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?

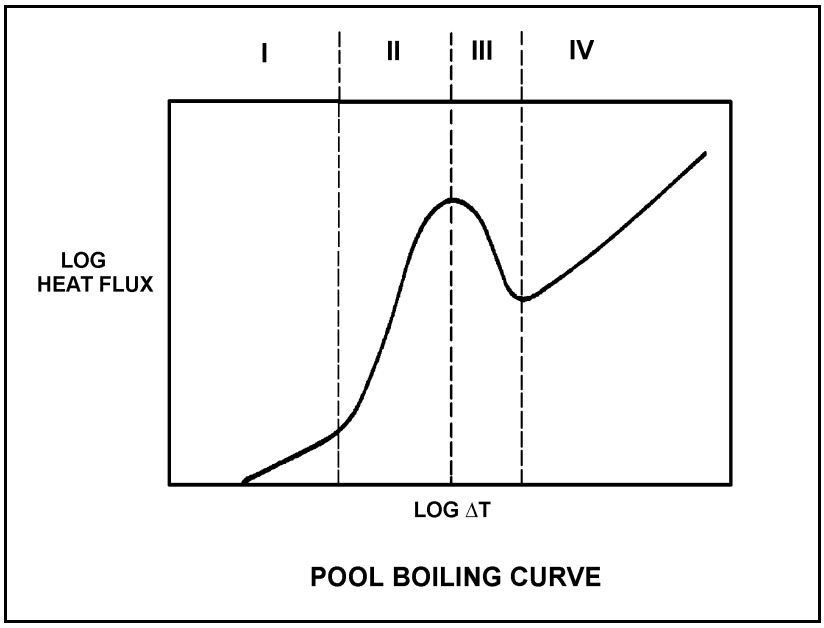
A. Regions II and III

B. Region II only

C. Regions I and II

D. Region I only

ANSWER: C.



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 maximized 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...

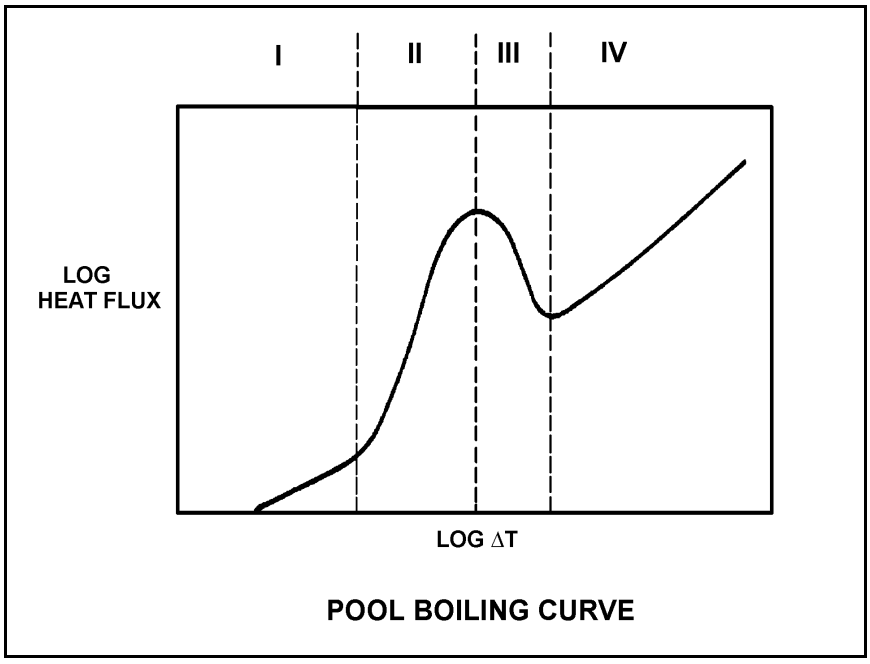
A. I.

B. II.

C. III.

D. IV.

ANSWER: B.



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.

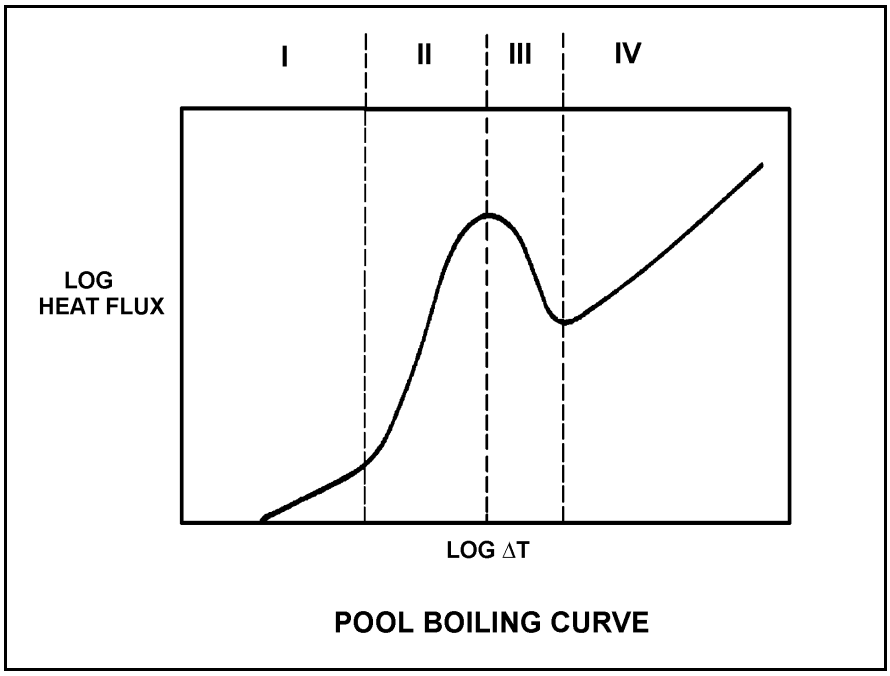
A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



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?

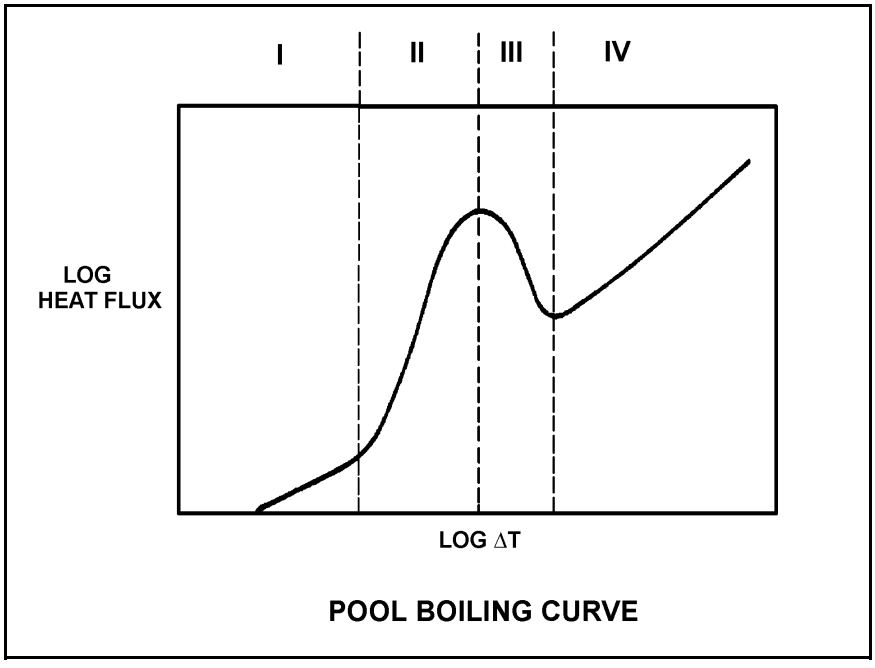
A. Region I

B. Region II

C. Region III

D. Region IV

ANSWER: B.



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?

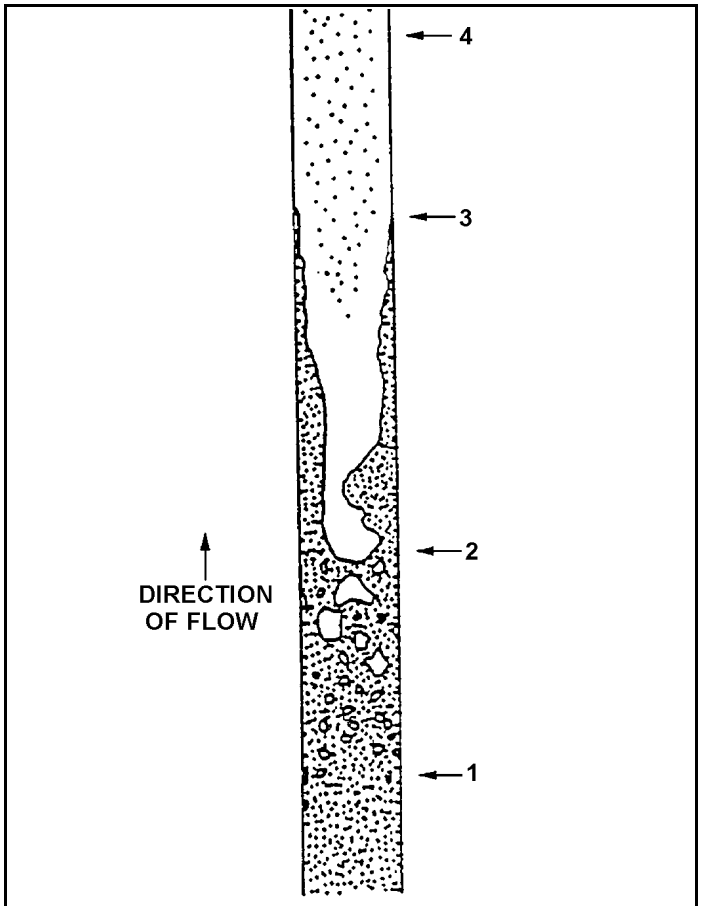
A. 1

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?

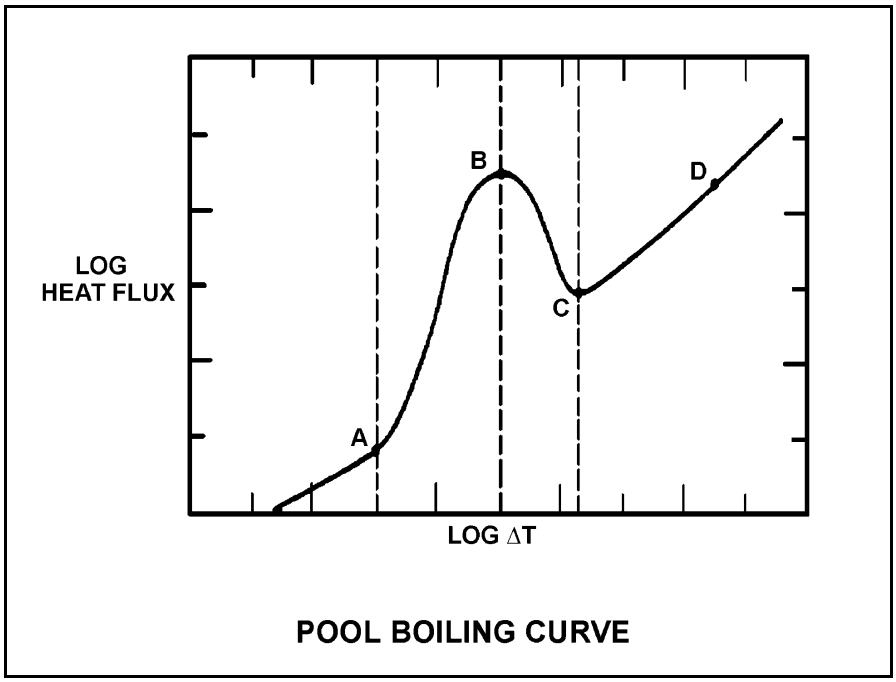
A. A

B. B

C. C

D. D

ANSWER: B.



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?

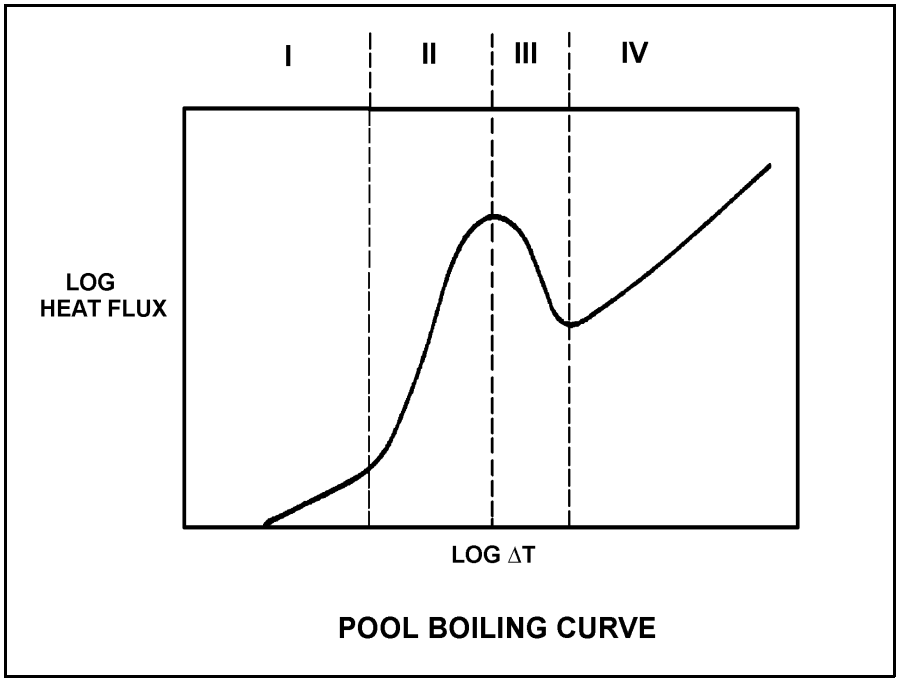
A. I

B. II

C. III

D. IV

ANSWER: C.



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?

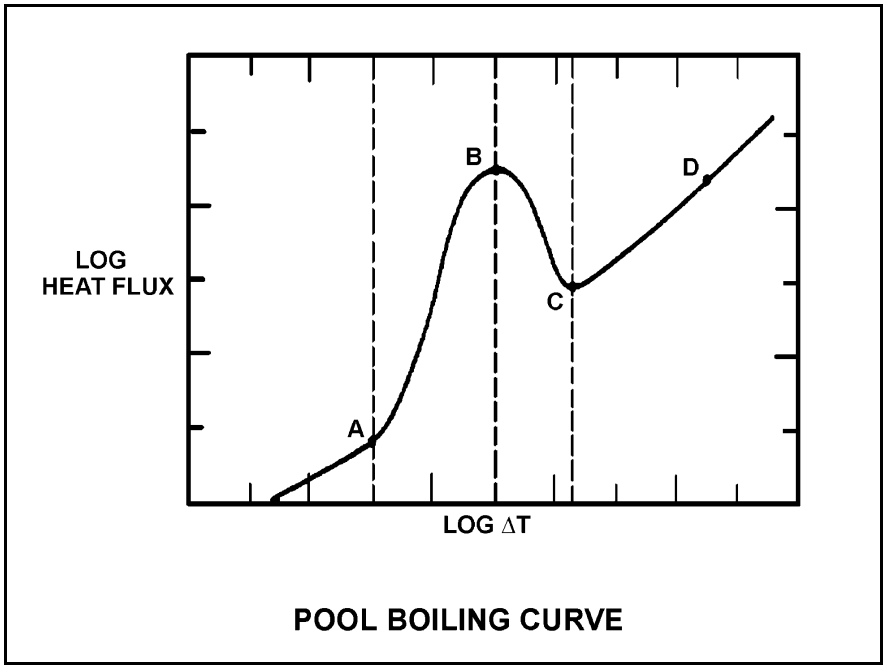
A. A

B. B

C. C

D. D

ANSWER: C.



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...

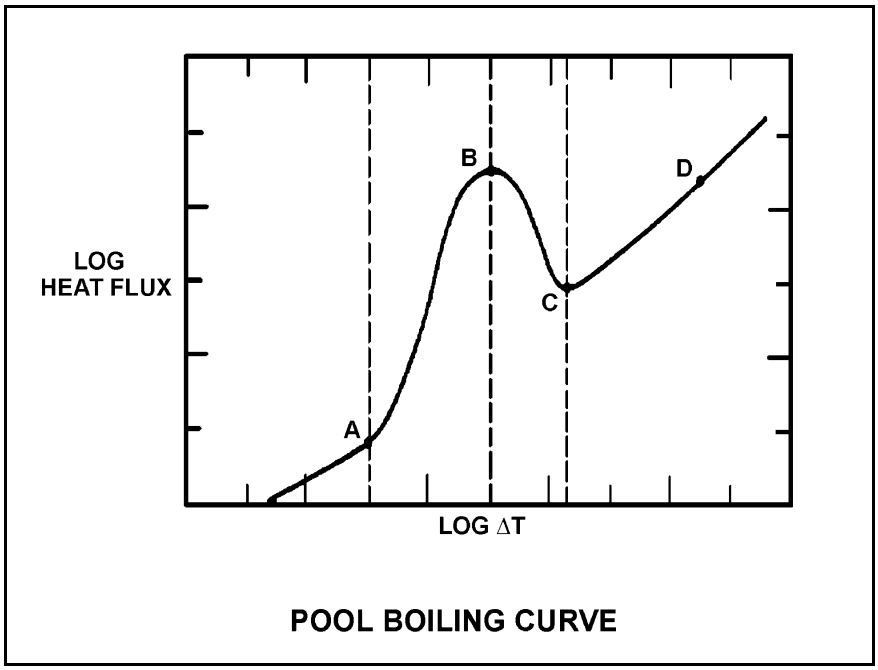
A. nucleate boiling.

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?

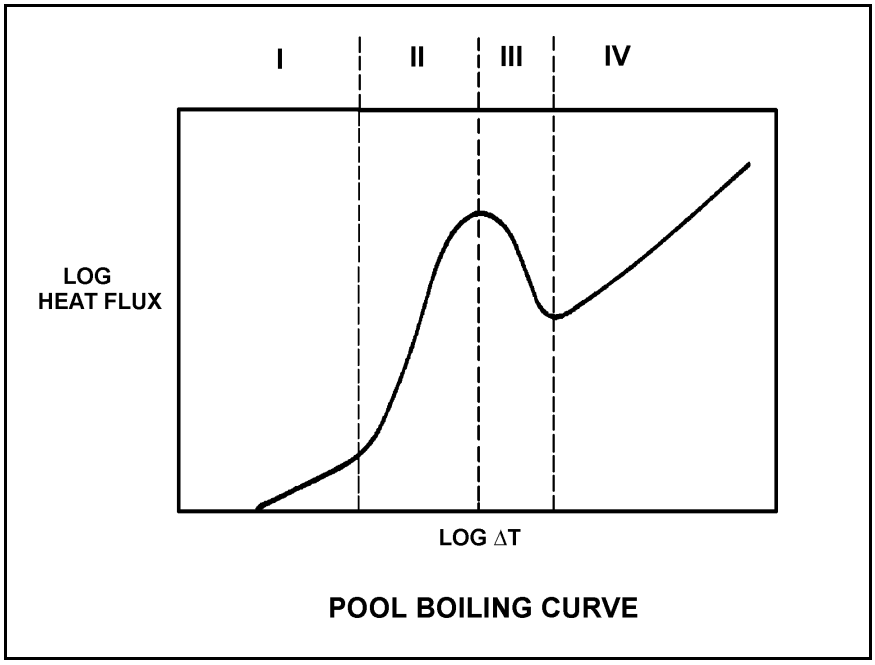
A. Complete steam blanketing of the fuel rod surface

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...

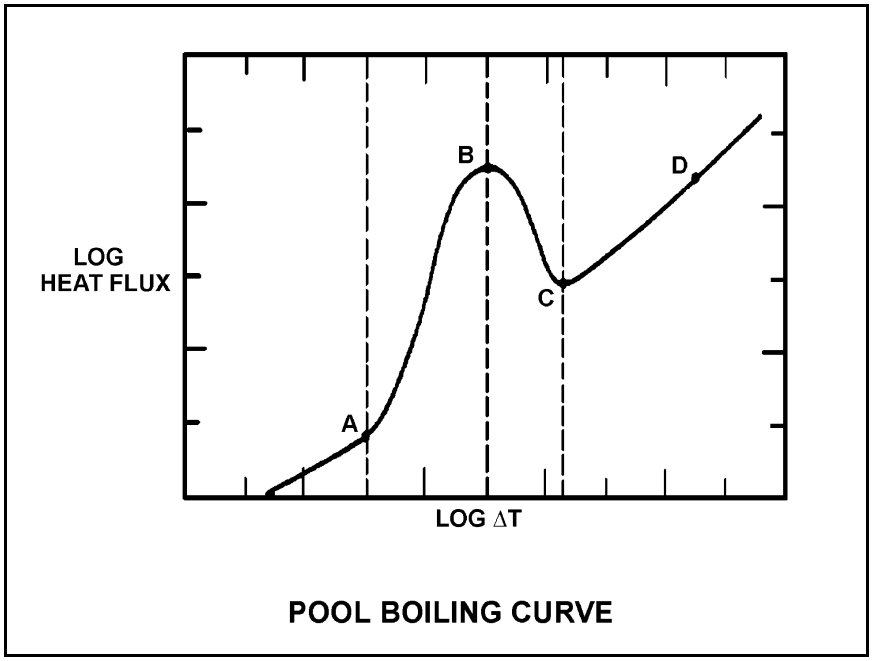
A. nucleate boiling.

B. stable film boiling.

C. partial film boiling.

D. single-phase convection.

ANSWER: C.



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?

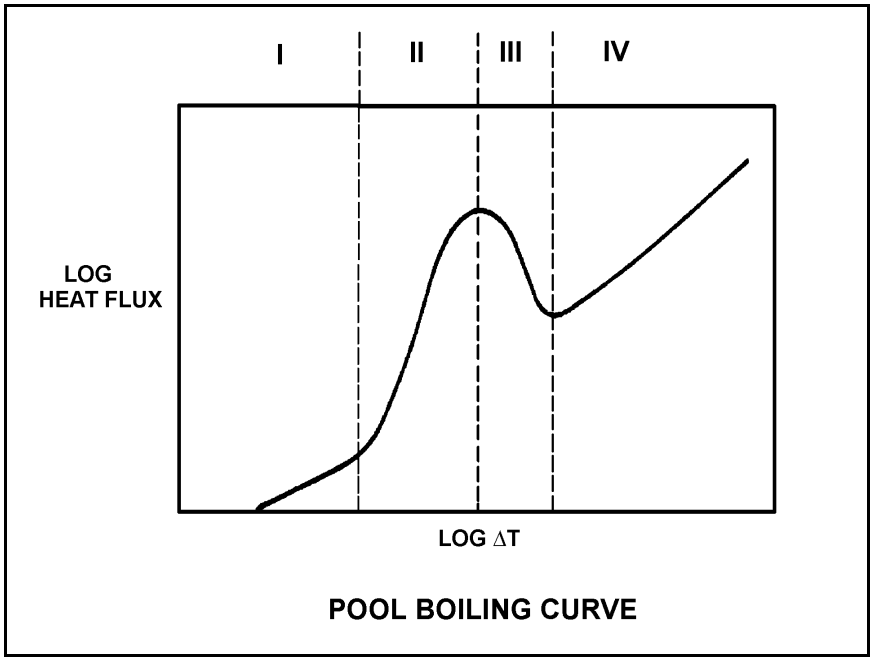
A. Complete steam blanketing of the fuel rod surface

B. Alternate wetting and drying of the fuel rod surface

C. Saturated nucleate boiling

D. Subcooled nucleate boiling

ANSWER: A.



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 reduce 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. $\frac{\text{Steam Volume}}{\text{Water Volume}}$

B. $\frac{\text{Steam Volume}}{\text{Steam Volume + Water Volume}}$

C. $\frac{\text{Steam Volume + Water Volume}}{\text{Steam Volume - Water Volume}}$

D. $\frac{\text{Steam Volume + Water Volume}}{\text{Steam Volume x Water Volume}}$

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 initial 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.)

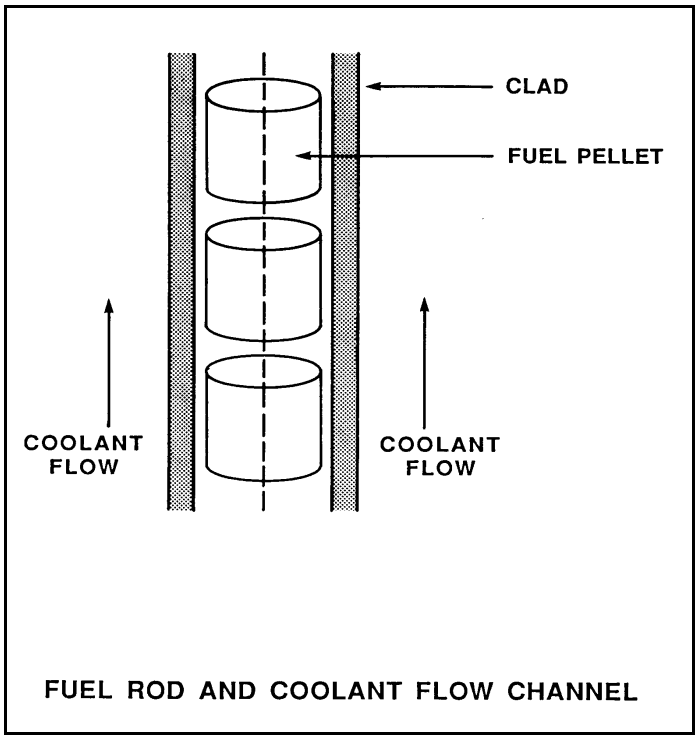
A. fuel pellet centerline to pellet surface.

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 _____.

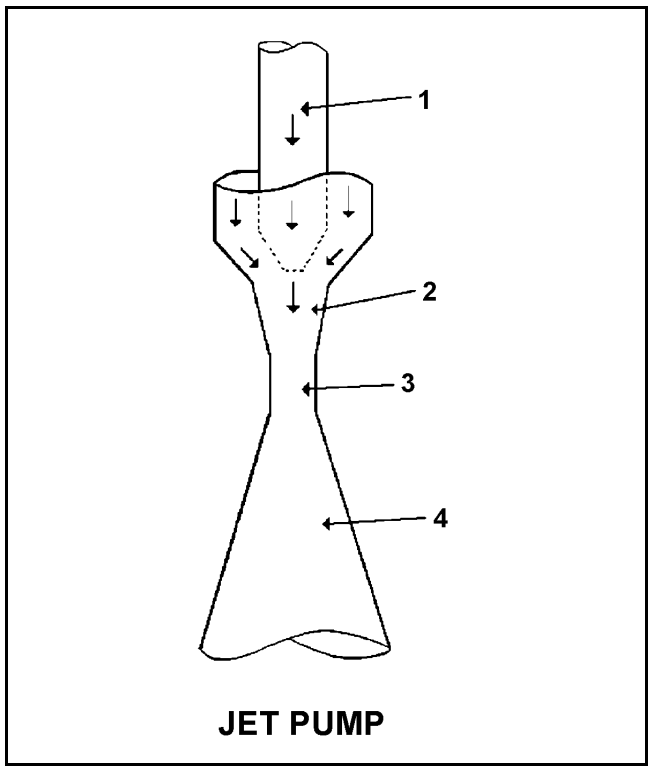
A. 1; 4

B. 2; 4

C. 1; 3

D. 2; 3

ANSWER: C.



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 _____.

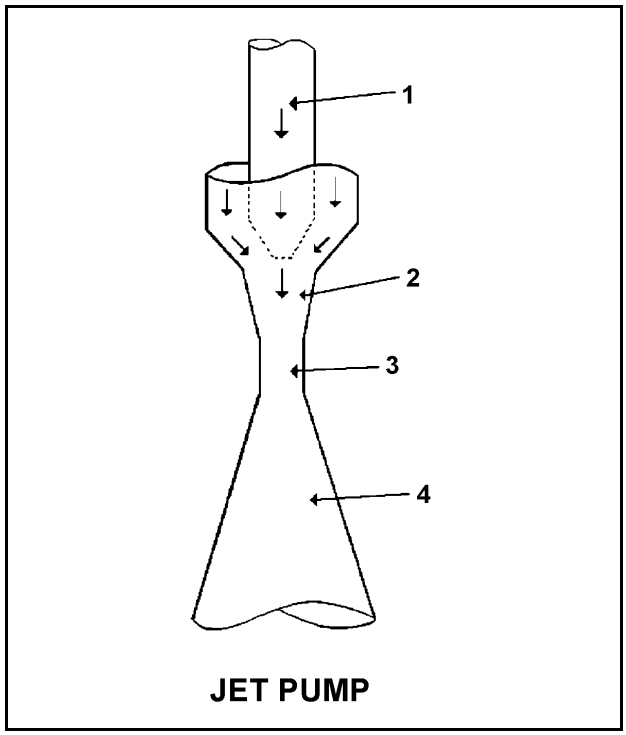
A. 3; 3

B. 3; 4

C. 4; 3

D. 4; 4

ANSWER: A.



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 _____.

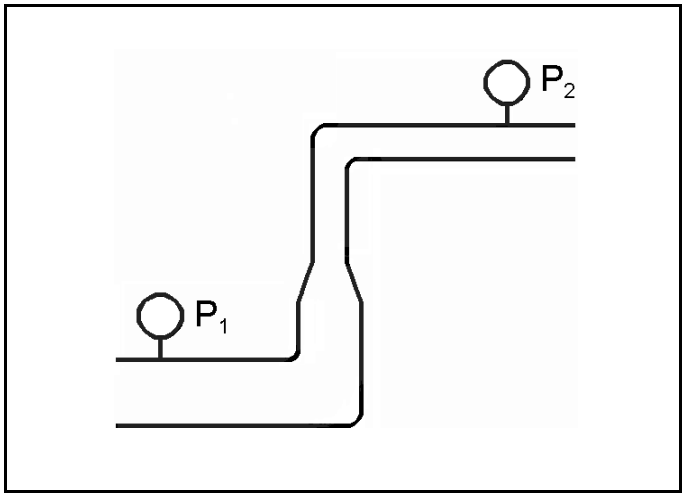
A. 2 psig; left to right

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 <u>not</u> 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.