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. $\frac{\text{core average bundle power}}{\text{individual bundle power}}$

B. $\frac{\text{peak nodal power}}{\text{core average nodal power}}$

C. $\frac{\text{core average nodal power}}{\text{peak nodal power}}$

D. $\frac{\text{individual bundle power}}{\text{core average bundle power}}$

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. $\frac{\text{core average bundle power}}{\text{peak nodal power}}$

B. $\frac{\text{peak nodal power}}{\text{core average bundle power}}$

C. $\frac{\text{bundle average nodal power}}{\text{nodal power}}$

D. $\frac{\text{nodal power}}{\text{bundle average nodal power}}$

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.)

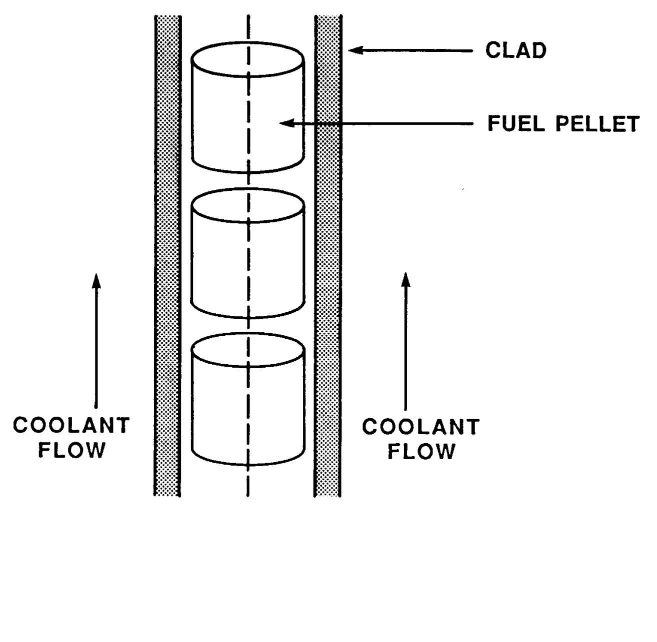
A. 1,000°F

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.)

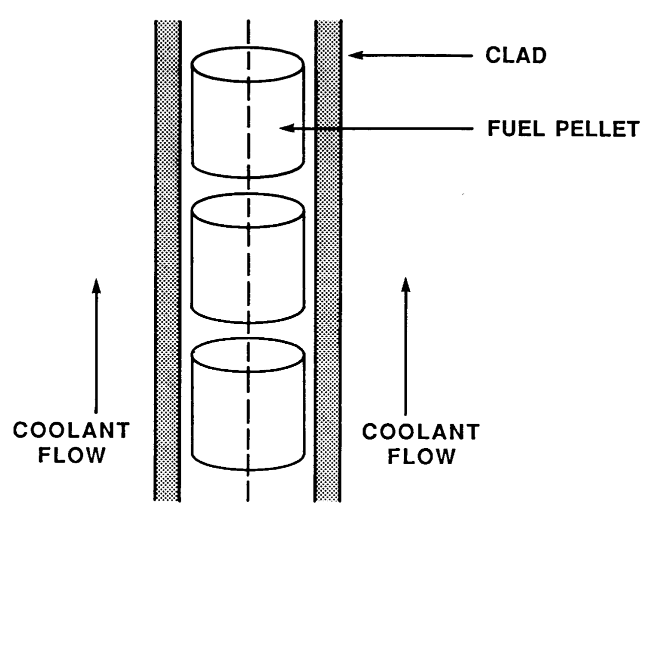
A. 1,250°F

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.)

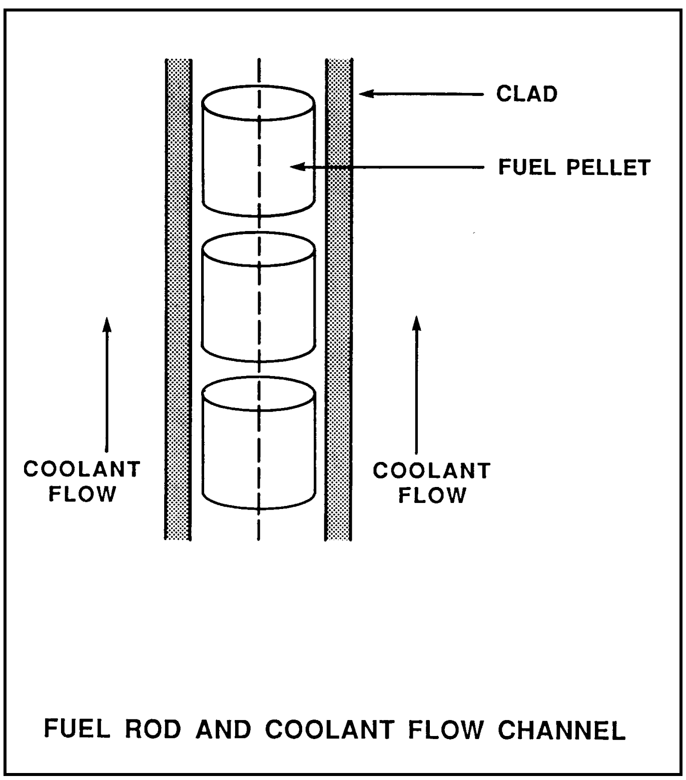
A. 1,100°F

B. 1,350°F

C. 1,600°F

D. 1,850°F

ANSWER: C.



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.)

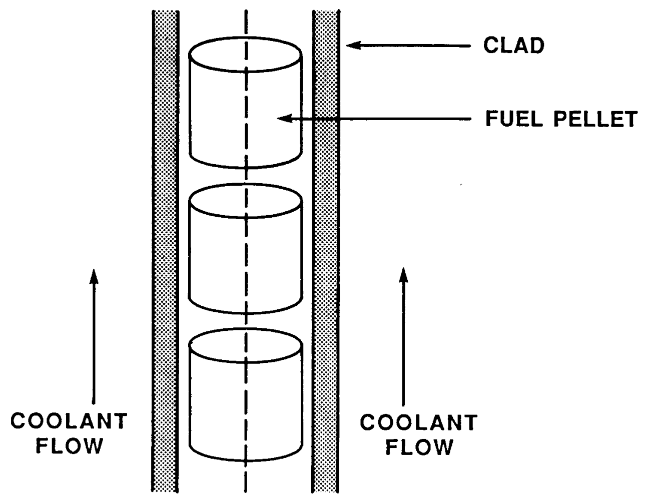
A. 1,100°F

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.)

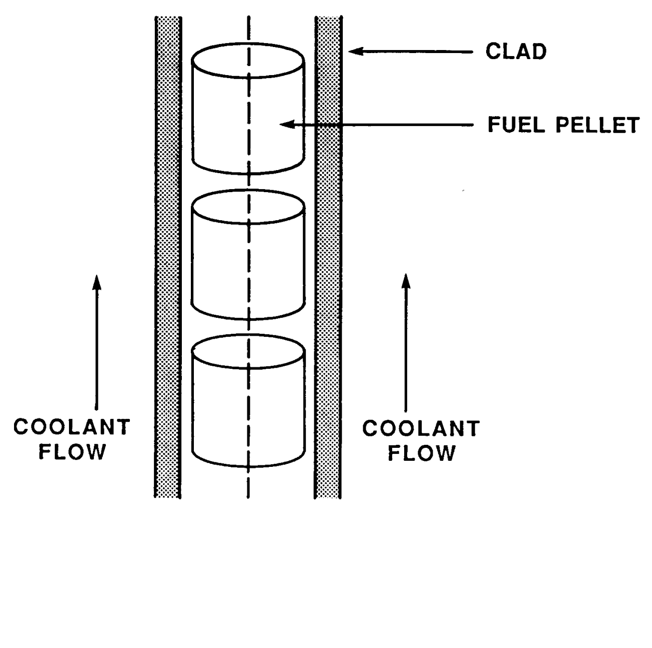
A. 1,270°F

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?

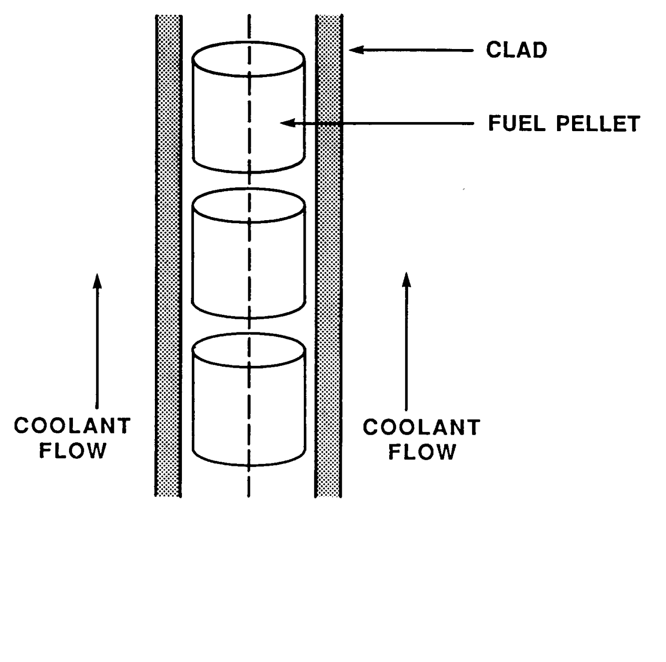
A. 550°F

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.)

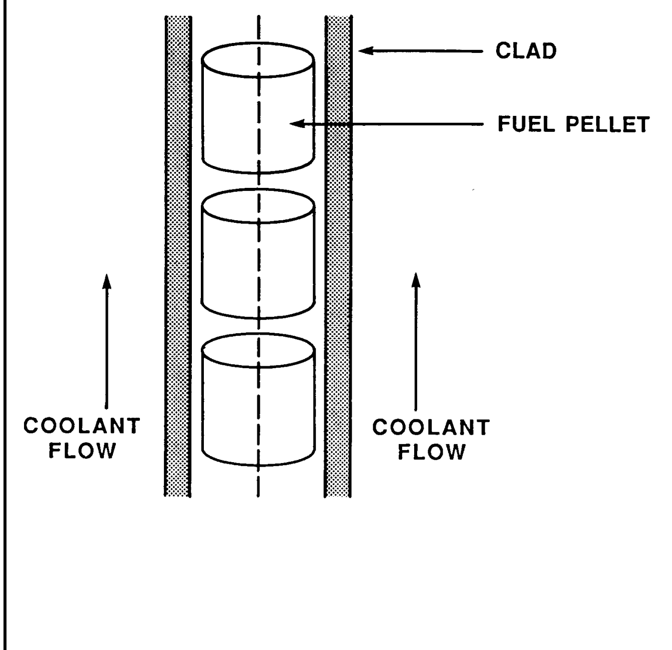
A. 1,080°F

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 <u>not</u> 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?

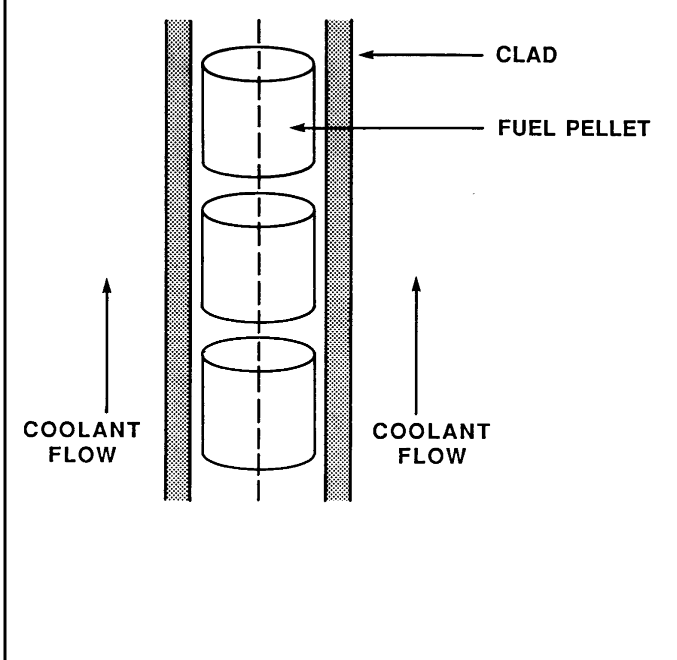
A. 610°F

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%?

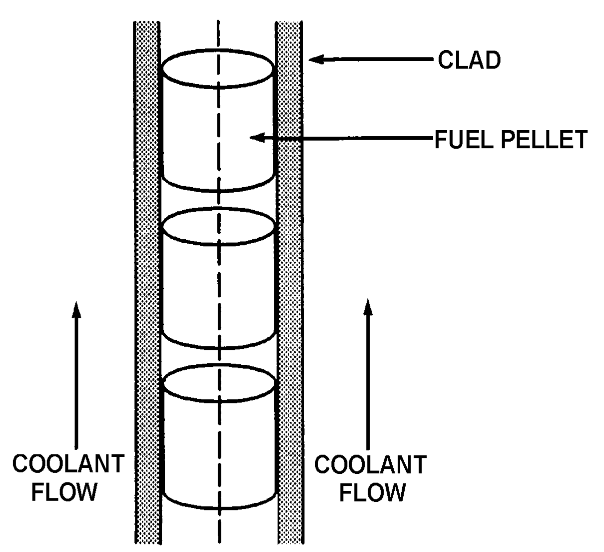
A. 1,425°F

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 not 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 not 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 <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: 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.