutdown with the shutdown cooling system maintaining reactor coolant temperature at 240°F immediately following an uncontrolled cooldown from 500°F. If reactor coolant temperature is held constant at 240°F, which one of the following describes the change in tensile stress on the inner wall of the reactor vessel (RV) over the next few hours?

A. Decreases, because the temperature gradient across the RV wall will decrease.

B. Increases, because the temperature gradient across the RV wall will decrease.

C. Decreases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

D. Increases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B299 (P1997)

Which one of the following describes the effect of fast neutron irradiation on a reactor pressure vessel?

A. Increased fatigue crack growth rate

B. Increased plastic deformation prior to failure

C. Increased ductility

D. Increased nil-ductility reference transition temperature

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B500 (P499)

Which one of the following types of radiation most significantly reduces the ductility of the metal of a reactor pressure vessel?

A. Beta

B. Thermal neutrons

C. Gamma

D. Fast neutrons

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B599 (P298)

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

A. decrease due to the propagation of existing flaws.

B. increase due to the propagation of existing flaws.

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

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

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1100 (P1100)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles with an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles with an average power capacity of 60%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

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

B. Reactor A due to the greater number of heatup/cooldown cycles.

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

D. Reactor B due to the fewer number of heatup/cooldown cycles.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1200 (P1898)

Which one of the following is the <u>major</u> contributor to embrittlement of the reactor vessel?

A. High-energy fission fragments

B. High operating temperature

C. High-energy gamma radiation

D. High-energy neutron radiation

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1800 (P1699)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles with an average power capacity of 60%. Reactor B has experienced 40 heatup/cooldown cycles with an average power capacity of 50%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the higher average power capacity

B. Reactor A due to the fewer number of heatup/cooldown cycles

C. Reactor B due to the lower average power capacity

D. Reactor B due to the greater number of heatup/cooldown cycles

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1900 (P899)

After several years of operation the maximum allowable stress to the reactor pressure vessel is more limited by the inner wall than the outer wall because...

A. the inner wall operates at a higher temperature than the outer wall.

B. the inner wall has a smaller surface area than the outer wall.

C. the inner wall experiences more neutron-induced embrittlement than the outer wall.

D. the inner wall experiences more tensile stress than the outer wall.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1999 (P998)

Prolonged exposure to __________ will cause nil-ductility transition temperature of the reactor vessel to __________.

A. neutron radiation; increase

B. neutron radiation; decrease

C. normal operating pressure; increase

D. normal operating pressure; decrease

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2100 (P2098)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 40 heatup/cooldown cycles and has an average power capacity of 50%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the fewer number of heatup/cooldown cycles

B. Reactor A due to the higher average power capacity

C. Reactor B due to the greater number of heatup/cooldown cycles

D. Reactor B due to the lower average power capacity

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2600 (P2599)

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

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

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

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

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

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

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2800 (P2799)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 20 heatup/cooldown cycles and has an average power capacity of 80%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature and why?

A. Reactor A due to the lower average power capacity

B. Reactor A due to the greater number of heatup/cooldown cycles

C. Reactor B due to the higher average power capacity

D. Reactor B due to the fewer number of heatup/cooldown cycles

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2900 (P2298)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles and has an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the greater number of heatup/cooldown cycles

B. Reactor A due to the lower average power capacity

C. Reactor B due to the fewer number of heatup/cooldown cycles

D. Reactor B due to the higher average power capacity

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3000 (P2698)

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

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

A. Reactor A because it has produced the greater number of fissions.

B. Reactor B because it has produced the fewer number of fissions.

C. Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

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

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3200 (P3197)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing determines that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 42°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the specimen NDT temperature would <u>not</u> decrease during the described 18-month period of operation.

D. The test results are questionable because the specimen NDT temperature would decrease by <u>more</u> than 2°F during the described 18-month period of operation.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3300 (P3297)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing determines that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 44°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is <u>more</u> susceptible to brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is <u>less</u> susceptible to brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the vessel NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D. The test results are questionable because the vessel NDT temperature would increase by <u>at least</u> 10°F during the described 18-month period of operation.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3600 (P3598)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing indicates that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 32°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is more likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is less likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the actual specimen NDT temperature would not decrease during the described 18-month period of operation.

D. The test results are questionable because the actual specimen NDT temperature would decrease by much less than indicated by the test results.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3900 (P3898)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 90% and has been operating for 10 years. Reactor B has an average lifetime power capacity of 80% and has been operating for 15 years.

Which reactor will have the higher reactor vessel nil ductility transition temperature and why?

A. Reactor A because it has the higher average lifetime power capacity.

B. Reactor B because it has the lower average lifetime power capacity.

C. Reactor A because it has produced significantly less fissions.

D. Reactor B because it has produced significantly more fissions.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4250 (P4250)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The tests determined that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 72°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the specimen NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D. The test results are questionable because the specimen NDT temperature would increase by <u>less</u> than indicated during the described 18-month period of operation.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4450 (P4450)

A nuclear reactor is shut down for refueling. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The specimen was last tested six years ago. During the subsequent six years, the reactor has completed several 18-month fuel cycles with an average power level of 85%.

The test determines that the nil-ductility transition (NDT) temperature of the specimen has remained unchanged at 44°F since it was last tested. Which one of the following conclusions is warranted?

A. The test results are credible, however, the reactor vessel is more susceptible to brittle fracture now than six years ago.

B. The test results are credible, however, the reactor vessel is less susceptible to brittle fracture now than six years ago.

C. The test results are questionable because the specimen NDT temperature should have increased since it was last tested.

D. The test results are questionable because the specimen NDT temperature should have decreased since it was last tested.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4650 (P4650)

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

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

A. Reactor A because it has produced the fewer total number of fissions.

B. Reactor B because it has produced the greater total number of fissions.

C. Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

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

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B5550 (P5550)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 90% and has been operating for 24 years. Reactor B has an average lifetime power capacity of 72% and has been operating for 30 years.

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

A. Reactor A because it has produced the greater total number of fissions.

B. Reactor B because it has produced the fewer total number of fissions.

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

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

ANSWER: D.