TOPIC: 192004
KNOWLEDGE: K1.01 [3.1/3.2]
QID: P133

The moderator temperature coefficient describes the change in reactivity per degree change in...

A. fuel temperature.

B. fuel cladding temperature.

C. reactor vessel temperature.

D. reactor coolant temperature.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P650 (B1952)

Which one of the following isotopes is the most significant contributor to the resonance capture of fission neutrons in a reactor at the beginning of a fuel cycle?

A. U-238

B. U-233

C. Pu-240

D. Pu-239

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P1950 (B753)

Factors that affect the probability of resonance absorption of a neutron by a nucleus include...

A. excitation energy of the neutron, kinetic energy of the nucleus, and kinetic energy of the neutron.

B. kinetic energy of the neutron, excitation energy of the nucleus, and excitation energy of the neutron.

C. excitation energy of the nucleus, excitation energy of the neutron, and kinetic energy of the nucleus.

D. kinetic energy of the nucleus, kinetic energy of the neutron, and excitation energy of the nucleus.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P2050 (B3352)

Which one of the following isotopes is the most significant contributor to the resonance capture of fission neutrons in a reactor at the end of a fuel cycle?

A. U-235

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P3150 (B3153)

Which one of the following has the smallest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Uranium-235

B. Uranium-238

C. Samarium-149

D. Xenon-135

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P251

Under which one of the following conditions is a reactor most likely to have a positive moderator temperature coefficient?

A. High reactor coolant temperature at the beginning of a fuel cycle.

B. High reactor coolant temperature at the end of a fuel cycle.

C. Low reactor coolant temperature at the beginning of a fuel cycle.

D. Low reactor coolant temperature at the end of a fuel cycle.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P1150

A reactor has operated at steady-state 100 percent power for the past 6 months. Compared to 6 months ago, the current moderator temperature coefficient is...

A. more negative, due to control rod withdrawal.

B. less negative, due to control rod insertion.

C. more negative, due to a smaller reactor coolant boron concentration.

D. less negative, due to a greater reactor coolant boron concentration.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P1650 (B652)

Which one of the following contains the pair of nuclides that are the <u>most</u> significant contributors to the total resonance capture in the core near the end of a fuel cycle?

A. U-238 and Pu-239

B. U-238 and Pu-240

C. Pu-239 and U-235

D. Pu-239 and Pu-240

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P2150

Which one of the following conditions will cause the moderator temperature coefficient (MTC) to become more negative? (Consider only the direct effect of the indicated change on MTC.)

A. The controlling bank of control rods is inserted 5 percent into the core.

B. Fuel temperature decreases from 1500°F to 1200°F.

C. Reactor coolant boron concentration increases by 20 ppm.

D. Moderator temperature decreases from 500°F to 450°F.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P2151 (B2152)

Which one of the following contains the nuclides responsible for most of the resonance capture of fission neutrons in a reactor at the beginning of the sixth fuel cycle? (Assume that each refueling process replaces one-third of the fuel.)

A. U-235 and Pu-239

B. U-235 and U-238

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P2251

Which one of the following contains two isotopes that add significant negative reactivity when fuel temperature increases near the end of a fuel cycle?

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P7637 (B7637)

Which one of the following describes a situation where an increase in moderator temperature can add positive reactivity?

A. At low moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

B. At low moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

C. At high moderator temperatures, an increase in moderator temperature can reduce neutron leakage from the core sufficiently to add positive reactivity.

D. At high moderator temperatures, an increase in moderator temperature can reduce neutron capture by the moderator sufficiently to add positive reactivity.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P50

As the reactor coolant boron concentration increases, the moderator temperature coefficient becomes less negative. This is because a 1°F increase in reactor coolant temperature at higher boron concentrations results in a larger increase in the...

A. fast fission factor.

B. thermal utilization factor.

C. total nonleakage probability.

D. resonance escape probability.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P123

In which one of the following conditions is the moderator temperature coefficient <u>most</u> negative?

A. Beginning of a fuel cycle (BOC), high reactor coolant temperature

B. BOC, low reactor coolant temperature

C. End of a fuel cycle (EOC), high reactor coolant temperature

D. EOC, low reactor coolant temperature

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P252

During a nuclear power plant heatup near the end of a fuel cycle, the moderator temperature coefficient becomes increasingly more negative. This is because...

A. as moderator density decreases, more thermal neutrons are absorbed by the moderator than by the fuel.

B. the change in the thermal utilization factor dominates the change in the resonance escape probability.

C. a greater density change per °F occurs at higher reactor coolant temperatures.

D. the core transitions from an undermoderated condition to an overmoderated condition.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P450

The moderator temperature coefficient will be <u>least</u> negative at a __________ reactor coolant temperature and a __________ reactor coolant boron concentration.

A. high; high

B. high; low

C. low; high

D. low; low

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P751

A reactor is operating at full power following a refueling outage. Compared to the current moderator temperature coefficient (MTC), the MTC just prior to the refueling was...

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

C. less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.

D. more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P951 (B2452)

During a reactor coolant system cooldown, positive reactivity is added to the core if the moderator temperature coefficient is negative. This is partially due to...

A. a decreasing thermal utilization factor.

B. an increasing thermal utilization factor.

C. a decreasing resonance escape probability.

D. an increasing resonance escape probability.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P1250

As the core ages, the moderator temperature coefficient becomes more negative. This is primarily due to...

A. fission product poison buildup in the fuel.

B. decreasing fuel centerline temperature.

C. decreasing control rod worth.

D. decreasing reactor coolant boron concentration.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P1450

The moderator temperature coefficient will be <u>most</u> negative at a __________ reactor coolant temperature and a __________ reactor coolant boron concentration.

A. low; low

B. high; low

C. low; high

D. high; high

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P1752

Which one of the following describes the initial reactivity effect of a moderator temperature decrease in an undermoderated reactor?

A. Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B. Negative reactivity will be added because more neutrons will be captured by the moderator.

C. Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

D. Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P1850

Which one of the following describes why the moderator temperature coefficient is more negative near the end of a fuel cycle (EOC) compared to the beginning of a fuel cycle (BOC)?

A. Increased nucleate boiling near the EOC amplifies the negative reactivity added by a 1°F moderator temperature increase.

B. Increased control rod insertion near the EOC amplifies the negative reactivity added by a 1°F moderator temperature increase.

C. Decreased fuel temperature near the EOC results in reduced resonance neutron capture for a 1°F increase in moderator temperature.

D. Decreased coolant boron concentration near the EOC results in fewer boron atoms leaving the core for a 1°F moderator temperature increase.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P2650 (B2652)

Which one of the following describes the initial reactivity effect of a moderator temperature decrease in an overmoderated reactor?

A. Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

B. Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

C. Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.

D. Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P2750

A reactor is operating at 100 percent power following a refueling outage. Compared to the moderator temperature coefficient (MTC) just prior to the refueling, the current MTC is...

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

C. less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.

D. more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P2950

Which one of the following describes the initial reactivity effect of a moderator temperature increase in an overmoderated reactor?

A. Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B. Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.

C. Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

D. Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P3151

How does the addition of boric acid to the reactor coolant affect the moderator temperature coefficient (MTC) in an undermoderated reactor?

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P3352

Compared to the moderator temperature coefficient (MTC) of reactivity near the beginning of a fuel cycle, the MTC near the end of a fuel cycle is: (Assume 100 percent power for all cases.)

A. more negative, because as U-235 depletes, more fission neutrons are able to escape resonance capture.

B. less negative, because as U-238 depletes, more fission neutrons are able to escape resonance capture.

C. more negative, because as reactor coolant boron concentration decreases, the thermal utilization of fission neutrons increases.

D. less negative, because as control rods are withdrawn from the core, the thermal utilization of fission neutrons increases.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P3650 (B3652)

Which one of the following describes the initial reactivity effect of a moderator temperature increase in an undermoderated reactor?

A. Negative reactivity will be added because more neutrons will be absorbed by U-238 at resonance energies while slowing down.

B. Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.

C. Positive reactivity will be added because fewer neutrons will be absorbed by U-238 at resonance energies while slowing down.

D. Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P6126

When compared to the beginning of a fuel cycle, the moderator temperature coefficient at 100 percent power near the end of a fuel cycle is...

A. more negative, because fewer boron-10 nuclei are removed from the core for a given moderator temperature increase.

B. less negative, because more boron-10 nuclei are removed from the core for a given moderator temperature increase.

C. more negative, because a smaller fraction of the neutron flux will leak out of the core following a given moderator temperature increase.

D. less negative, because a larger fraction of the neutron flux will leak out of the core following a given moderator temperature increase.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P7426

How does increasing the reactor coolant boron concentration affect the moderator temperature coefficient (MTC) in an overmoderated reactor?

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06 [3.1/3.1]
QID: P7667

A reactor is shut down near the middle of a fuel cycle with the shutdown cooling system in service. The initial reactor coolant temperature is 160°F. In this condition, the reactor is undermoderated.

Then, a heatup and pressurization is performed to bring the reactor coolant system to normal operating temperature and pressure. The reactor remains subcritical.

During the heatup, K_{eff} will…

A. increase continuously.

B. decrease continuously.

C. initially increase, and then decrease.

D. initially decrease, and then increase.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P51

Why does the fuel temperature coefficient becomes <u>less</u> negative at higher fuel temperatures?

A. As reactor power increases, the rate of increase in the fuel temperature diminishes.

B. Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

C. The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

D. The amount of Doppler broadening per degree change in fuel temperature diminishes.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P651

Which one of the following will cause the Doppler power coefficient to become more negative?

A. Increased clad creep

B. Increased pellet swell

C. Lower power level

D. Higher reactor coolant boron concentration

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P1052

A reactor is operating continuously at steady-state 100 percent power. As core burnup increases, the fuel temperature coefficient becomes __________ negative because the average fuel temperature __________.

A. more; decreases

B. more; increases

C. less; decreases

D. less; increases

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P1851

Which one of the following pairs of nuclides is responsible for most of the negative reactivity associated with a fuel temperature increase near the end of a fuel cycle?

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P1951

A nuclear power plant is operating at steady-state 70 percent power. Which one of the following will result in a less negative fuel temperature coefficient? (Consider only the direct effect of the change in each listed parameter.)

A. Increase in Pu-240 inventory in the core.

B. Increase in moderator temperature.

C. Increase in fuel temperature.

D. Increase in coolant voids.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2052

Compared to operation at a low power level, the fuel temperature coefficient of reactivity at a high power level is __________ negative due to __________.

A. less; improved pellet-to-clad heat transfer

B. more; buildup of fission product poisons

C. less; higher fuel temperature

D. more; increased neutron flux

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2352 (B2453)

Refer to the curve of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 (see figure below).

If fuel temperature increases, the area under the curve will __________; and negative reactivity will be added to the core because __________.

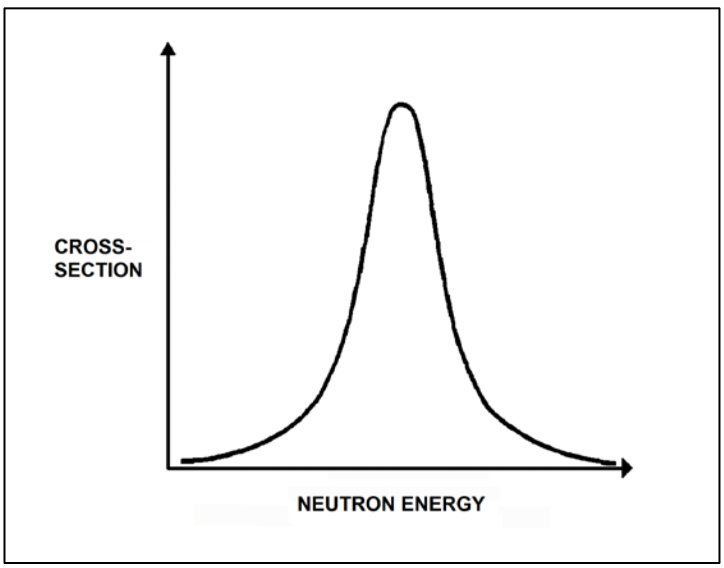
A. increase; neutrons of a wider range of energies will be absorbed by U-238

B. increase; more neutrons will be absorbed by U-238 at the resonance neutron energy

C. remain the same; neutrons of a wider range of energies will be absorbed by U-238

D. remain the same; more neutrons will be absorbed by U-238 at the resonance neutron energy

ANSWER: C.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2451

Which one of the following describes how the magnitude of the fuel temperature coefficient of reactivity is affected as the core ages?

A. It remains essentially constant over core life.

B. It becomes more negative, due to the buildup of Pu-240.

C. It becomes less negative, due to the decrease in RCS boron concentration.

D. It becomes more negative initially due to buildup of fissions product poisons, then less negative due to fuel depletion.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2651 (B2553)

In a comparison of the fuel temperature coefficient at the beginning and end of a fuel cycle, the fuel temperature coefficient is more negative at the __________ of a fuel cycle because __________. (Assume the same initial fuel temperature throughout the fuel cycle.)

A. end; more Pu-240 is in the core

B. end; more fission product poisons are in the core

C. beginning; more U-238 is in the core

D. beginning; less fission product poisons are in the core

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2751 (B2753)

Refer to the curve of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (eV) resonance peak in U-238 for a reactor operating at 50 percent power (see figure below).

If fuel temperature decreases by 50°F, the area under the curve will __________; and positive reactivity will be added to the core because __________.

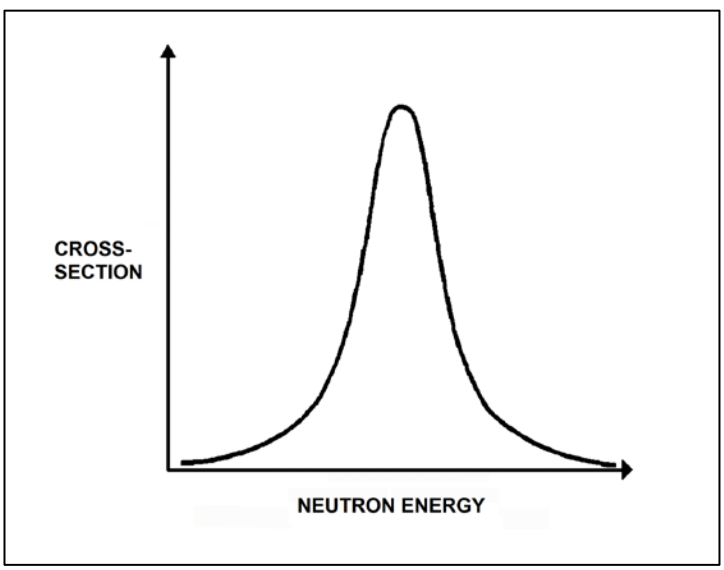
A. decrease; fewer neutrons will be absorbed by U-238 overall

B. decrease; fewer 6.7 eV neutrons will be absorbed by U-238 at the resonance energy

C. remain the same; fewer neutrons will be absorbed by U-238 overall

D. remain the same; fewer 6.7 eV neutrons will be absorbed by U-238 at the resonance energy

ANSWER: C.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2850 (B2852)

Refer to the curve of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a reactor operating at 80 percent power (see figure below).

If reactor power is increased to 100 percent, the height of the curve will __________; and the area under the curve will __________.

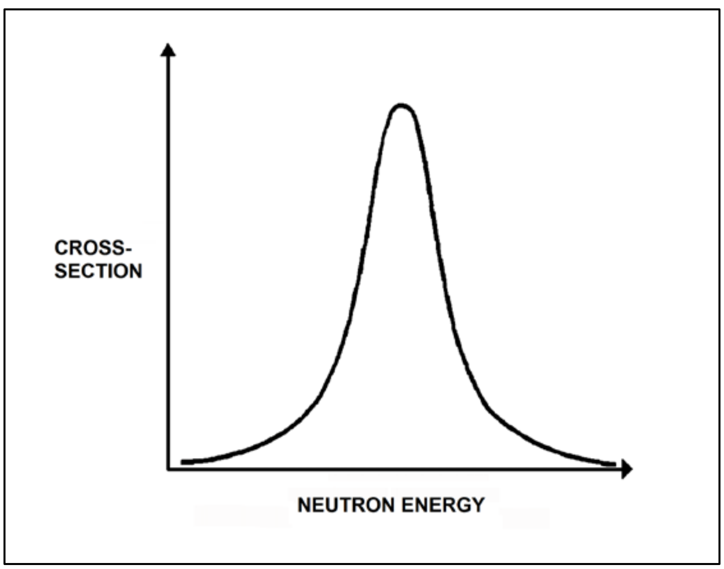
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: D.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P3750 (B3753)

Refer to the drawing of a curve showing the neutron absorption characteristics of a typical U-238 nucleus at a resonance neutron energy (see figure below). The associated reactor is currently operating at steady-state 80 percent power.

During a subsequent reactor power decrease to 70 percent, the curve will become __________; and the percentage of the core neutron population lost to resonance capture by U-238 will __________.

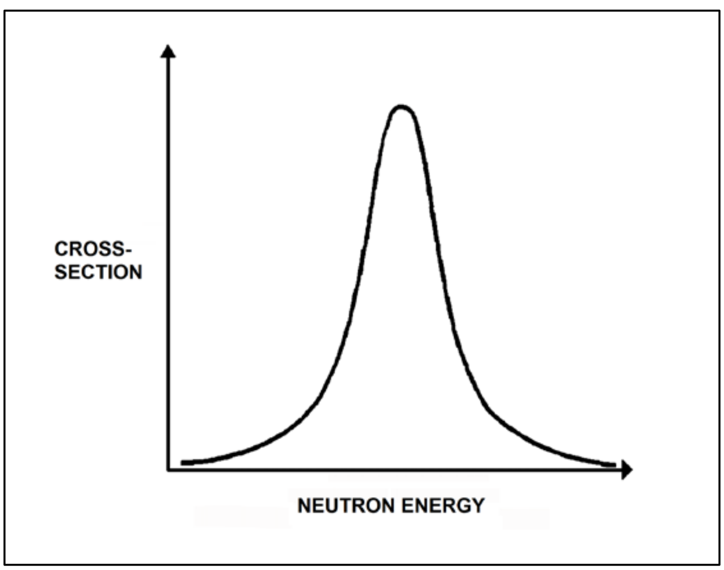
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: D.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P3850 (B3852)

Refer to the curve of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a reactor operating at 80 percent power (see figure below).

If reactor power is decreased to 60 percent, the height of the curve will __________; and the area under the curve will __________.

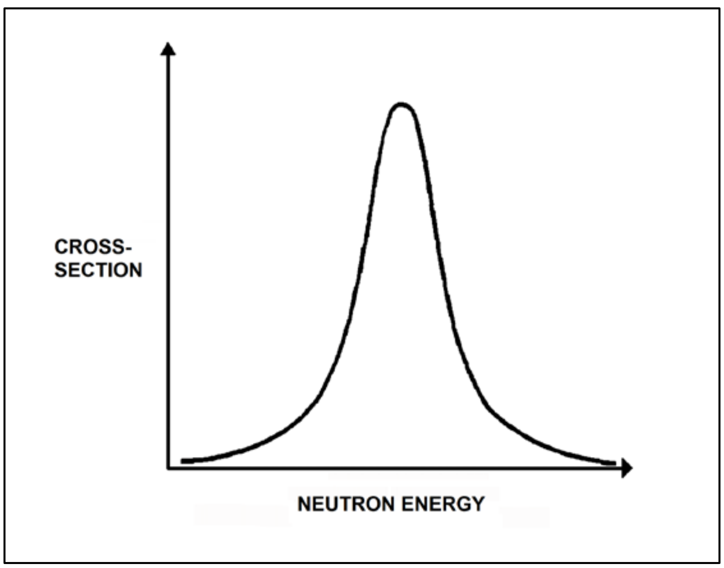
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P4826 (B4826)

If the average temperature of a fuel pellet decreases by 50°F, the microscopic cross-section for absorption of neutrons at a resonance energy of U-238 will __________; and the microscopic cross-sections for absorption of neutrons at energies that are slightly higher or lower than a U-238 resonance energy will __________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P6626 (B6627)

If the average temperature of a fuel pellet increases by 50°F, the microscopic cross-section for absorption of neutrons at a resonance energy of U-238 will __________; and the microscopic cross-sections for absorption of neutrons at energies that are slightly higher or lower than a U-238 resonance energy will __________.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P6926 (B6926)

Which one of the following 10 percent reactor power level changes produces the largest amount of negative reactivity from the fuel temperature coefficient? (Assume that each power level change produces the same increase/decrease in fuel temperature.)

A. 30 percent to 40 percent

B. 30 percent to 20 percent

C. 80 percent to 90 percent

D. 80 percent to 70 percent

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P7648 (B7648)

Refer to the drawing of a curve showing the neutron absorption cross-section for U-238 at a resonance energy (see figure below). The reactor associated with the curve is operating at 80 percent power.

If reactor power is increased to 90 percent over the next few hours, the curve will become ________; and the percentage of the core neutron population lost to resonance capture by U-238 will ________.

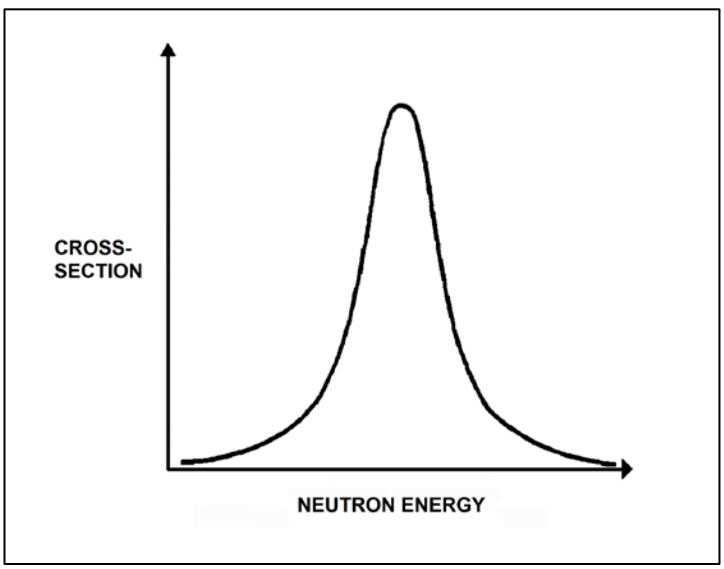
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: A.



TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P7678 (B7678)

A reactor has an initial effective fuel temperature of 800°F. If the effective fuel temperature increases to 1,000°F, the fuel temperature coefficient will become __________ negative; because at higher effective fuel temperatures, a 1°F increase in effective fuel temperature produces a __________ change in Doppler broadening.

A. less; greater

B. less; smaller

C. more; greater

D. more; smaller

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.08 [3.1/3.1]
QID: P253

Which one of the following groups contain parameters that, if varied, will each have a <u>direct</u> effect on the power coefficient?

A. Control rod position, reactor power, moderator void fraction

B. Moderator temperature, reactor coolant system pressure, xenon-135 concentration

C. Fuel temperature, xenon-135 concentration, control rod position

D. Moderator void fraction, fuel temperature, moderator temperature

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.08 [3.1/3.1]
QID: P652

Which one of the following is responsible for the largest positive reactivity addition immediately following a reactor trip from 100 percent power at the beginning of a fuel cycle? (Assume reactor coolant system parameters stabilize at their normal post-trip values.)

A. The change in Xe-135 concentration.

B. The change in control rod position.

C. The change in fuel temperature.

D. The change in moderator temperature.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.08 [3.1/3.1]
QID: P851

A nuclear power plant is initially operating at steady-state 50 percent power. Which one of the following contains only parameters that, if varied, will each directly change the magnitude of the power defect?

A. Control rod position, reactor power, and moderator void fraction

B. Moderator void fraction, fuel temperature, and moderator temperature

C. Fuel temperature, xenon-135 concentration, and control rod position

D. Moderator temperature, reactor coolant system pressure, and xenon-135 concentration

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.08 [3.1/3.1]
QID: P1353

A reactor is initially critical at the point of adding heat during a xenon-free reactor startup near the beginning of a fuel cycle. Reactor power is ramped to 50 percent over a 4 hour period.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A. buildup of core xenon-135.

B. increased fuel temperature.

C. burnout of burnable poisons.

D. increased reactor coolant temperature.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.08 [3.1/3.1]
QID: P1551

A nuclear power plant has been operating at steady-state 50 percent power for one month following a refueling outage. Then, reactor power is ramped to 100 percent over a 2-hour period.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A. increased reactor coolant temperature.

B. buildup of core xenon-135.

C. burnout of burnable poisons.

D. increased fuel temperature.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.09 [2.8/2.9]
QID: P552

As reactor coolant boron concentration decreases, the differential boron worth (ΔK/K/ppm) becomes...

A. less negative, due to a larger number of water molecules in the core.

B. less negative, due to a smaller number of boron molecules in the core.

C. more negative, due to a larger number of water molecules in the core.

D. more negative, due to a smaller number of boron molecules in the core.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.09 [2.8/2.9]
QID: P1350

With higher concentrations of boron in the reactor coolant, the core neutron flux distribution shifts to __________ energies where the absorption cross section of boron is __________.

A. higher; smaller

B. higher; greater

C. lower; smaller

D. lower; greater

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.10 [2.9/2.9]
QID: P1152

Differential boron worth (ΔK/K/ppm) will become __________ negative as moderator temperature increases because, at higher moderator temperatures, a 1 ppm increase in reactor coolant boron concentration will add __________ boron atoms to the core.

A. more; fewer

B. more; more

C. less; fewer

D. less; more

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.10 [2.9/2.9]
QID: P1252

Differential boron worth (ΔK/K/ppm) becomes more negative as...

A. burnable poisons deplete.

B. boron concentration increases.

C. moderator temperature increases.

D. fission product poison concentration increases.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.10 [2.9/2.9]
QID: P3552

The following are the initial conditions for a nuclear power plant:

- Reactor power is 50 percent.
- Average reactor coolant temperature is 570°F.
- Reactor coolant boron concentration is 400 ppm.

After a power increase, the current plant conditions are as follows:

- Reactor power is 80 percent.
- Average reactor coolant temperature is 582°F.
- Reactor coolant boron concentration is 400 ppm.

When compared to the initial differential boron worth (DBW) in ΔK/K/ppm, the current DBW is…

A. more negative, because a 1°F increase in reactor coolant temperature will remove more boron-10 atoms from the core.

B. more negative, because a 1 ppm increase in reactor coolant boron concentration will add more boron-10 atoms to the core.

C. less negative, because a 1°F increase in reactor coolant temperature will remove fewer boron-10 atoms from the core.

D. less negative, because a 1 ppm increase in reactor coolant boron concentration will add fewer boron-10 atoms to the core.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.11 [2.9/3.1]
QID: P351

The amount of boric acid required to increase the reactor coolant boron concentration by 50 ppm at 1,200 ppm is approximately __________ as the amount of boric acid required to increase the reactor coolant boron concentration by 50 ppm at 100 ppm.

A. the same

B. four times as large

C. eight times as large

D. twelve times as large

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.11 [2.9/3.1]
QID: P1050

The amount of pure water required to decrease the reactor coolant boron concentration by 20 ppm at 100 ppm is approximately __________ the amount of pure water required to decrease the reactor coolant boron concentration by 20 ppm at 1,000 ppm.

A. one-tenth

B. the same as

C. 10 times

D. 100 times

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P52

A reactivity coefficient measures a/an __________ change in reactivity, while a reactivity defect measures a __________ change in reactivity.

A. integrated; total

B. integrated; differential

C. unit; total

D. unit; differential

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P352

Given the following initial parameters:

Reactor coolant boron concentration	=	600 ppm
Moderator temperature coefficient	=	-0.015 %ΔK/K/°F
Differential boron worth	=	-0.010 %ΔK/K/ppm

Which one of the following is the final reactor coolant boron concentration required to decrease average reactor coolant temperature by 4°F. (Assume no change in control rod position or reactor/turbine power).

A. 606 ppm

B. 603 ppm

C. 597 ppm

D. 594 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P852

Given the following initial parameters:

Reactor coolant boron concentration	=	500 ppm
Moderator temperature coefficient	=	-0.012 %ΔK/K/°F
Differential boron worth	=	-0.008 %ΔK/K/ppm

Which one of the following is the final reactor coolant boron concentration required to increase average coolant temperature by 6°F. (Assume no change in control rod position or reactor/turbine power.)

A. 491 ppm

B. 496 ppm

C. 504 ppm

D. 509 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P953

Given the following initial parameters:

Power coefficient	=	-0.016 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Control rod worth	=	-0.030 %ΔK/K/inch
Reactor coolant boron concentration	=	500 ppm

Which one of the following is the final reactor coolant boron concentration required to support increasing reactor power from 30 percent to 80 percent by boration/dilution with 10 inches of outward control rod motion. (Ignore any change in fission product poison reactivity.)

A. 390 ppm

B. 420 ppm

C. 450 ppm

D. 470 ppm

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P1553

A nuclear power plant is operating at steady-state 100 percent power. Given the following initial parameters, select the final reactor coolant boron concentration required to decrease average coolant temperature by 6°F. (Assume no change in control rod position or reactor/turbine power.)

Reactor coolant boron concentration = 500 ppm
Moderator temperature coefficient = -0.012 %ΔK/K/°F
Differential boron worth = -0.008 %ΔK/K/ppm

A. 509 ppm

B. 504 ppm

C. 496 ppm

D. 491 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P1753

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.025 %ΔK/K/inch
Reactor coolant boron concentration	=	500 ppm

Which one of the following is the final reactor coolant boron concentration required to support increasing reactor power from 30 percent to 80 percent by boration/dilution with 10 inches of outward control rod motion? (Ignore any change in fission product poison reactivity.)

A. 425 ppm

B. 450 ppm

C. 550 ppm

D. 575 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P2353

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.025 %ΔK/K/inch
Reactor coolant boron concentration	=	500 ppm

Which one of the following is the final reactor coolant boron concentration required to support decreasing reactor power from 80 percent to 30 percent by boration/dilution with 10 inches of inward control rod motion? (Ignore any change in fission product poison reactivity.)

A. 425 ppm

B. 475 ppm

C. 525 ppm

D. 575 ppm

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P2453

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.025 %ΔK/K/inch
Reactor coolant boron concentration	=	600 ppm

Which one of the following is the final reactor coolant boron concentration required to support increasing reactor power from 40 percent to 80 percent with 40 inches of outward control rod motion? (Ignore any change in fission product poison reactivity.)

A. 420 ppm

B. 580 ppm

C. 620 ppm

D. 780 ppm

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P2553

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.025 %ΔK/K/inch
Reactor coolant boron concentration	=	500 ppm

Which one of the following is the final reactor coolant boron concentration required to support decreasing reactor power from 100 percent to 30 percent by boration/dilution with 20 inches of inward control rod motion? (Ignore any change in fission product poison reactivity.)

A. 410 ppm

B. 425 ppm

C. 575 ppm

D. 590 ppm

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.12 [2.7/2.7]
QID: P6527

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.020 %ΔK/K/inch
Reactor coolant boron concentration	=	600 ppm

Which one of the following is the final reactor coolant boron concentration required to support increasing reactor power from 20 percent to 50 percent with 10 inches of control rod withdrawal? (Ignore any change in fission product poison reactivity.)

A. 520 ppm

B. 560 ppm

C. 640 ppm

D. 680 ppm

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P2071 (B2070)

Ignoring the effects of changes in fission product poisons, which one of the following power changes requires the <u>greatest</u> amount of positive reactivity addition?

A. 3 percent to 5 percent

B. 5 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 60 percent

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P2169 (B2669)

Ignoring the effects of changes in fission product poisons, which one of the following power changes requires the smallest amount of positive reactivity addition?

A. 2 percent to 5 percent

B. 5 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 50 percent

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P2851 (B2470)

Ignoring the effects of changes in fission product poisons, which one of the following power changes requires the greatest amount of positive reactivity addition?

A. 3 percent to 10 percent

B. 10 percent to 25 percent

C. 25 percent to 60 percent

D. 60 percent to 100 percent

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P2953 (B5034)

Ignoring the effects of changes in fission product poisons, which one of the following reactor power changes requires the greatest amount of positive reactivity addition?

A. 3 percent to 10 percent

B. 10 percent to 25 percent

C. 25 percent to 65 percent

D. 65 percent to 100 percent

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P3753 (B3769)

Ignoring the effects of changes in fission product poisons, which one of the following power changes requires the smallest amount of positive reactivity addition?

A. 3 percent to 10 percent

B. 10 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 40 percent

ANSWER: B.