TOPIC: 193009
KNOWLEDGE: K1.02 [2.3/2.8]
QID: P1195

A nuclear power plant is operating at steady-state 80 percent power in the middle of a fuel cycle. All control rods are fully withdrawn and in manual control. Core axial power distribution is peaked below the core midplane.

Which one of the following will cause the maximum axial peaking (or hot channel) factor to initially decrease?

A. One bank of control rods is inserted 10 percent.

B. Turbine load/reactor power is reduced by 10 percent.

C. Reactor coolant system boron concentration is reduced by 10 ppm.

D. A control rod located at the edge of the core fully inserts into the core.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.02 [2.3/2.8]
QID: P7650

A reactor is operating at 80 percent power near the middle of a fuel cycle. All control rods are nearly fully withdrawn and in manual control. Core axial power distribution is peaked below the core midplane.

Which one of the following will increase the core maximum axial peaking (or hot channel) factor? (Assume no operator action is taken unless stated, and that main turbine load and core xenon distribution do not change unless stated.)

A. Turbine load/reactor power is reduced by 10 percent.

B. The controlling bank of control rods is withdrawn 4 inches.

C. Reactor coolant system boron concentration is reduced by 15 ppm.

D. A fully withdrawn control rod located at the edge of the core drops to the bottom of the core.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P3295

A PWR core consists of 50,000 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 heat flux hot channel factor (also called the total core peaking factor) is 2.0, what is the maximum linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P3794

A PWR core consists of 50,000 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 heat flux hot channel factor (also called the total core peaking factor) is 1.5, what is the maximum linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P4949

A PWR core consists of 50,000 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 heat flux hot channel factor (also called the total core peaking factor) is 3.0, what is the maximum linear power density being produced in the core?

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P5249

A reactor is operating at 3,400 MW thermal power. The core linear power density limit is 12.2 kW/ft.

Given:

- The reactor core contains 198 fuel assemblies.
- Each fuel assembly contains 262 fuel rods, each with an active length of 12 feet.
- The highest total peaking factors measured in the core are as follows:

  Location A: 2.5
  Location B: 2.4
  Location C: 2.3
  Location D: 2.2

Which one of the following describes the operating conditions in the core relative to the linear power density limit?

A. All locations in the core are operating below the linear power density limit.

B. Location A has exceeded the linear power density limit while locations B, C, and D are operating below the limit.

C. Locations A and B have exceeded the linear power density limit while locations C and D are operating below the limit.

D. Locations A, B, and C have exceeded the linear power density limit while location D is operating below the limit.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P6249 (B6247)

A reactor is operating at steady-state conditions in the power range with the following average temperatures in a core plane:

$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 1,680°F

Assume the fuel rod heat transfer coefficients and reactor coolant temperatures are equal throughout the core plane. If the maximum total peaking factor in the core plane is 2.1, what is the maximum fuel centerline temperature in the core plane?

A. 2,923°F

B. 3,528°F

C. 4,078°F

D. 4,683°F

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.04 [2.3/2.7]
QID: P7690

A reactor is operating at 3,300 MW thermal power. The core linear power density limit is 12.4 kW/ft.

Given:

- The reactor core contains 198 fuel assemblies.
- Each fuel assembly contains 262 fuel rods, each with an active length of 12 feet.
- The highest total peaking factors measured in the core are as follows:

  Location A: 2.5
  Location B: 2.4
  Location C: 2.3
  Location D: 2.2

Which one of the following describes the operating conditions in the core relative to the linear power density limit?

A. All locations in the core are operating below the linear power density limit.

B. Location A has exceeded the linear power density limit while locations B, C, and D are operating below the limit.

C. Locations A and B have exceeded the linear power density limit while locations C and D are operating below the limit.

D. Locations A, B, and C have exceeded the linear power density limit while location D is operating below the limit.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P56

What is the basis for the limit on maximum linear power density (kW/ft)?

A. To provide assurance of fuel integrity.

B. To prevent xenon-135 oscillations.

C. To allow for fuel pellet manufacturing tolerances.

D. To prevent nucleate boiling.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P94

If a reactor is operated within the core thermal limits, then...

A. plant thermal efficiency is optimized.

B. fuel cladding integrity is ensured.

C. pressurized thermal shock will be prevented.

D. reactor vessel thermal stresses will be minimized.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P396 (B1793)

The 2,200°F maximum 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.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P894

During normal operation, fuel cladding integrity is ensured by...

A. the primary system relief valves.

B. core bypass flow restrictions.

C. the secondary system relief valves.

D. operating within core thermal limits.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P994

Maximum fuel cladding integrity is maintained by...

A. always operating below 110 percent of reactor coolant system design pressure.

B. actuation of the reactor protection system upon a reactor accident.

C. ensuring that actual heat flux is always less than critical heat flux.

D. ensuring operation above the critical heat flux during all operating conditions.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1194

Peaking (or hot channel) factors are used to establish a maximum reactor power level such that fuel pellet temperature is limited to prevent __________ of the fuel pellets; and fuel cladding temperature is limited to prevent __________ of the fuel cladding during most analyzed transients and abnormal conditions.

A. melting; melting

B. excessive expansion; melting

C. melting; excessive oxidation

D. excessive expansion; excessive oxidation

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1295

Reactor thermal limits are established to...

A. ensure the integrity of the reactor fuel.

B. prevent exceeding reactor vessel mechanical limitations.

C. minimize the coolant temperature rise across the core.

D. establish control rod insertion limits.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P1395 (B1893)

Thermal limits are established to protect the reactor, 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.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2194 (B2194)

Which one of the following describes the basis for the 2,200°F maximum fuel cladding temperature limit?

A. 2,200°F is approximately 500°F below the fuel cladding melting temperature.

B. The material strength of zircaloy decreases rapidly at temperatures above 2,200°F.

C. The rate of the zircaloy-water reaction increases significantly at temperatures above 2,200°F.

D. At the normal operating pressure of the reactor vessel, a cladding temperature above 2,200°F indicates that the critical heat flux has been exceeded.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2796

The initial stable parameters for a fuel rod segment are as follows:

Power density = 3 kW/ft
$T_{coolant}$ = 579°F
$T_{fuel\ centerline}$ = 2,400°F

After a reactor power increase, the current stable parameters for the same fuel rod segment are as follows:

Power density = 5 kW/ft
$T_{coolant}$ = 590°F
$T_{fuel\ centerline}$ = ?

Assume the reactor coolant flow rate has not changed and the reactor coolant is not boiling. What is the stable $T_{fuel\ centerline}$ at the higher power level?

A. 3,035°F

B. 3,614°F

C. 3,625°F

D. 4,590°F

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.05 [3.1/3.5]
QID: P2995 (B2292)

Which one of the following describes the basis for the 2,200°F maximum fuel cladding temperature limit?

A. 2,200°F is approximately 500°F below the fuel cladding melting temperature.

B. The rate of the zircaloy-steam reaction increases significantly above 2,200°F.

C. If fuel cladding temperature reaches 2,200°F, the onset of transition boiling is imminent.

D. The differential expansion between the fuel pellets and the fuel cladding becomes excessive at temperatures greater than 2,200°F.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P383 (B394)

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

Given the following initial core parameters:

Reactor power = 100 percent
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 3,000°F

What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

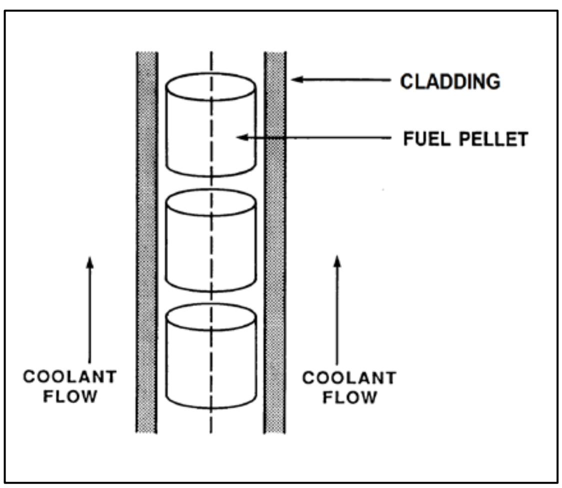
A. 1,000°F

B. 1,250°F

C. 1,500°F

D. 1,750°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P394 (B396)

The pellet-to-cladding 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 rate.

D. reduce internal cladding strain.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P495 (B495)

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

Given the following initial core parameters:

Reactor power = 100 percent
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,500°F

What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

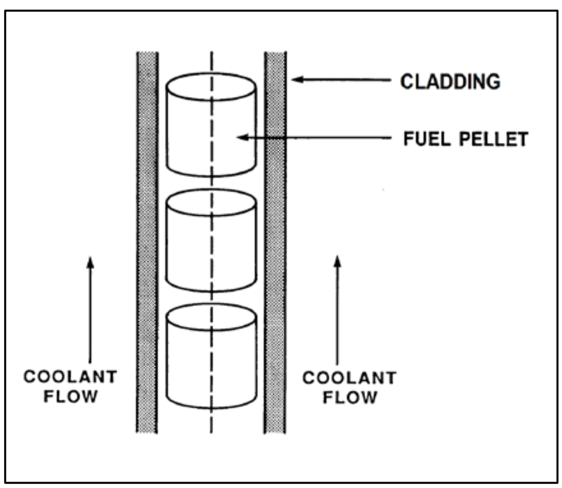
A. 1,250°F

B. 1,300°F

C. 1,400°F

D. 1,500°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1095

A reactor is operating at steady-state 80 percent power with all control rods fully withdrawn and in manual control. Compared to a 50 percent insertion of one control rod, a 50 percent insertion of a group (or bank) of control rods will cause a __________ increase in the maximum axial peaking factor and a __________ increase in the maximum radial peaking factor. (Assume reactor power remains constant.)

A. smaller; smaller

B. smaller; larger

C. larger; smaller

D. larger; larger

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1594 (B1594)

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

Given the following initial core parameters:

Reactor power = 100 percent
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,700°F

What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

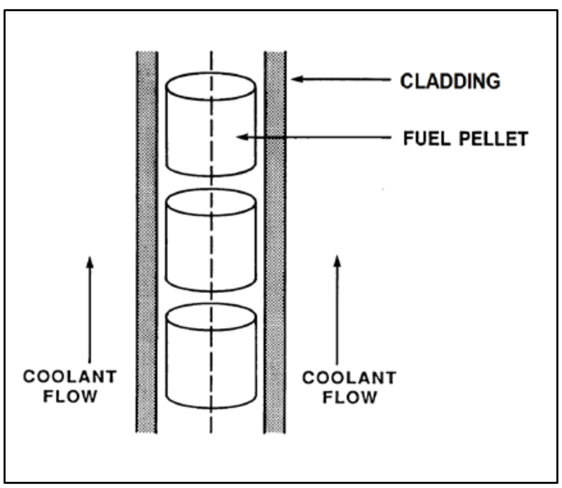
A. 1,100°F

B. 1,350°F

C. 1,600°F

D. 1,850°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1795

A reactor is operating at 80 percent power with all control rods fully withdrawn. Compared to a 50 percent insertion of a group (or bank) of control rods, a 50 percent insertion of a single control rod will cause a __________ increase in the maximum axial peaking factor and a __________ increase in the maximum radial peaking factor. (Assume reactor power remains constant.)

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1894 (B1395)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel rod at the end of a fuel cycle (EOC) when compared to the beginning of the same fuel cycle (BOC)?

A. Smaller at EOC, due to fuel pellet densification.

B. Smaller at EOC, due to contamination of fill gas with fission product gases.

C. Larger at EOC, due to reduction in gap between the fuel pellets and cladding.

D. Larger at EOC, due to a greater temperature difference between the fuel pellets and coolant.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P1994 (B1995)

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

Given the following initial core parameters:

Reactor power = 80 percent
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 2,540°F

What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

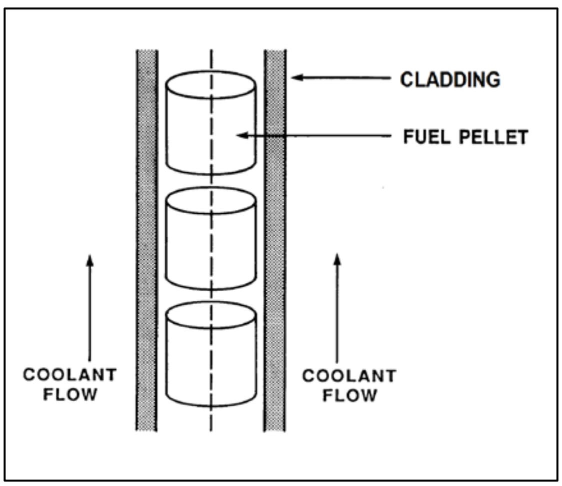
A. 1,270°F

B. 1,370°F

C. 1,440°F

D. 1,540°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2195 (B2192)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel rod at the beginning of a fuel cycle (BOC) compared to the end of a fuel cycle (EOC)?

A. Greater at BOC, due to a higher fuel pellet density.

B. Greater 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 cladding.

D. Smaller at BOC, due to a smaller corrosion film on the surface of the fuel rods.

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2296 (B2696)

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

Given the following initial core parameters:

Reactor power = 60 percent
$T_{coolant}$ = 560°F
$T_{fuel\ centerline}$ = 2,500°F

What would the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubled? (Assume reactor power and $T_{coolant}$ are constant.)

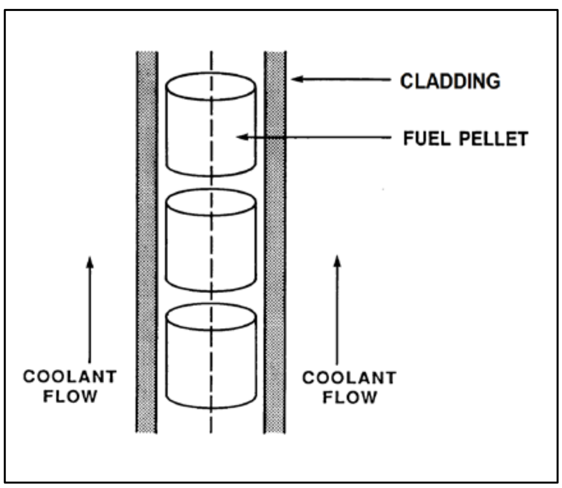
A. 1,080°F

B. 1,250°F

C. 1,530°F

D. 1,810°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [3.1/3.5]
QID: P2395 (B2394)

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

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 if the total fuel-to-coolant thermal conductivity doubled? (Assume core decay heat level and $T_{coolant}$ are constant.)

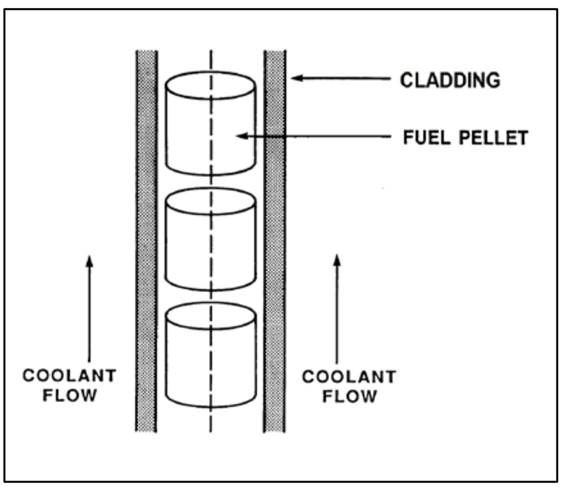
A. 550°F

B. 500°F

C. 450°F

D. 400°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3195 (B3193)

Refer to the partial 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

What will the fuel centerline temperature be at the end of the fuel cycle with the same coolant temperature and reactor decay heat conditions if the total fuel-to-coolant thermal conductivity doubles?

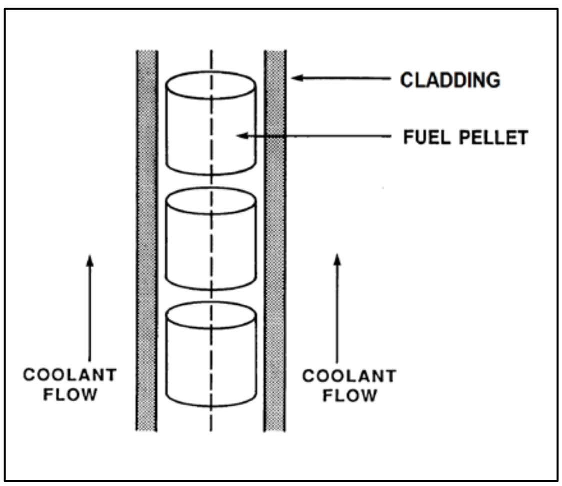
A. 610°F

B. 580°F

C. 550°F

D. 520°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3395 (B1697)

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

Given the following initial core parameters:

Reactor power = 50 percent
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,750°F

What will the fuel centerline temperature be if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power and $T_{coolant}$ are constant.)

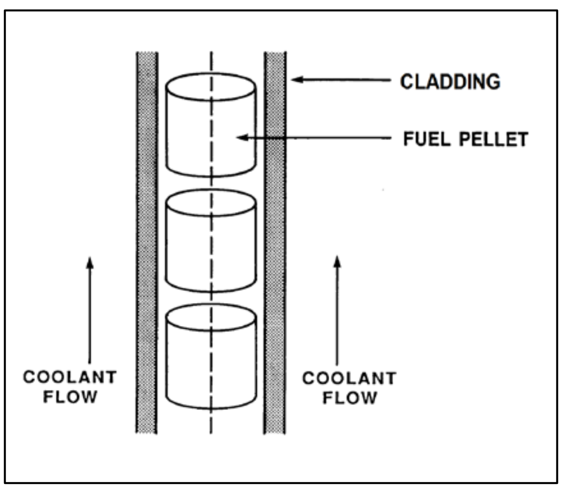
A. 1,100°F

B. 1,375°F

C. 1,525°F

D. 1,650°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P3895

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

Given the following initial stable core parameters:

Reactor power = 50 percent
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,250°F

Assume the total heat transfer coefficient and the reactor coolant temperature do not change. What will the stable fuel centerline temperature be if reactor power is increased to 75 percent?

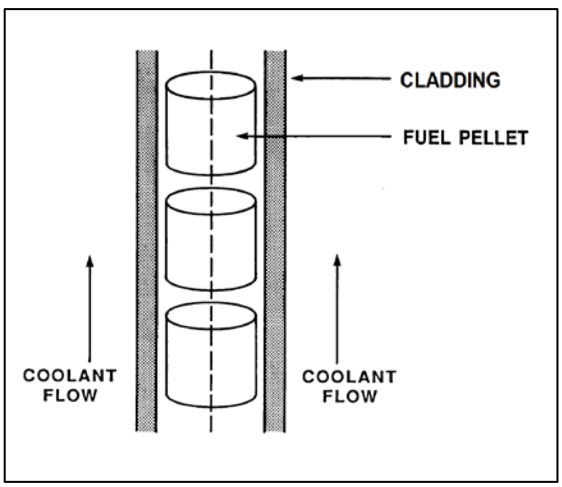
A. 2,550°F

B. 2,800°F

C. 2,950°F

D. 3,100°F

[redacted]



TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P6449 (B6449)

Consider a new fuel rod operating at a constant power level for several weeks. During this period, fuel pellet densification in the fuel rod causes the heat transfer rate from the fuel pellets to the cladding to __________; this change causes the average fuel temperature in the fuel rod to __________.

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

[redacted]

TOPIC: 193009
KNOWLEDGE: K1.07 [2.9/3.3]
QID: P7630

If fuel pellet densification occurs in a fuel rod producing a constant power output, the average linear power density in the fuel rod will __________ because pellet densification causes fuel pellets to __________.

A. decrease; swell

B. decrease; shrink

C. increase; swell

D. increase; shrink

[redacted]