科目：　193009
知能類：K1.01 [2.3/2.8]
序號：　P2794 (N/A)

A nuclear reactor is operating at 75% power at the middle of a fuel cycle with radial power distribution peaked in the center of the core. All control rods are fully withdrawn and in manual control.

Assuming all control rods remain fully withdrawn, except as noted, which one of the following will cause the maximum steady-state radial peaking (or hot channel) factor to decrease?

A. Turbine load/reactor power is reduced by 20%.

B. A control rod located at the edge of the core drops into the core.

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

D. The reactor is operated continuously at 75% power for three months.

ANSWER: D.

一部處於燃料週期中期的核子反應器以 75%功率運轉，其徑向功率分佈於爐心中央達到尖峰。所有控制棒完全抽出且採手動控制。

所有控制棒除非另有註明，否則仍維持完全抽出下，下列何者將造成最高穩態徑向尖峰(或熱通道)因數減少？

A. 汽機負載/反應器功率減少 20%。

B. 位於爐心邊緣的控制棒掉入爐心。

C. 反應器冷卻水系統的硼濃度減少 10 ppm。

D. 反應器以 75%功率連續運轉三個月後。

答案：D.

科目：　193009
知能類：K1.02 [2.3/2.8]
序號：　P1195

A nuclear reactor is operating at 80% power near the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. The moderator temperature coefficient is negative. Core axial power distribution is peaked below the core midplane.

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

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

B. One control rod fully inserts into the core.

C. Turbine load/reactor power is reduced by 20%.

D. Reactor coolant system boron concentration is reduced by 50 ppm.

ANSWER: C.

一部處於燃料週期初期的核子反應器以 80%功率運轉。所有控制棒均完全抽出且採手動控制。緩和劑溫度係數為負。爐心軸向功率分佈於爐心中間平面下方達到尖峰。

下列何者將導致爐心最高軸向尖峰(或熱通道)因數顯著減少？(假設運轉員沒有採取後續動作，除非另有指明，否則主汽機負載和爐心氙毒分佈維持不變)

A. 一組控制棒組插入 10%。

B. 一根控制棒完全插入爐心。

C. 汽機負載/反應器功率減少 20%。

D. 反應器冷卻水系統硼濃度減少 50 ppm。

答案：C.

科目：　193009
知能類：K1.02 [2.3/2.8]
序號：　P2894

A nuclear reactor is operating at steady-state 80% power at the beginning of a fuel cycle. All control rods are fully withdrawn and in manual control. The moderator temperature coefficient is negative.

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

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

B. Power is maintained constant for one month.

C. Turbine load/reactor power is reduced by 20%.

D. Reactor coolant system boron concentration is increased by 50 ppm.

ANSWER: A.

一部處於燃料週期初期的核子反應器以 80%功率運轉。所有控制棒均完全抽出且採手動控制。緩和劑溫度係數為負。

下列何者將導致爐心最高軸向尖峰因數增加？(假設運轉員沒有採取後續動作，除非另有指明，否則主汽機負載和爐心氙毒分佈維持不變)

A. 一組控制棒組插入 10%。

B. 功率維持一個月不變。

C. 汽機負載/反應器功率減少 20%。

D. 反應器冷卻水系統硼濃度增加 50 ppm。

答案：A.

科目：　193009
知能類：K1.04 [2.3/2.7]
序號：　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 energy. If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 2.0, what is the maximum local 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

ANSWER: B.

一部壓水式反應器(PWR)爐心由 50,000 根燃料棒構成；每根燃料棒的有效長度為 12 ft。爐心產生 1,800 MW 的熱能。如果核能熱通率熱通道因數 $F_Q(z)$(又稱為總爐心尖峰因數)為 2.0，爐心中最高局部線性功率密度為多少？

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

答案：B.

科目：　193009
知能類：K1.04 [2.3/2.7]
序號：　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 energy. If the nuclear heat flux hot channel factor, $F_Q(z)$, (also called the total core peaking factor) is 1.5, what is the maximum local 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

ANSWER: A.

一部壓水式反應器(PWR)爐心由 50,000 根燃料棒構成；每根燃料棒的有效長度為 12 ft。爐心產生 1,800 MW 的熱能。如果核能熱通率熱通道因數 $F_Q(z)$(又稱為總爐心尖峰因數)為 1.5，爐心中最高局部線性功率密度為多少？

A. 4.5 kW/ft

B. 6.0 kW/ft

C. 9.0 kW/ft

D. 12.0 kW/ft

答案：A.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P56

The basis for the maximum power density (kW/foot) power limit is to...

A. provide assurance of fuel integrity.

B. prevent xenon oscillations.

C. allow for fuel pellet manufacturing tolerances.

D. prevent nucleate boiling.

ANSWER: A.

最高功率密度(kW/ft)的功率限制基礎是……

A. 確保燃料完整

B. 防止氙振盪

C. 允許燃料丸的製造偏差

D. 防止核沸騰

答案：A.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P94

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

A. plant thermal efficiency is optimized.

B. fuel cladding integrity is ensured.

C. pressurized thermal shock will be prevented.

D. reactor vessel thermal stresses will be minimized.

ANSWER: B.

如果核子反應器於爐心熱限值內運轉，則……

A. 電廠熱效率為最佳化。

B. 確保燃料護套完整。

C. 防止壓力熱震。

D. 反應爐槽熱應力將降至最低。

答案：B.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P396 (B1793)

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.

規定 2,200°F 最高尖峰燃料護套溫度限值的原因是……

A. 2,200°F 約較燃料護套熔化溫度低 500°F。

B. 溫度高於 2,200°F 時，鋯合金－蒸汽反應速率顯著增加。

C. 護套溫度高於 2,200°F，則相對的燃料中央溫度將高於燃料熔點。

D. 溫度高於 2,200°F 時，鋯合金的熱傳導係數迅速降低。

答案：B.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P894

During normal operation, fuel clad 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.

ANSWER: D.

正常運轉期間，下列何者能確保燃料護套完整？

A. 一次系統釋壓閥

B. 限制爐心旁通水流

C. 二次系統釋壓閥

D. 於爐心熱限值內運轉

答案：D.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P994

Maximum fuel cladding integrity is attained by...

A. always operating below 110% 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.

ANSWER: C.

下列何者能確保燃料護套獲得最高完整性？

A. 始終以低於 110%反應器冷卻水系統設計壓力的條件運轉。

B. 反應器發生事故時，啟動反應器保護系統。

C. 確保實際熱通率始終少於臨界熱通率。

D. 確保在所有運轉條件下，均以高於臨界熱通率的條件運轉。

答案：C.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P1194

Nuclear reactor core peaking (or hot channel) factors are used to establish a maximum reactor power level such that fuel pellet temperature is limited to prevent __________ and fuel clad temperature is limited to prevent _________ during most analyzed transients and abnormal conditions.

A. fuel pellet melting; fuel clad melting

B. excessive fuel pellet expansion; fuel clad melting

C. fuel pellet melting; excessive fuel clad oxidation

D. excessive fuel pellet expansion; excessive fuel clad oxidation

ANSWER: C.

運用核子反應器爐心尖峰(或熱通道)因數來建立反應器最大功率，就能在大多數已分析的暫態(analyzed transient)和異常狀況時，限制燃料丸溫度以防範______，並限制燃料護套溫度以防止______。

A. 燃料丸熔化；燃料護套熔化

B. 燃料丸過度膨脹；燃料護套熔化

C. 燃料丸熔化；燃料護套過度氧化

D. 燃料丸過度膨脹；燃料護套過度氧化

答案：C.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P1295

Nuclear 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.

ANSWER: A.

建立核子反應器熱限值的目的為何？

A. 確保反應器燃料的完整。

B. 防止超過反應爐槽機械限值。

C. 將爐心兩端的冷卻水溫升高值降至最低。

D. 制訂控制棒插入限值。

答案：A.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P1395 (B1893)

Thermal limits are established to protect the nuclear reactor core, and thereby protect the public during 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.

熱限值乃用以保護核子反應器爐心，在何種電廠運轉情況下可保護民眾：

A. 只有在正常運轉。

B. 只有在正常與異常運轉。

C. 只有在正常、異常與假想事故運轉。

D. 正常、異常、假想與非假想事故運轉(unpostulated accident operations)。

答案：C.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P2194 (B2194)

Which one of the following describes the basis for the 2200°F maximum fuel clad temperature limit?

A. The material strength of zircaloy decreases rapidly at temperatures above 2200°F.

B. At the normal operating pressure of the reactor vessel a clad temperature above 2200°F indicates that the critical heat flux has been exceeded.

C. The rate of the zircaloy-water reaction becomes significant at temperatures above 2200°F.

D. 2200°F is approximately 500°F below the fuel clad melting temperature.

ANSWER: C.

下列何者為2200°F最大燃料護套溫度限制的基準？

A. 鋯合金之材料強度在溫度2200°F以上會快速降低。

B. 反應爐槽在正常運轉壓力時，護套溫度2200°F代表已超過臨界熱通率。

C. 溫度大於2200°F時，會使鋯合金-水反應速率變得顯著。

D. 2200°F大約比燃料護套熔化溫度低500°F。

答案：C.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P2595

The linear power density thermal limit is designed to prevent melting of the _________ during normal reactor plant operation; the limit is dependent on the axial and radial peaking factors, of which the _________ peaking factor is normally the most limiting.

A. fuel clad; axial

B. fuel clad; radial

C. fuel pellets; axial

D. fuel pellets; radial

ANSWER: D.

設計線性功率密度熱限值的用意，在於核能電廠正常運轉時防止______熔化；此限值端視軸向與徑向尖峰因數而定，其中的______尖峰因數一般最具限制性。

A. 燃料護套；軸向

B. 燃料護套；徑向

C. 燃料丸；軸向

D. 燃料丸；徑向

答案：D.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P2696 (B2693)

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 1800°F
10% of the fuel clad has exceeded 1800°F
5% of the fuel clad has exceeded 2000°F
0.5% of the fuel clad has reached 2200°F
0.0% of the fuel clad has exceeded 2200°F
Peak centerline fuel temperature is 4650°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. Explosive hydrogen concentration inside the reactor vessel

B. Explosive hydrogen concentration inside the reactor containment building

C. Release of radioactive fission products due to melting of the fuel pellets and fuel clad

D. Release of radioactive fission products due to rupture of the fuel clad

ANSWER: D.

一部核子反應器歷經冷卻水流失事故。由於爐心冷卻不足，導致在事故發生一小時後，出現下列爐心溫度：

90%燃料護套維持在1800°F以下
10%燃料護套超過1800°F
5%燃料護套超過2000°F
0.5%燃料護套達到2200°F
0.0%燃料護套超過2200°F
燃料中央尖峰溫度為4650°F

若直接從爐頂注入緊急冷卻水，使上述燃料與護套溫度狀況，於往後24小時維持不變，將發生下列何者不利之結果？

A. 反應爐內出現爆炸性氫氣濃度。

B. 反應器圍阻體廠房內出現爆炸性氫氣濃度。

C. 燃料丸與燃料護套熔化而釋放出放射性分裂產物。

D. 燃料護套破裂而釋放出放射性分裂產物。

答案：D.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P2796 (N/A)

Given the following initial core parameters for a segment of a fuel rod:

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

Reactor power is increased such that the following core parameters now exist for the same fuel rod segment:

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

Assuming no boiling occurs and coolant flow rate is unchanged, what will be the new stable $T_{fuel\ centerline}$?

A. 3,035°F

B. 3,614°F

C. 3,625°F

D. 4,590°F

ANSWER: C.

關於一段燃料棒，已知下列爐心初始參數：

功率密度 = 3 kW/ft
$T_{coolant}$ = 579°F
$T_{fuel\ centerline}$ = 2,400°F

反應器功率增加，同一段燃料棒的爐心現有參數如下：

功率密度 = 5 kW/ft
$T_{coolant}$ = 590°F
$T_{fuel\ centerline}$ = ？°F

假設沒有發生沸騰，冷卻水流率維持不變，新的穩定 $T_{fuel\ centerline}$ 為多少？

A. 3,035°F

B. 3,614°F

C. 3,625°F

D. 4,590°F

答案：C.

科目：　193009
知能類：K1.05 [3.1/3.5]
序號：　P2995(B2292)

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.

下列何者為2200°F之最大燃料護套溫度限制的基準？

A. 2200°F大約比燃料護套熔化溫度低500°F。

B. 溫度大於2200°F會使鋯合金-蒸汽反應速率顯著增加。

C. 若燃料護套溫度達到2200°F，則變態沸騰(transition boiling)(偏離核沸騰)即將開始。

D. 溫度大於2200°F時，燃料丸與燃料護套會發生過度差膨脹。

答案：B.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P383 (B394)

Refer to the drawing of a fuel rod and coolant flow channel at 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

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. 2,000°F

B. 1,750°F

C. 1,500°F

D. 1,250°F

ANSWER: B.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 3,000°F

在爐心壽命末期，若燃料對冷卻水之總熱傳導係數增加一倍，則燃料中央溫度將為多少？(假設反應器功率維持不變)

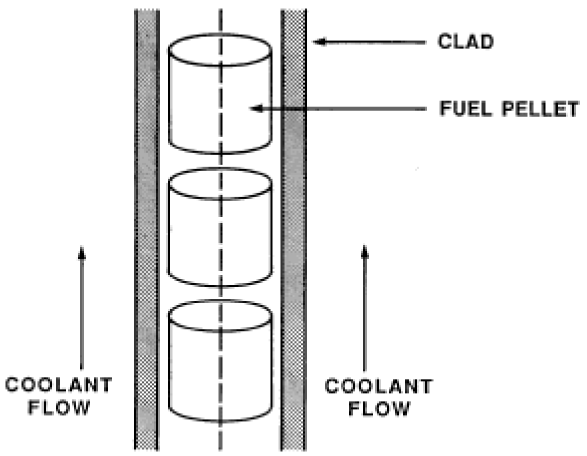
A. 2,000°F

B. 1,750°F

C. 1,500°F

D. 1,250°F

答案：B.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P394 (B396)

The pellet-to-clad gap in fuel rod construction is designed to...

A. decrease fuel pellet slump.

B. reflect fission neutrons.

C. increase heat transfer rate.

D. reduce internal clad strain.

ANSWER: D.

在燃料棒結構中，燃料丸與護套的間隙是設計用以……

A. 減少燃料丸塌陷(slump)。

B. 反射分裂中子。

C. 增加熱傳率。

D. 降低護套內部應變。

答案：D.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P495 (B495)

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 = 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. 1,000°F

B. 1,250°F

C. 1,500°F

D. 1,750°F

ANSWER: C.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,500°F

在爐心壽命末期，若燃料對冷卻水之總熱傳導係數增加一倍，則燃料中央溫度將是下列何者？(假設反應器功率維持不變)

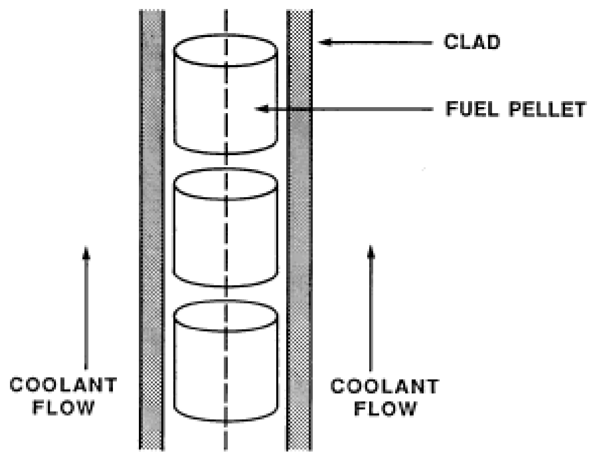
A. 1,000°F

B. 1,250°F

C. 1,500°F

D. 1,750°F

答案：C.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P1095

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

A. larger; smaller

B. larger; larger

C. smaller; smaller

D. smaller; larger

ANSWER: A.

一部核子反應器以 80%功率運轉，所有控制棒完全抽出。相較於將一根控制棒插入 50%，若把一組控制棒組插入 50%，將導致軸向尖峰熱通道因數增加______，徑向尖峰熱通道因數增加______(假設反應器功率維持不變)。

A. 較大；較小

B. 較大；較大

C. 較小；較小

D. 較小；較大

答案：A.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P1594 (B1594)

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

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

A. 1,100°F

B. 1,350°F

C 1,600°F

D. 1,850°F

ANSWER: C.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝100%
$T_{coolant}$ = 500°F
$T_{fuel\ centerline}$ = 2,700°F

在爐心壽命末期時，若燃料對冷卻水的總熱傳導係數增加一倍，則燃料中央溫度將是下列何者？(假設反應器功率維持不變)

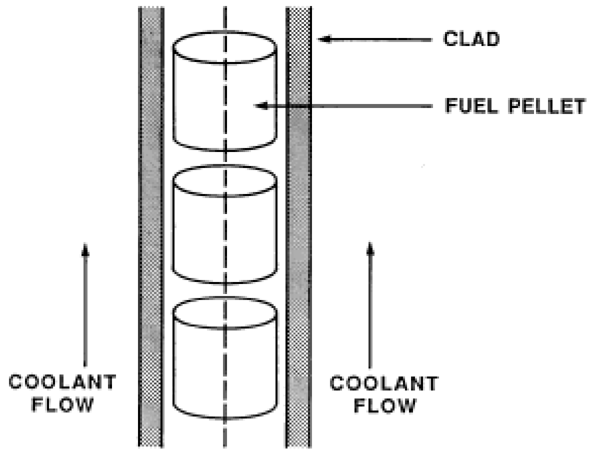
A. 1,100°F

B. 1,350°F

C. 1,600°F

D. 1,850°F

答案：C.



FUEL ROD AND COOLANT FLOW CHANNEL

科目： 193009
知能類：K1.07 [3.1/3.5]
序號： P1795

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

A. larger; smaller

B. larger; larger

C. smaller; smaller

D. smaller; larger

ANSWER: D.

一部核子反應器以 80%功率運轉，所有控制棒完全抽出。相較於將一組控制棒組插入 50%，若把一根控制棒插入 50%，將導致軸向尖峰熱通道因數增加______，徑向尖峰熱通道因數增加______(假設反應器功率維持不變)。

A. 較大；較小

B. 較大；較大

C. 較小；較小

D. 較小；較大

答案：D.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P1894 (B1395)

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.

相較於爐心壽命初期(BOL)，在爐心壽命末期(EOL)時，燃料對冷卻水的熱傳導係數如何？

A. 在EOL時較小，因為燃料丸密化。

B. 在EOL時較小，因為填充氣體被分裂產物氣體污染。

C. 在EOL時較大，因為燃料丸與護套間的間隙縮小。

D. 在EOL時較大，因為燃料丸與冷卻水之間的溫差較大。

答案：C.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P1994 (B1995)

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 = 60%
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 2,540°F

Which one of the following will be the fuel centerline temperature at the end of core life if the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

A. 1,270°F

B. 1,370°F

C. 1,440°F

D. 1,540°F

ANSWER: D.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝60%
$T_{coolant}$ = 540°F
$T_{fuel\ centerline}$ = 2,540°F

在爐心壽命末期時，若燃料對冷卻水的總熱傳導係數增加一倍，則燃料中央溫度將是下列何者？(假設反應器功率維持不變)

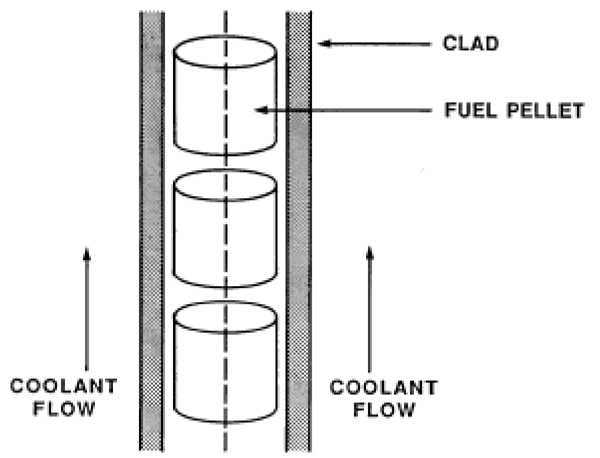
A. 1,270°F

B. 1,370°F

C. 1,440°F

D. 1,540°F

答案：D.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P2195 (B2192)

Which one of the following describes the fuel-to-coolant thermal conductivity for a fuel assembly at the beginning of core life (BOL) as compared to the end of core life (EOL)?

A. Larger at BOL due to a higher fuel pellet density

B. Larger at BOL due to lower contamination of fuel rod fill gas with fission product gases

C. Smaller at BOL due to a larger gap between the fuel pellets and clad

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

ANSWER: C.

相較於爐心壽命末期(EOL)，對一在爐心壽命初期(BOL)的燃料元件而言，燃料對冷卻水之熱傳導係數將如何？

A. 在BOL時較大，因為燃料丸密度較高。

B. 在BOL時較大，因為填充氣體被分裂產物氣體污染的程度較低。

C. 在BOL時較小，因為燃料丸與護套間的間隙較大。

D. 在BOL時較小，因為燃料棒表面的腐蝕膜較小。

答案：C.

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P2296 (B2696)

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 = 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 core life 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.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝60%
$T_{coolant}$ = 560°F
$T_{fuel\ centerline}$ = 2,500°F

在燃料週期末期，若燃料對冷卻水的總熱傳導係數增加一倍，則燃料中央溫度將是下列何者？(假設反應器功率維持不變)

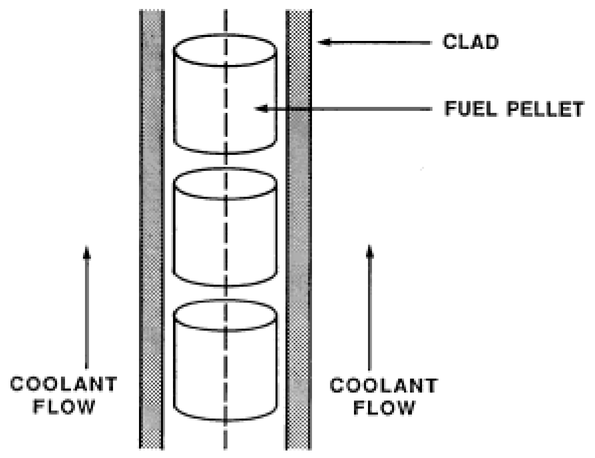
A. 1,080°F

B. 1,250°F

C. 1,530°F

D. 1,810°F

答案：C.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P2395 (B2394)

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

The nuclear 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.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

此核子反應器停機時，具有下列參數值：

$T_{coolant}$ = 320°F
$T_{fuel\ centerline}$ = 780°F

爐心壽命末期時，若燃料對冷卻水的總熱傳導係數增加一倍，在冷卻水溫度與反應器衰變熱不變下，則燃料中央溫度為多少？

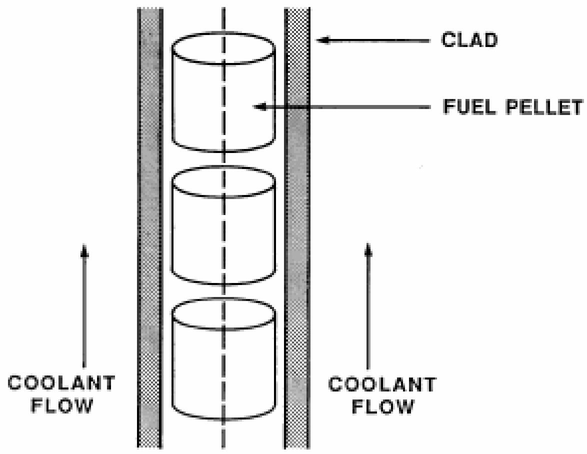
A. 550°F

B. 500°F

C. 450°F

D. 400°F

答案：A.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [3.1/3.5]
序號：　P2594

A nuclear reactor is operating at steady state 80% reactor power with core power distribution peaked both radially and axially in the center of the core. Reactor coolant boron concentration changes are used to maintain a constant T_{ave} and control rod position does <u>not</u> change.

Neglecting any change in fission product poison distribution, during the next three 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.

一部核子反應器以 80%功率穩態運轉，爐心功率分佈於爐心中央達到徑向和軸向尖峰。利用反應器冷卻水的硼濃度變化以維持 T_{ave} 不變，控制棒位<u>沒有</u>變化。

假設忽略分裂產物毒素分佈的任何改變，在往後三個月內，最高徑向尖峰因數將______，最高軸向尖峰因數將______。

A. 增加；減少

B. 增加；增加

C. 減少；減少

D. 減少；增加

答案：C.

科目：　193009
知能類：K1.07 [2.9/3.3]
序號：　P3195 (B3193)

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

The nuclear 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.

請參照下圖中的燃料棒與冷卻水流通道。

此核子反應器於燃料週期初期停機，並具有下列平均參數值：

$T_{coolant}$ = 440°F
$T_{fuel\ centerline}$ = 780°F

若燃料對冷卻水的總熱傳導係數在整個爐心壽命期間增加一倍，在冷卻水溫度與反應器衰變熱不變下，燃料週期末期的燃料中央溫度為何？

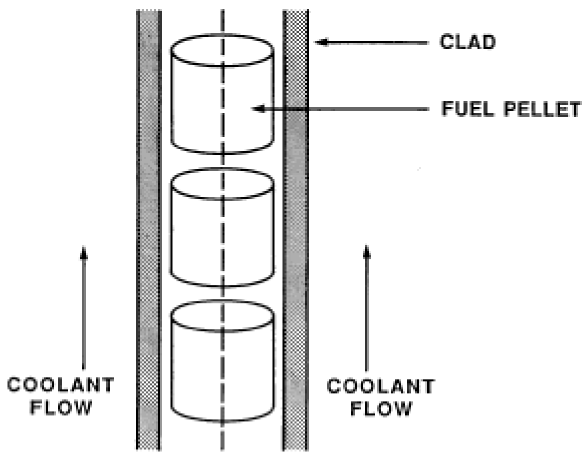
A. 610°F

B. 580°F

C. 550°F

D. 520°F

答案：A.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [2.9/3.3]
序號：　P3395 (B1697)

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 and $T_{coolant}$ are constant.)

A. 1,100°F

B. 1,375°F

C. 1,525°F

D. 1,650°F

ANSWER: D.

請參照下圖中，處於爐心壽命初期的燃料棒與冷卻水流通道。

已知下列初始爐心參數：

反應器功率 ＝50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,750°F

在爐心壽命末期時，若燃料對冷卻水之總熱傳導係數增加一倍，則燃料中央溫度將是下列何者？(假設反應器功率與$T_{coolant}$維持不變)

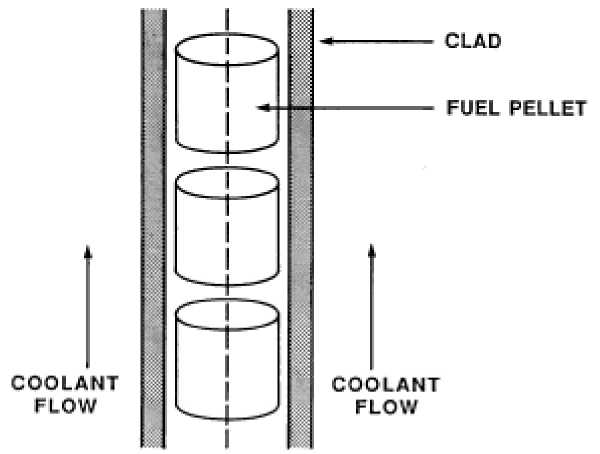
A. 1,100°F

B. 1,375°F

C. 1,525°F

D. 1,650°F

答案：D.



FUEL ROD AND COOLANT FLOW CHANNEL

科目：　193009
知能類：K1.07 [2.9/3.3]
序號：　P3895

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
$T_{fuel\ centerline}$ = 2,250°F

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

A. 2,550°F

B. 2,800°F

C. 2,950°F

D. 3,100°F

ANSWER: D.

請參照下圖的燃料棒與冷卻水流通道。

已知下列穩定爐心初始參數：

反應器功率 = 50%
$T_{coolant}$ = 550°F
$T_{fuel\ centerline}$ = 2,250°F

假設總熱傳導係數及反應器冷卻水溫度不變，如果反應器功率增至 75%，穩定燃料中央溫度約為多少？

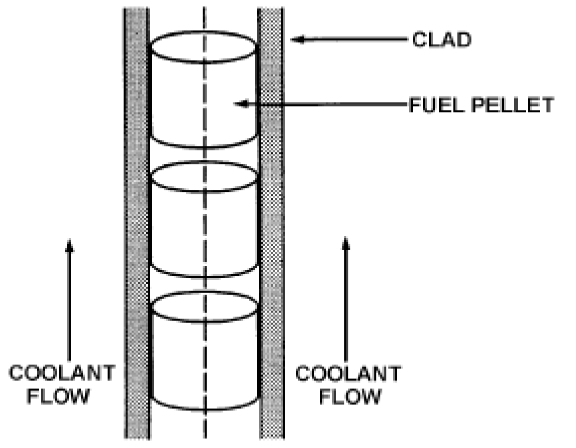
A. 2,550°F

B. 2,800°F

C. 2,950°F

D. 3,100°F

答案：D.



FUEL ROD AND COOLANT FLOW CHANNEL

科目/題號：193009/1 (2016 新增)
知能類：K1.02〔2.3/2.8〕
序號：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- inch.
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.
ANSWER: C.

反應器接近燃料週期中期運轉在 80%功率。所有控制棒幾乎全部抽出且以手動控制。爐心軸向功率分布尖峰在爐心中央平面之下。下列何者將會增加爐心軸向功率尖峰因數(或熱通道因數)？(除非說明否則假設運轉員未採取行動，且主汽機負載和爐心氙毒分布未改變)
A.主汽機負載/反應器功率減少 10%
B.控制棒組之控制棒抽出 4-inch
C.反應器冷卻水系統硼酸濃度減少 15ppm
D.一支位於爐心邊緣全出的控制棒掉落至爐心底部

答案： C

科目/題號：193009/2 (2016 新增)
知能類：K1.02〔2.3/2.7〕
序號：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
ANSWER: C.

一座壓水式反應器爐心包含 5 萬支燃料棒；每支燃料棒的有效長度為 12 feet。爐心產生 1,800MWt。假如總熱通量通道因數(或稱總爐心尖峰因數)為 3.0，則爐心所產生之最大線性功率密度為何？
A.4.5kW/ft
B.6.0kW/ft
C.9.0 kW/ft
D.12.0 kW/ft

答案： C

科目/題號：193009/3 (2016 新增)
知能類：K1.02〔2.3/2.7〕
序號：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.
ANSWER: D.

一反應器運轉在 3,400MWt。爐心線性功率密度限值為 12.2kW/ft。
已知：
●反應器爐心包含 198 組燃料組件。
●每一組燃料組件包含 262 支燃料棒，每支燃料棒有效長度 12 呎。
●爐心所量測到的最大總尖峰因數如下：
位置 A: 2.5
位置 B: 2.4
位置 C: 2.3
位置 D: 2.2
下列何者敘述為爐心中相對於線性功率密度限值的運轉條件？
A.所有爐心位置均運轉於線性功率密度限值之內
B.位置 A 超出線性功率密度限值，而位置 B、C、D 運轉於限值之內
C.位置 A 和 B 超出線性功率密度限值，而位置 C 和 D 運轉於限值之內
D.位置 A、B、C 超出線性功率密度限值，而位置 D 運轉於限值之內

答案： D

科目/題號：193009/4 (2016新增)
知能類： K1.04 [2.3/2.7]
序號： P6249 (B6247)

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

Tcoolant = 550°F

Tfuel centerline = 1,680°F

Assume that 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
ANSWER: A.

一反應器穩定運轉在功率階具有下列爐心平面平均溫度：

爐心冷卻水溫度 = 550˚F

燃料棒中心線溫度 =1,680˚F

假設燃料熱傳係數和反應器冷卻水溫度在整個爐心平面均相同。假若爐心平面之最大總尖峰因數為2.1，則爐心平面最大燃料棒中心線溫度是多少？

A.2,923˚F
B.3,528˚F
C.4,078˚F
D.4,683˚F

答案： A

科目/題號：193009/5 (2016新增)
知能類：K1.07 [2.9/3.3]
序號：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
ANSWER: A.

考慮一支新燃料棒運轉在一固定功率已數週。在此期間燃料棒中的燃料丸密化(densification)作用，導致從燃料丸至護套的熱傳率將_____；此改變將引起燃料棒中平均燃料溫度將_____。

A.減少；增加
B.減少；減少
C.增加；增加
D.增加；減少

答案： A

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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
ANSWER: D.

假設在燃料產生固定功率輸出時發生燃料丸密化(densification)作用，則燃料棒之平均線性功率密度將會_____因為燃料丸密化作用引起燃料丸間_____。
A.減少；膨脹
B.減少；收縮
C.增加；膨脹
D.增加；收縮

答案： D