TOPIC: 292004
KNOWLEDGE: K1.01 [3.2/3.2]
QID: B252

The moderator temperature coefficient describes a change in _______________ resulting from a change in _______________.

A. reactivity; moderator temperature

B. K_{eff}; moderator temperature

C. moderator temperature; reactivity

D. moderator temperature; K_{eff}

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B353 (P350)

Which one of the following will result in a less negative fuel temperature coefficient? (Consider only the direct effect of the change in the listed parameters.)

A. Increase in fuel burnup.

B. Decrease in fuel temperature.

C. Increase in void fraction.

D. Decrease in moderator temperature.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B651 (P751)

A nuclear reactor is currently at end-of-life in its fuel cycle, and it will be refueled next month. In comparison to the current moderator temperature coefficient (MTC), the MTC after refueling will be...

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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B752

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

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

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

C. more negative at all coolant temperatures.

D. less negative at all coolant temperatures.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B852

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. Control rods are inserted from 50% rod density to 75% rod density.

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

C. Recirculation flow increases by 10%.

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

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B1152

Which one of the following describes the change in the moderator temperature coefficient (MTC) of reactivity over core life? (Assume 100% power for all cases.)

A. Control rod withdrawal results in increased thermal neutron utilization, which results in a less negative MTC at end of fuel cycle (EOC).

B. Fission product poison buildup results in decreased thermal neutron utilization, which results in a more negative MTC at EOC.

C. Burnup of U-235 results in decreased thermal neutron utilization, which results in a more negative MTC at EOC.

D. Decreased voiding in the core results in increased thermal neutron utilization, which results in a less negative MTC at EOC.

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B1253

The moderator temperature coefficient of reactivity is _____________ negative at end of core life because, over core life, the utilization of thermal neutrons _____________.

A. more; decreases

B. less; decreases

C. more; increases

D. less; increases

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B1752 (P1752)

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

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

B. Negative reactivity will be added because more neutron leakage will occur.

C. Positive reactivity will be added because less neutron leakage will occur.

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

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2052

A nuclear reactor is shut down with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water with a temperature of 100°F.

Which one of the following could increase <u>or</u> decrease K_{eff} depending on core burnup?

A. A spent fuel assembly is removed from the core.

B. Refueling water temperature is decreased to 95°F.

C. A fresh neutron source is installed in the core.

D. Movable incore source range instrumentation is repositioned to increase source range count rate.

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2252

Under which one of the following conditions is a nuclear reactor core most likely to have a <u>positive</u> moderator temperature coefficient?

A. Low coolant temperature at beginning-of-life

B. Low coolant temperature at end-of-life

C. High coolant temperature at beginning-of-life

D. High coolant temperature at end-of-life

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2452 (P951)

During a reactor vessel cooldown, positive reactivity is added to the core (assuming a negative moderator temperature coefficient). This is partially due to...

A. a decrease in the thermal utilization factor.

B. an increase in the thermal utilization factor.

C. a decrease in the resonance escape probability.

D. an increase in the resonance escape probability.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2652 (P2650)

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

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

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.

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

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2853

Which one of the following describes the change in the moderator temperature coefficient (MTC) of reactivity over core life? (Assume 100% power for all cases.)

A. MTC becomes less negative because as control rods are withdrawn from the core, the increase in the number of neutrons leaking from the core for a 1°F increase in moderator temperature is smaller.

B. MTC becomes less negative because as U-238 depletes, a 1°F increase in moderator temperature results in fewer neutrons escaping resonance capture.

C. MTC becomes more negative because as U-235 depletes, a 1°F increase in moderator temperature permits more neutrons to leak out of the core.

D. MTC becomes more negative because as fission product poisons build up, the increase in the number of neutrons being absorbed by fission product poisons for a 1°F increase in moderator temperature is larger.

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B2952 (P2950)

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

A. Negative reactivity will be added because more neutron leakage will occur.

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

C. Positive reactivity will be added because less neutron leakage will occur.

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

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B3152 (P3151)

How does control rod withdrawal affect the moderator temperature coefficient in an undermoderated nuclear reactor core?

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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B3652 (P3650)

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

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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B4226

A nuclear reactor is shut down with the reactor vessel head removed. The core is covered by 23 feet of refueling water at a temperature of 100°F.

Which one of the following will increase core K_{eff} if the reactor is at the end of core life, but will decrease core K_{eff} if the reactor is at the middle of core life?

A. A fresh neutron source is installed in the core.

B. Refueling water temperature is increased to 105°F.

C. A spent fuel assembly is replaced with a new fuel assembly.

D. Movable incore source range instrumentation is repositioned to increase source range count rate.

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B753 (P1950)

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

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

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

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B1052

As fuel temperature increases, the effective resonance absorption peaks exhibited by U-238 will _______________ in height and will _______________ in width.

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.03 [2.6/2.7]
QID: B3153 (P3150)

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

A. Uranium-235

B. Uranium-238

C. Samarium-149

D. Xenon-135

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B652 (P1650)

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

A. Pu-239 and U-235

B. Pu-239 and Pu-240

C. U-238 and Pu-240

D. U-238 and Pu-239

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1553 (P1951)

A nuclear power plant is operating at 70% 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 void fraction

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1852

Which one of the following is a characteristic of Doppler broadening?

A. As reactor coolant temperature increases, less moderator molecules will be present in the core to thermalize neutrons.

B. As reactor fuel temperature increases, neutrons from a wider energy spectrum will be captured in the fuel.

C. As moderator void percentage increases, neutrons will travel farther in the core before being absorbed or scattered.

D. As control rods are withdrawn, additional reactor fuel will be exposed and result in a power increase.

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1952 (P650)

Which one of the following isotopes is the <u>most</u> significant contributor to resonance capture of fission neutrons in a nuclear reactor core at the beginning of core life?

A. U-238

B. U-233

C. Pu-240

D. Pu-239

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B3352 (P2050)

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

A. U-235

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B3753 (P3750)

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 nuclear reactor is currently operating at steady-state 80% power.

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

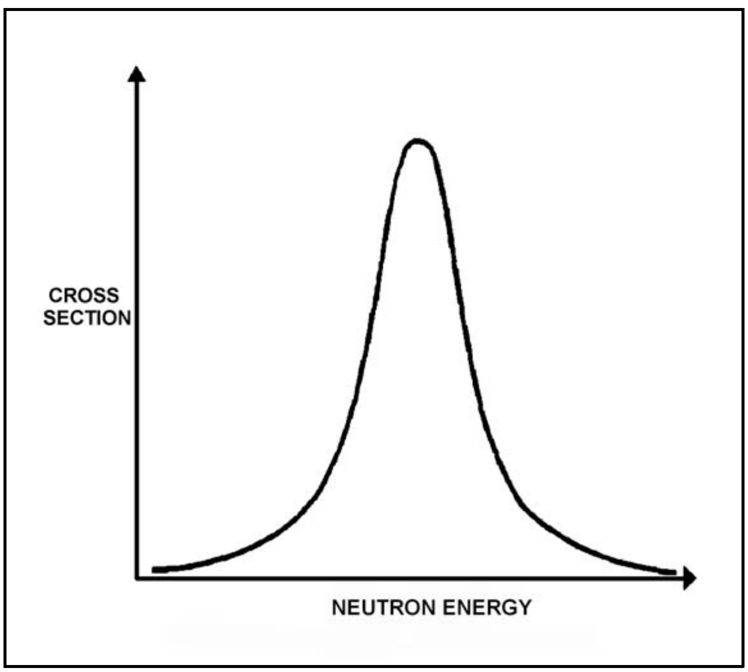
A. taller and more narrow; decrease

B. taller and more narrow; increase

C. shorter and broader; decrease

D. shorter and broader; increase

ANSWER: A.



TOPIC: 292004
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B3852 (P3850)

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

If reactor power is decreased to 60%, the height of the curve will _________ and the area under the curve will _________.

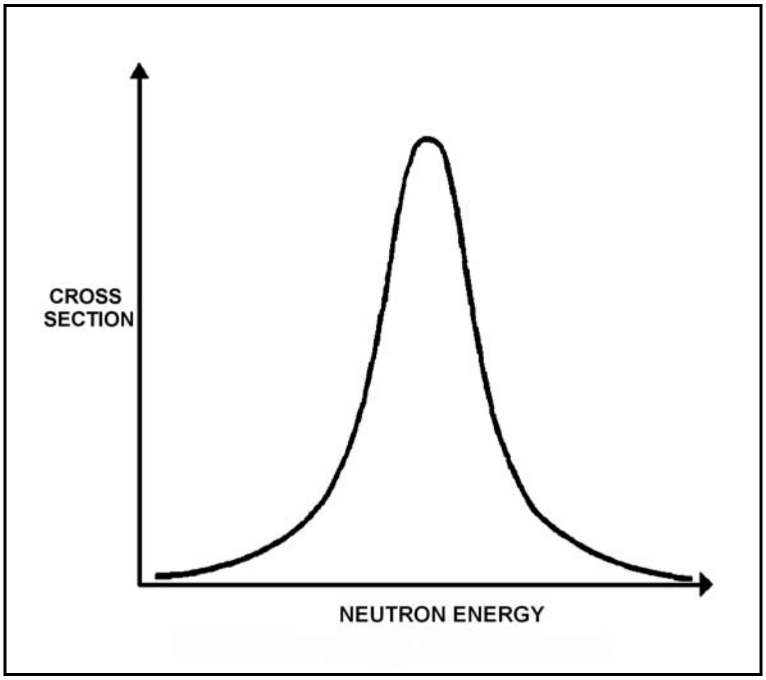
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.



TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B4826 (P4826)

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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B452 (P2251)

Which one of the following pairs of isotopes is responsible for the negative reactivity associated with a fuel temperature increase near the end of core life?

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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B552 (P2451)

Which one of the following describes how the magnitude of the Doppler coefficient of reactivity is affected over core life?

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

B. It becomes less negative due to the buildup of fission products.

C. It becomes more negative initially due to gadolinium burnout, then less negative due to fuel depletion.

D. It remains essentially constant.

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1353

Compared to beginning of core life, the Doppler coefficient of reactivity is _____________ negative at end of core life due to _____________. (Assume the same initial fuel temperature.)

A. less; depletion of U-238

B. more; burnout of gadolinium

C. less; buildup of fission products

D. more; buildup of Pu-240

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2053 (P2052)

Compared to operating at a low power level, the fuel temperature (Doppler) coefficient of reactivity at a high power level is ____________ negative due to ____________. (Assume the same core age.)

A. less; buildup of fission product poisons

B. more; improved pellet-to-clad heat transfer

C. less; higher fuel temperature

D. more; increased neutron flux

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2152 (P2151)

Which one of the following contains the nuclides responsible for most of the resonance capture of fission neutrons in a nuclear reactor core at the beginning of the sixth fuel cycle? (Assume that each refueling 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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2453 (P2352)

Refer to the drawing 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 ____________.

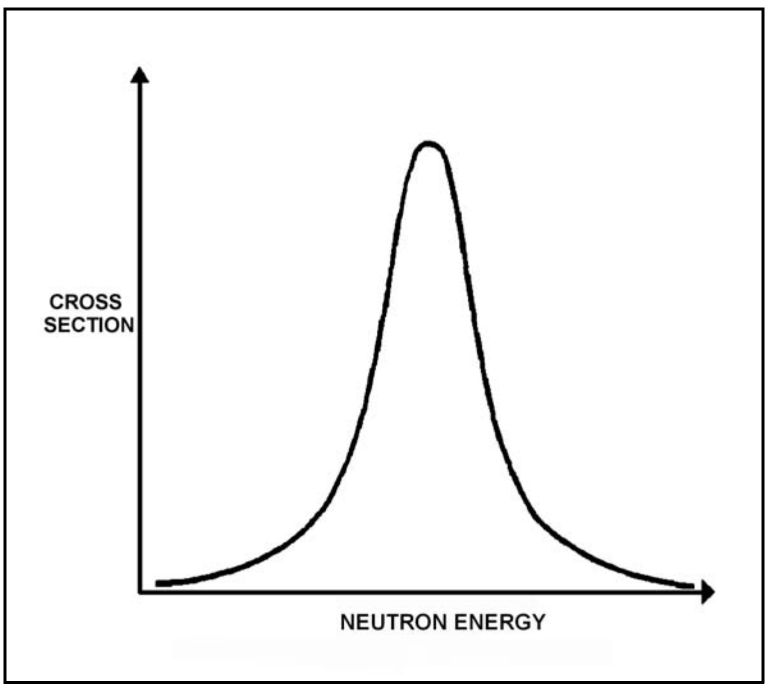
A. increase; neutrons of a wider range of energies will be absorbed by U-238

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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2553 (P2651)

The fuel temperature (Doppler) coefficient of reactivity 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 products are in the core

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

D. beginning; less fission products are in the core

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2753 (P2751)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (eV) resonance peak in U-238 for a nuclear reactor operating at 50% 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 ____________.

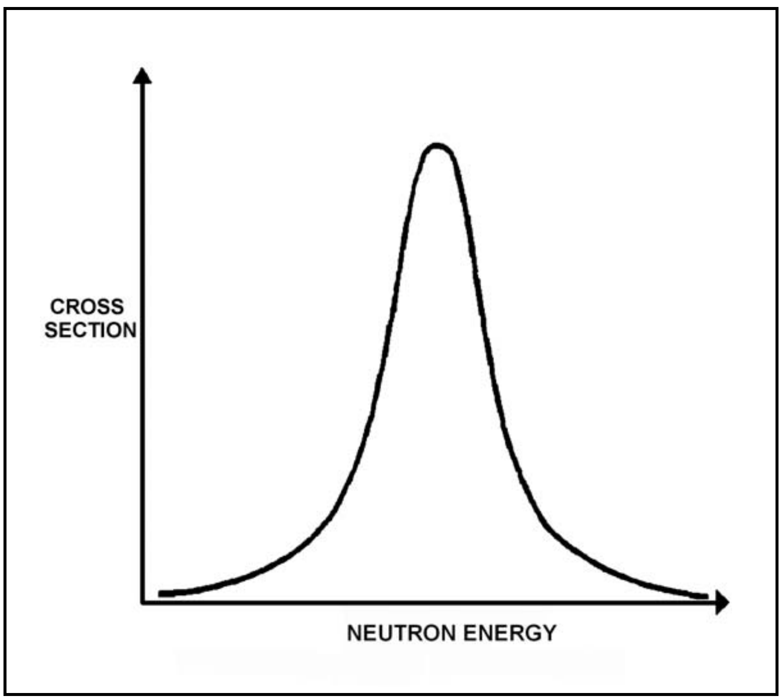
A. decrease; fewer neutrons will be absorbed by U-238 overall

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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2852 (P2850)

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

If reactor power is increased to 100%, the height of the curve will _________ and the area under the curve will _________.

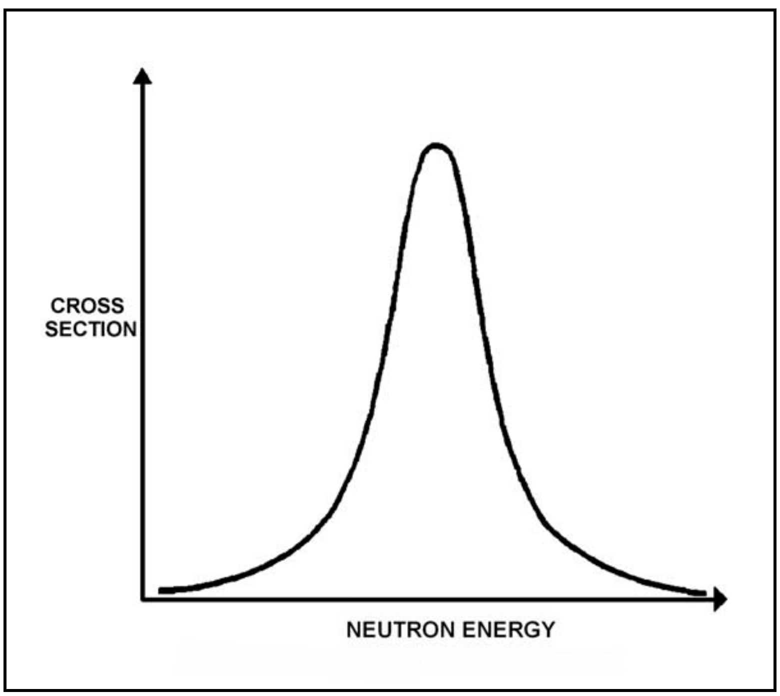
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: D



TOPIC: 292004
KNOWLEDGE: K1.10 [3.2/3.2]
QID: B125

Which one of the following will cause the void coefficient to become less negative? (Consider only the direct effects of the indicated changes.)

A. Core void fraction increases.

B. Fuel temperature decreases.

C. Gadolinium burns out.

D. Control rods are partially inserted.

ANSWER: B.

TOPIC: 292004
KNOWLEDGE: K1.10 [3.2/3.2]
QID: B354

Which one of the following is the primary reason the void coefficient becomes less negative with core burnup toward the end of core life?

A. The thermal neutron flux increases.

B. The thermal diffusion length decreases.

C. The fuel centerline temperature increases.

D. The control rod density decreases.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.10 [3.2/3.2]
QID: B2153

Which one of the following describes why most reactor power is produced in the lower half of a core (versus the upper half) that has been operating at 100% power for several weeks at the beginning of a fuel cycle?

A. Xenon concentration is higher in the upper half of the core.

B. The moderator-to-fuel ratio is higher in the upper half of the core.

C. The void coefficient is adding more negative reactivity in the upper half of the core.

D. Control rods are adding more negative reactivity in the upper half of the core.

ANSWER: C.

TOPIC: 292004
KNOWLEDGE: K1.11 [2.5/2.6]
QID: B953

Which one of the following describes how and why the void coefficient of reactivity changes as void fraction increases during a control rod withdrawal at power?

A. Becomes less negative due to the increased absorption of neutrons by U-238.

B. Becomes less negative due to a greater fraction of neutrons lost to leakage from the core.

C. Becomes more negative due to the reduction in the fast fission contribution to the neutron population.

D. Becomes more negative due to a greater fractional loss of moderator for a 1% void increase at higher void fractions.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.14 [3.3/3.3]
QID: B253

During a nuclear reactor startup with the reactor coolant at 520°F, excessive control rod withdrawal results in a 10 second reactor period with reactor power low in the intermediate range. Without any further operator action, which one of the following coefficients of reactivity will respond first to reduce the rate of the power increase?

A. Pressure

B. Void

C. Moderator

D. Doppler

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.14 [3.3/3.3]
QID: B272

For a normal reactor power increase from 20% to 100%, the smallest change in negative reactivity at steady-state conditions will be caused by...

A. void content.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.14 [3.3/3.3]
QID: B1653

Which one of the following lists the moderator temperature coefficient (MTC), fuel temperature coefficient (FTC), and void coefficient (VC) in typical order of magnitude from most negative to least negative for a nuclear reactor at 50% power in the middle of a fuel cycle?

A. FTC, VC, MTC

B. FTC, MTC, VC

C. VC, FTC, MTC

D. VC, MTC, FTC

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.14 [3.3/3.3]
QID: B2353

During a normal power decrease from 100% to 20%, the <u>smallest</u> positive reactivity addition will be caused by the change in...

A. void percentage.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

ANSWER: D.