TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B45

The term “neutron generation time” is defined as the average time between...

A. neutron absorption and the resulting fission.

B. the production of a delayed neutron and subsequent neutron thermalization.

C. neutron absorption producing a fission and absorption or leakage of resultant neutrons.

D. neutron thermalization and subsequent neutron absorption.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B174

Which one of the following is the definition of the term, prompt neutron?

A. A high-energy neutron emitted from a neutron precursor, immediately after the fission process.

B. A neutron with an energy level greater than 0.1 MeV, emitted in less than 1.0×10^{-4} seconds following a nuclear fission.

C. A neutron emitted in less than 1.0×10^{-14} seconds following a nuclear fission.

D. A neutron emitted as a result of a gamma-neutron or alpha-neutron reaction.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B245

Delayed neutrons are neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

B. are expelled within 1.0 x 10^{-14} seconds of the fission event.

C. are expelled with the lowest average kinetic energy of all fission neutrons.

D. are responsible for the majority of U-235 fissions.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B1146 (P1945)

Which one of the following types of neutrons has an average neutron generation lifetime of 12.5 seconds?

A. Prompt

B. Delayed

C. Fast

D. Thermal

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B1345 (P1445)

A neutron that is expelled 1.0 x 10^{-2} seconds after the associated fission event is a __________ neutron.

A. thermal

B. delayed

C. prompt

D. capture

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B1545 (P1145)

Which one of the following is a characteristic of a prompt neutron?

A. Expelled with an average kinetic energy of 0.5 MeV.

B. Usually emitted by the excited nucleus of a fission product.

C. Accounts for more than 99 percent of fission neutrons.

D. Released an average of 13 seconds after the fission event.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B1845 (P545)

Delayed neutrons are fission neutrons that...

A. are released at the instant of fission.

B. are responsible for the majority of U-235 fissions.

C. have reached thermal equilibrium with the surrounding medium.

D. are expelled at a lower average kinetic energy than most other fission neutrons.

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B1945 (P845)

Delayed neutrons are neutrons that...

A. are responsible for the majority of U-235 fissions.

B. are expelled within 1.0 x 10^{-14} seconds of the fission event.

C. have reached thermal equilibrium with the surrounding medium.

D. are produced from the radioactive decay of certain fission fragments.

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2046 (P2045)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the prompt neutron is more likely to... (Assume that both neutrons remain in the core.)

A. require a greater number of collisions to become a thermal neutron.

B. be captured by U-238 at a resonance energy peak between 1 eV and 1000 eV.

C. be expelled with a lower kinetic energy.

D. cause thermal fission of a U-235 nucleus.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2145 (P2145)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the prompt neutron is more likely to... (Assume that both neutrons remain in the core.)

A. cause fast fission of a U-238 nucleus.

B. be captured by a U-238 nucleus at a resonance energy between 1 eV and 1000 eV.

C. be captured by a Xe-135 nucleus.

D. cause thermal fission of a U-235 nucleus.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2245 (P5023)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the delayed neutron is more likely to... (Assume that each neutron remains in the core unless otherwise stated.)

A. cause fission of a U-238 nucleus.

B. travel to an adjacent fuel assembly.

C. be absorbed in a B-10 nucleus.

D. leak out of the core.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2345 (P2345)

A neutron that is released 1.0 x 10^{-10} seconds after the associated fission event is classified as a __________ fission neutron.

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2545 (P2545)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the prompt neutron is more likely to...

A. be captured by a Xe-135 nucleus.

B. cause thermal fission of a U-235 nucleus.

C. leak out of the core while slowing down.

D. be captured by a U-238 nucleus at a resonance energy.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2645 (P2645)

In a comparison between a delayed neutron and a prompt neutron produced from the same fission event, the delayed neutron is more likely to...

A. leak out of the core.

B. cause fission of a U-238 nucleus.

C. become a thermal neutron.

D. cause fission of a Pu-240 nucleus.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B2945 (P2945)

Which one of the following types of neutrons in a reactor is more likely to cause fission of a U-238 nucleus in the reactor fuel? (Assume that each type of neutron remains in the reactor until it interacts with a U-238 nucleus.)

A. A thermal neutron.

B. A prompt fission neutron beginning to slow down.

C. A delayed fission neutron beginning to slow down.

D. A fission neutron at a U-238 resonance energy.

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B3145 (P2845)

During a brief time interval in a typical reactor operating steady-state near the beginning of a fuel cycle, 1.0×10^3 delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted during this same time interval?

A. 1.5×10^5

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^8

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B3345 (P2445)

In a comparison between a prompt neutron and a delayed neutron produced from the same fission event, the delayed neutron requires __________ collisions in the moderator to become thermal; and is __________ likely to cause fission of a U-238 nucleus. (Assume that both neutrons remain in the core.)

A. more; more

B. more; less

C. fewer; more

D. fewer; less

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B3545 (P3545)

During a brief time interval in a typical reactor operating steady-state at the beginning of a fuel cycle, 1.0×10^5 delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted in the reactor during this same time interval?

A. 1.5×10^5

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^8

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B4123 (P4123)

A neutron that appears 1.0 x 10^{-16} seconds after the associated fission event is classified as a __________ fission neutron.

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B4923 (P4923)

During a brief time interval in a typical reactor operating steady-state near the beginning of a fuel cycle, 4.25 x 10^5 delayed neutrons were produced.

Approximately how many prompt neutrons were produced in the reactor during this same time interval?

A. 1.5 x 10^6

B. 6.5 x 10^6

C. 1.5 x 10^7

D. 6.5 x 10^7

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B7123 (P7123)

Which one of the following is the process that produces the majority of delayed neutrons in an operating nuclear power plant reactor?

A. A thermal neutron is absorbed by a fuel nucleus. After a period of time, the nucleus fissions and releases a delayed neutron.

B. A thermal neutron is absorbed by a fuel nucleus. The fuel nucleus fissions. During the decay process of the fission products, a delayed neutron is emitted.

C. A fast neutron is absorbed by a fuel nucleus. After a period of time, the nucleus fissions and releases a delayed neutron.

D. A fast neutron is absorbed by a fuel nucleus. The fuel nucleus fissions. During the decay process of the fission products, a delayed neutron is emitted.

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B7523 (P7523)

During a brief time interval in a typical reactor operating steady-state near the beginning of a fuel cycle, 4.25×10^{10} prompt neutrons were produced.

Approximately how many delayed neutrons were produced in the reactor during this same time interval?

A. 2.8×10^{8}

B. 6.5×10^{8}

C. 2.8×10^{9}

D. 6.5×10^{9}

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B7677 (P7677)

Which one of the following is the process that produces the majority of prompt neutrons in an operating nuclear power plant reactor?

A. A thermal neutron is absorbed by a fuel nucleus. Almost immediately, the nucleus fissions and emits one or more prompt neutrons.

B. A thermal neutron is absorbed by a fuel nucleus. Almost immediately, the fuel nucleus fissions and produces fission products. During the decay of the fission products, one or more prompt neutrons are emitted.

C. A fast neutron is absorbed by a fuel nucleus. Almost immediately, the nucleus fissions and emits one or more prompt neutrons.

D. A fast neutron is absorbed by a fuel nucleus. Almost immediately, the fuel nucleus fissions and produces fission products. During the decay of the fission products, one or more prompt neutrons are emitted.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B345

A neutron that possesses the same kinetic energy as its surroundings is called a/an __________ neutron.

A. slow

B. intermediate

C. resonance

D. thermal

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B545

A neutron is ‘thermal’ when...

A. its kinetic energy is in the 1 eV to 1,000 eV energy range.

B. it is in energy equilibrium with the moderating medium.

C. it is released from the fission of a U-235 atom.

D. its cross-section for absorption in the fuel undergoes a sudden decrease.

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B645

The kinetic energy of thermal neutrons in a reactor operating at full power is...

A. less than 0.1 eV.

B. between 1 and 10 eV.

C. between 100 and 1,000 eV.

D. greater than 1 MeV.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B846

Which one of the following describes the energy level of a thermal neutron in a reactor operating at full power?

A. The kinetic energy of the neutron has decreased until it is in equilibrium with its surroundings.

B. The potential energy of the neutron has decreased to nearly zero as the neutron approaches equilibrium with its surroundings.

C. The kinetic energy of the neutron has decreased sufficiently to allow the neutron to be resonantly absorbed by U-238.

D. The potential energy of the neutron has decreased to a level that will allow the neutron to be absorbed by U-235.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B945

Regarding a thermal neutron, the word "thermal" indicates that the neutron...

A. was expelled greater than 10^{-14} seconds after the fission event.

B. is a product of a thermal fission reaction.

C. was released by the decay of fission fragments.

D. is at the same energy level as the surrounding atoms.

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.03 [2.7/2.7]
QID: B2446

A thermal neutron exists at an energy __________ the epithermal range; and its cross section for absorption in U-235 __________ as the neutron energy decreases.

A. above; decreases

B. above; increases

C. below; decreases

D. below; increases

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B246

A fission neutron will typically lose the most energy when it interacts with a/an...

A. hydrogen atom in a water molecule.

B. oxygen atom in a water molecule.

C. helium atom in the fuel pin fill gas.

D. zirconium atom in the fuel clad.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B445

Which one of the following conditions will increase the amount of neutron moderation in a reactor operating at 50 percent power?

A. Increasing moderator temperature

B. Reducing feedwater inlet temperature

C. Reducing reactor vessel pressure

D. Reducing reactor recirculation system flow rate

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B446

Neutron moderation refers to a decrease in neutron__________; primarily due to __________.

A. population; neutron absorption by the control rods

B. population; neutron leakage at the core boundary

C. energy; scattering reactions in the fuel pellets

D. energy; scattering reactions in the reactor coolant

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B745

During moderation of a fission neutron, the neutron is <u>most</u> susceptible to resonance absorption when it is a/an __________ neutron.

A. slow

B. fast

C. epithermal

D. thermal

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B1646

Which one of the following will decrease the ability of the coolant to moderate neutrons in a reactor operating at saturated conditions?

A. Decreasing coolant temperature.

B. Decreasing feedwater inlet temperature.

C. Decreasing reactor vessel pressure.

D. Increasing reactor recirculation system flow rate.

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B2746

A fast neutron will lose the greatest amount of energy during a scattering reaction in the moderator if it interacts with...

A. an oxygen nucleus.

B. a hydrogen nucleus.

C. a deuterium nucleus.

D. an electron orbiting a nucleus.

ANSWER: B.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B6623

Which one of the following accounts for the majority of energy transfer from a fission neutron while slowing down in a moderator?

A. Collisions with the nuclei in the moderator.

B. Collisions with the electrons in the moderator.

C. Interactions with the electric fields of the nuclei in the moderator.

D. Interactions with the electric fields of the electrons in the moderator.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B7767 (P7767)

Which one of the following nuclei will cause the greater loss of kinetic energy from a 2.1 MeV fission neutron during a head-on collision? (Assume that each nucleus is stationary just prior to the collision and the neutron is elastically scattered in all cases.)

A. A helium-4 nucleus in the fuel rod fill gas.

B. An oxygen-16 nucleus in the reactor coolant.

C. A zirconium-90 nucleus in the fuel cladding.

D. A uranium-235 nucleus in a fuel pellet.

ANSWER: A.

TOPIC: 292001
KNOWLEDGE: K1.05 [2.4/2.6]
QID: B346

The best neutron moderator is __________ and is composed of __________ atoms.

A. dense; large

B. not dense; large

C. dense; small

D. not dense; small

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.05 [2.4/2.6]
QID: B1046

The ideal moderator has a __________ macroscopic absorption cross section for thermal neutrons and a __________ average logarithmic energy decrement.

A. large; small

B. large; large

C. small; small

D. small; large

ANSWER: D.

TOPIC: 292001
KNOWLEDGE: K1.05 [2.4/2.6]
QID: B5323

The ideal neutron moderator has a __________ microscopic scattering cross section for thermal neutrons and a __________ density.

A. small; low

B. small; high

C. large; low

D. large; high

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.01 [1.9/1.9]
QID: B7737 (P7737)

Before a fission neutron could migrate out of a fuel pellet, the neutron was absorbed by the nucleus of a uranium atom. The absorption occurred at a neutron energy of 2.1 MeV. If the neutron was absorbed by a U-235 nucleus, the most likely outcome would be __________; if the neutron was absorbed by a U-238 nucleus, the most likely outcome would be __________.

A. fission; fission

B. fission; capture

C. capture; fission

D. capture; capture

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.07 [3.5/3.5]
K1.08 [2.7/2.8]
QID: B186 (P44)

Initially, a reactor is subcritical with the effective multiplication factor (K_{eff}) equal to 0.998. After a brief withdrawal of control rods, K_{eff} equals 1.002. The reactor is currently...

A. prompt critical.

B. supercritical.

C. exactly critical.

D. subcritical.

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.07 [3.5/3.5]
QID: B247 (P445)

Which one of the following conditions describes a reactor that is exactly critical?

A. $K_{eff} = 0; \Delta K/K = 0$

B. $K_{eff} = 0; \Delta K/K = 1$

C. $K_{eff} = 1; \Delta K/K = 0$

D. $K_{eff} = 1; \Delta K/K = 1$

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B46

Which one of the following does not affect K_{eff}?

A. Core dimensions.

B. Core burnup.

C. Moderator-to-fuel ratio.

D. Installed neutron sources.

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B348

Which one of the following, if decreased, will <u>not</u> affect K_{eff}?

A. Fuel enrichment.

B. Control rod worth.

C. Neutron contribution from neutron sources.

D. Shutdown margin when the reactor is subcritical.

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B847 (P1846)

The effective multiplication factor (K_{eff}) describes the ratio of the number of fission neutrons at the end of one generation to the number of fission neutrons at the __________ of the __________ generation.

A. beginning; next

B. beginning; previous

C. end; next

D. end; previous

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B1447 (P1346)

The effective multiplication factor (K_{eff}) can be determined by dividing the number of neutrons in the third generation by the number of neutrons in the __________ generation.

A. first

B. second

C. third

D. fourth

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B2647 (P2647)

A thermal neutron is about to interact with a U-238 nucleus in an operating reactor. Which one of the following describes the most likely interaction and its effect on K_{eff}?

A. The neutron will be scattered, thereby leaving K_{eff} unchanged.

B. The neutron will be absorbed and the nucleus will fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and the nucleus will fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and the nucleus will decay to Pu-239, thereby increasing K_{eff}.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3147 (P3046)

A nuclear power plant is currently operating at steady-state 80 percent power near the end of its fuel cycle. During the next 3 days of steady-state power operation, no operator action is taken.

How will K_{eff} be affected during the 3-day period?

A. K_{eff} will gradually increase during the entire period.

B. K_{eff} will gradually decrease during the entire period.

C. K_{eff} will tend to increase, but inherent reactivity feedback will maintain K_{eff} at 1.0.

D. K_{eff} will tend to decrease, but inherent reactivity feedback will maintain K_{eff} at 1.0.

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B6424 (P6424)

A 1.5 MeV neutron is about to interact with a U-238 nucleus in an operating reactor. Which one of the following describes the most likely interaction and its effect on K_{eff}?

A. The neutron will be scattered, thereby leaving K_{eff} unchanged.

B. The neutron will be absorbed and the nucleus will fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and the nucleus will fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and the nucleus will decay to Pu-239, thereby increasing K_{eff}.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B1147

Which one of the following combinations of core conditions at 30 percent power indicates the largest amount of excess reactivity exists in the core?

	Control Rod Position	Reactor Recirculation Flow
A.	25% rod density	25%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	25%

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B1247

Which one of the following combinations of core conditions at 35 percent power indicates the least amount of excess reactivity exists in the core?

	Control Rod Position	Reactor Recirculation Flow
A.	50% inserted	50%
B.	50% inserted	25%
C.	25% inserted	50%
D.	25% inserted	25%

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B1848 (P646)

Which one of the following defines K-excess?

A. K_{eff} - 1

B. K_{eff} + 1

C. (K_{eff} - 1)/K_{eff}

D. (1-K_{eff})/K_{eff}

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B2048 (P1246)

Which one of the following is a reason for installing excess reactivity (K_{excess}) in a reactor?

A. To compensate for the conversion of U-238 to Pu-239 during a fuel cycle.

B. To compensate for burnout of Xe-135 and Sm-149 during a power increase.

C. To ensure the fuel temperature coefficient remains negative during a fuel cycle.

D. To compensate for the negative reactivity added by the power coefficient during a power increase.

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B2747 (P2847)

A reactor is operating at full power at the beginning of a fuel cycle. A neutron has just been absorbed by a U-238 nucleus at a resonance energy of 6.7 electron volts.

Which one of the following describes the most likely reaction for the newly formed U-239 nucleus and the effect of this reaction on K_{excess}?

A. Decays over several days to Pu-239, which increases K_{excess}.

B. Decays over several days to Pu-240, which increases K_{excess}.

C. Immediately undergoes fast fission, which decreases K_{excess}.

D. Immediately undergoes thermal fission, which decreases K_{excess}.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B2947

The following are combinations of critical conditions that may exist for the same reactor operating at 50 percent power at different times in core life. Which one of the following combinations indicates the <u>largest</u> amount of excess reactivity present in the reactor fuel?

	Control Rod Position	Reactor Recirculation Flow
A.	25% rod density	75%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	75%

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B3447

The following are combinations of critical conditions that existed for the same reactor operating at 50 percent power at different times in core life. Which one of the following combinations indicates the <u>smallest</u> amount of excess reactivity present in the reactor fuel?

	Control Rod Position	Reactor Recirculation Flow
A.	25% rod density	75%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	75%

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B3547 (P3547)

Which one of the following is a benefit of installing excess reactivity (K_{excess}) in a reactor?

A. Ensures that sufficient control rod negative reactivity is available to shut down the reactor.

B. Ensures that the reactor can be made critical during a peak xenon condition after a reactor scram.

C. Ensures that positive reactivity additions result in controllable reactor power responses.

D. Ensures that the U-235 fuel enrichment is the same at the beginning and the end of a fuel cycle.

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.10 [3.2/3.5]
QID: B248 (P245)

The shutdown margin determination for an operating reactor assumes the complete withdrawal of…

A. a single control rod of high reactivity worth.

B. a symmetrical pair of control rods of high reactivity worth.

C. a single control rod of average reactivity worth.

D. a symmetrical pair of control rods of average reactivity worth.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.10 [3.2/3.5]
QID: B1348

The shutdown margin for an operating reactor is the amount of reactivity by which a xenon-free reactor at 68°F would be subcritical if all control rods were fully...

A. withdrawn, except for an average worth control rod which remains fully inserted.

B. inserted, except for an average worth control rod which remains fully withdrawn.

C. withdrawn, except for the highest worth control rod which remains fully inserted.

D. inserted, except for the highest worth control rod which remains fully withdrawn.

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.11 [3.2/3.3]
QID: B47

The fractional change in neutron population from one generation to the next is called...

A. beta.

B. lambda.

C. reactivity.

D. K-effective.

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B648 (P1946)

In a subcritical reactor, K_{eff} was increased from 0.85 to 0.95 by rod withdrawal. Which one of the following is the approximate amount of reactivity that was added to the core?

A. 0.099 $\Delta K/K$

B. 0.124 $\Delta K/K$

C. 0.176 $\Delta K/K$

D. 0.229 $\Delta K/K$

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B748 (P3347)

With K_{eff} equal to 0.983, how much positive reactivity must be added to make the reactor critical? (Round answer to the nearest 0.01 %ΔK/K.)

A. 1.70 %ΔK/K

B. 1.73 %ΔK/K

C. 3.40 %ΔK/K

D. 3.43 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B1548 (P446)

With K_{eff} equal to 0.987, how much reactivity must be added to make the reactor critical? (Round answer to the nearest 0.01 %ΔK/K.)

A. 1.01 %ΔK/K

B. 1.03 %ΔK/K

C. 1.30 %ΔK/K

D. 1.32 %ΔK/K

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B1947 (P2447)

With K_{eff} equal to 0.985, how much positive reactivity is required to make the reactor critical? (Round answer to the nearest 0.01 %ΔK/K.)

A. 1.49 %ΔK/K

B. 1.50 %ΔK/K

C. 1.52 %ΔK/K

D. 1.55 %ΔK/K

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B2848 (P2146)

With K_{eff} equal to 0.982, how much positive reactivity is required to make the reactor critical? (Round answer to the nearest 0.01 %ΔK/K.)

A. 1.72 %ΔK/K

B. 1.77 %ΔK/K

C. 1.80 %ΔK/K

D. 1.83 %ΔK/K

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B7647 (P7647)

Initially, a reactor was shutdown at a stable power level of 2.0×10^{-5} percent. After a small positive reactivity addition, the current stable power level is 3.0×10^{-5} percent. If the initial K_{eff} was 0.982, what is the current K_{eff}?

A. 0.988

B. 0.992

C. 0.996

D. Cannot be determined without additional information.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B548

The shutdown margin (SDM) upon full insertion of all control rods following a reactor scram from full power is __________ the SDM immediately prior to the scram.

A. equal to

B. less than

C. greater than

D. independent of

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B948

Which one of the following core changes will <u>decrease</u> shutdown margin?

A. Fuel depletion during reactor operation.

B. Buildup of Sm-149 after a reactor scram.

C. Increasing moderator temperature 10°F while shutdown.

D. Depletion of gadolinium during reactor operation.

ANSWER: D.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B1048

One hour ago, a reactor scrammed from steady-state 100 percent power due to an instrument malfunction. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 1.0 %ΔK/K
Fuel temperature	=	( ) 2.0 %ΔK/K
Control rods	=	( ) 14.0 %ΔK/K
Voids	=	( ) 3.0 %ΔK/K

A. -8.0 %ΔK/K

B. -10.0 %ΔK/K

C. -14.0 %ΔK/K

D. -20.0 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B1248

Which one of the following will increase the shutdown margin for a subcritical reactor operating at 250°F in the middle of a fuel cycle?

A. Decay of Xenon-135

B. Increased core recirculation flow rate

C. Reactor coolant heatup

D. Control rod withdrawal

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B1648

A reactor scrammed from steady-state 100 percent power due to an instrument malfunction 16 hours ago. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 1.5 %ΔK/K
Fuel temperature	=	( ) 2.5 %ΔK/K
Control rods	=	( ) 14.0 %ΔK/K
Voids	=	( ) 3.5 %ΔK/K

A. -6.5 %ΔK/K

B. -9.5 %ΔK/K

C. -11.5 %ΔK/K

D. -13.5 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B1748

Approximately 12 hours ago, a reactor scrammed from steady-state 100 percent power due to an instrument malfunction. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 2.0 %ΔK/K
Fuel temperature	=	( ) 2.5 %ΔK/K
Control rods	=	( ) 14.0 %ΔK/K
Voids	=	( ) 4.5 %ΔK/K

A. -5.0 %ΔK/K

B. -9.0 %ΔK/K

C. -14.0 %ΔK/K

D. -23.0 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B2148

A reactor scram from 100 percent steady-state power occurred 36 hours ago due to an instrument malfunction. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 1.0 %ΔK/K
Fuel temperature	=	( ) 2.0 %ΔK/K
Control rods	=	( ) 14.0 %ΔK/K
Voids	=	( ) 3.0 %ΔK/K

A. -8.0 %ΔK/K

B. -10.0 %ΔK/K

C. -14.0 %ΔK/K

D. -20.0 %ΔK/K

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B2248

Sixteen hours ago, a reactor scrammed from 100 percent steady-state power due to an instrument malfunction. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 2.0 %ΔK/K
Fuel temperature	=	( ) 3.0 %ΔK/K
Control rods	=	( ) 12.0 %ΔK/K
Voids	=	( ) 4.0 %ΔK/K

A. -5.0 %ΔK/K

B. -7.0 %ΔK/K

C. -9.0 %ΔK/K

D. -11.0 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B2348 (P2347)

Which one of the following changes will <u>decrease</u> the available shutdown margin in a reactor? (Assume <u>no</u> operator actions.)

A. Depletion of fuel during reactor operation.

B. Depletion of burnable poisons during reactor operation.

C. Buildup of samarium-149 following a reactor power transient.

D. Buildup of Xenon-135 following a reactor power transient.

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B2448

A reactor scrammed from 100 percent steady-state power due to an instrument malfunction 30 hours ago. All systems operated normally.

Given the following absolute values of reactivities added since the scram, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Xenon	=	( ) 1.5 %ΔK/K
Fuel temperature	=	( ) 2.5 %ΔK/K
Control rods	=	( ) 14.0 %ΔK/K
Voids	=	( ) 3.5 %ΔK/K

A. -6.5 %ΔK/K

B. -9.5 %ΔK/K

C. -11.5 %ΔK/K

D. -13.5 %ΔK/K

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B3648 (P3647)

A reactor is initially operating at steady-state 60 percent power near the end of a fuel cycle when a fully withdrawn control rod suddenly inserts completely into the core. No operator action is taken and the plant control systems stabilize the reactor at a power level in the power range.

Compared to the initial shutdown margin (SDM), the current SDM is __________; and compared to the initial core K_{eff}, the current core K_{eff} is __________.

A. the same; smaller

B. the same; the same

C. less negative; smaller

D. less negative; the same

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B3748 (P3747)

A nuclear power plant has just completed a refueling outage. Based on the expected core loading, reactor engineers have predicted a control rod configuration at which the reactor will become critical during the initial reactor startup following the refueling outage. However, the burnable poisons scheduled to be loaded were inadvertently omitted.

Which one of the following describes the effect of the burnable poison omission on achieving reactor criticality during the initial reactor startup following the refueling outage?

A. The reactor will become critical before the predicted critical control rod configuration is achieved.

B. The reactor will become critical after the predicted critical control rod configuration is achieved.

C. The reactor will be unable to achieve criticality because the fuel assemblies contain insufficient positive reactivity to make the reactor critical.

D. The reactor will be unable to achieve criticality because the control rods contain insufficient positive reactivity to make the reactor critical.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B4924

Reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle (BOC) and reactor B is operating near the end of a fuel cycle (EOC). Both reactors are operating at 100 percent power.

Which reactor would have the smaller K_{eff} five minutes after a reactor scram?

A. Reactor A, because the control rods will add more negative reactivity near the BOC.

B. Reactor A, because the power coefficient is more negative near the BOC.

C. Reactor B, because the control rods will add more negative reactivity near the EOC.

D. Reactor B, because the power coefficient is more negative near the EOC.

ANSWER: C.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B5224

A reactor was initially operating at steady-state 100 percent power near the middle of a fuel cycle when it was shut down and then cooled down to 200°F over a three-day period.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (–) as appropriate and choose the current value of core reactivity.

Control rods	= ( ) 12.50 %ΔK/K
Voids	= ( ) 3.50 %ΔK/K
Xenon	= ( ) 2.50 %ΔK/K
Fuel temperature	= ( ) 2.00 %ΔK/K
Moderator temperature	= ( ) 0.50 %ΔK/K

A. -3.0 %ΔK/K

B. -4.0 %ΔK/K

C. -8.0 %ΔK/K

D. -9.0 %ΔK/K

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B6224

Reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle (BOC) and reactor B is operating near the end of a fuel cycle (EOC). Both reactors are operating at 100 percent power.

Which reactor will have the greater core K_{eff} five minutes after a reactor scram?

A. Reactor A, because complete control rod insertion will add less negative reactivity near the BOC.

B. Reactor A, because the power coefficient is less negative near the BOC.

C. Reactor B, because complete control rod insertion will add less negative reactivity near the EOC.

D. Reactor B, because the power coefficient is less negative near the EOC.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B7224

A nuclear power plant was initially operating at equilibrium 100 percent power just prior to a refueling outage. The plant was shut down, refueled, restarted, and is currently operating at equilibrium 100 percent power. Assume the 100 percent power fission rate did <u>not</u> change.

Which one of the following describes the current plant status as compared to the plant status just prior to the refueling?

A. The core thermal neutron flux is greater.

B. The available shutdown margin is smaller.

C. The control rods are withdrawn farther from the core.

D. The equilibrium core Xe-135 concentration is smaller.

ANSWER: B.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B7787

A reactor is currently operating at steady-state 100 percent power near the beginning of a fuel cycle (BOC). When the <u>same</u> reactor is operating at steady-state 100 percent power near the end of a fuel cycle (EOC), how will the BOC and EOC shutdown margins compare?

A. The EOC shutdown margin will be more negative because the control rods will add more negative reactivity during a reactor scram near the EOC.

B. The EOC shutdown margin will be less negative because the control rods will add less negative reactivity during a reactor scram near the EOC.

C. The EOC shutdown margin will be more negative because xenon-135 will add more negative reactivity immediately after a reactor scram near the EOC.

D. The EOC shutdown margin will be less negative because xenon-135 will add less negative reactivity immediately after a reactor scram near the EOC.

ANSWER: A.

TOPIC: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B7817

Reactors A and B are identical except that reactor A is operating near the end of a fuel cycle (EOC) and reactor B is operating near the beginning of a fuel cycle (BOC). Both reactors are currently operating at steady-state 100 percent power. The total reactivity worth of the control rods is the same for both reactors.

Which reactor will have the greater K_{eff} value 5 minutes after a reactor scram, and why?

A. Reactor A, because the full insertion of all control rods will add less negative reactivity near the EOC.

B. Reactor A, because the xenon-135 negativity reactivity peak is greater after a scram near the EOC.

C. Reactor B, because the full insertion of all control rods will add less negative reactivity near the BOC.

D. Reactor B, because the xenon-135 negativity reactivity peak is greater after a scram near the BOC.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B124

A reactor startup is in progress. Which one of the following statements describes the reactor response to control rod withdrawal when taking the reactor critical?

A. The nuclear instrumentation will take longer to stabilize at each new subcritical power level.

B. The reactor will be critical when the period and power level remain constant, with no further rod withdrawal.

C. Each complete control rod withdrawal will result in the same amount of change in subcritical power level.

D. Each control rod withdrawal results in an initial negative period followed by a strong positive period.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B130

Which one of the following statements describes subcritical multiplication during a reactor startup?

A. Subcritical multiplication is the process of using source neutrons to maintain an equilibrium neutron population when K_{eff} is less than 1.

B. As K_{eff} approaches unity, a smaller change in neutron level occurs for a given change in K_{eff}.

C. The equilibrium subcritical neutron level is dependent on the source strength and the time between successive reactivity insertions.

D. As K_{eff} approaches unity, less time is required to reach the equilibrium neutron level for a given change in K_{eff}.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B176

A reactor is being taken critical by periodically withdrawing control rods in equal reactivity increments. The initial K_{eff} was 0.85. Which one of the following statements describes reactor conditions as K_{eff} approaches unity?

A. The neutron level change for successive incremental rod withdrawal becomes smaller.

B. A longer period of time is required to reach an equilibrium neutron level after each rod withdrawal.

C. Each rod withdrawal will result in the reactor becoming slightly supercritical due to a "prompt jump" and then returning to a subcritical condition.

D. If the rod withdrawal is stopped for several hours, the neutron level will decrease to the neutron source level.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B349

Of the following conditions, which group is necessary for subcritical multiplication to occur?

A. Neutron source, moderator, and fissionable material

B. Moderator, fission product decay, and K_{eff} less than one

C. K_{eff} less than one, gamma source, and fissionable material

D. Fissionable material, gamma source, and K_{eff} greater than one

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B350 (P347)

Which one of the following is a characteristic of subcritical multiplication?

A. The subcritical neutron level is directly proportional to the neutron source strength.

B. Doubling the indicated count rate by reactivity additions will reduce the margin to criticality by approximately one quarter.

C. For equal reactivity additions, it takes less time for the new equilibrium source range count rate to be reached as K_{eff} approaches unity.

D. An incremental withdrawal of any given control rod will produce an equivalent equilibrium count rate increase, whether K_{eff} is 0.88 or 0.92.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B449

A reactor startup is being performed with xenon-free conditions. Rod withdrawal is stopped just prior to criticality and neutron count rate is allowed to stabilize. No additional operator actions are taken.

During the next 30 minutes, count rate will...

A. remain essentially constant.

B. decrease and stabilize, due to long-lived delayed neutron precursors.

C. decrease to its prestartup level, due to the buildup of xenon-135.

D. increase to criticality, due to long-lived delayed neutron precursors.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B967 (P3149)

Which one of the following describes the purpose of a neutron source that is installed in a reactor during refueling for the third fuel cycle?

A. Ensures shutdown neutron level is large enough to be detected by nuclear instrumentation.

B. Provides additional excess reactivity to increase the length of the fuel cycle.

C. Amplifies the electrical noise fluctuations observed in source range instrumentation during shutdown.

D. Supplies the only shutdown source of neutrons available to begin a reactor startup.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1170 (P1848)

A nuclear power plant has been operating at 100 percent power for 2 months when a reactor scram occurs. Two weeks after the reactor scram, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source range nuclear instruments.

The majority of the source range count rate is being caused by the interaction of __________ with the detector.

A. intrinsic source neutrons

B. fission gammas from previous power operation

C. fission neutrons from subcritical multiplication

D. delayed fission neutrons from previous power operation

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1549 (P1549)

Which one of the following neutron sources undergoes the most significant source strength reduction during the hour immediately following a reactor scram from steady-state 100 percent power?

A. Spontaneous fission reactions

B. Photo-neutron reactions

C. Alpha-neutron reactions

D. Transuranic isotope decay

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2150 (P2149)

Which one of the following is the neutron source that produces the greatest neutron flux for the first few days following a reactor scram from extended high power operations?

A. Spontaneous neutron emission from the control rods.

B. Photo-neutron reactions in the moderator.

C. Spontaneous fission in the fuel.

D. Alpha-neutron reactions in the fuel.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B7687 (P7687)

The total neutron flux in a shutdown reactor is constant at 5.0 x 10^3 n/cm^2-sec. If non-fission neutron sources are supplying a constant flux of 1.0 x 10^2 n/cm^2-sec, what is K_{eff}?

A. 0.98

B. 0.96

C. 0.94

D. Cannot be determined without additional information.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B48

Which one of the following defines the delayed neutron fraction?

A. The fraction of the total number of delayed neutrons produced from fission that are emitted from delayed neutron precursors.

B. The fraction of the total number of fast neutrons produced from fission that are emitted from delayed neutron precursors.

C. The fraction of the total number of neutrons produced from fission that are emitted from delayed neutron precursors.

D. The fraction of the total number of thermal neutrons produced from fission that are emitted from delayed neutron precursors.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B351

Which one of the following describes how and why the core effective delayed neutron fraction varies over core life?

A. Increases, due to the burnup of U-238.

B. Decreases, due to the buildup of Pu-239.

C. Increases, due to the buildup of Pu-239.

D. Decreases, due to the burnup of U-238.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B371

Which one of the following lists the two isotopes that produce the most power in a reactor operating at 100 percent power near the end of a fuel cycle?

A. U-235 and U-238

B. Pu-241 and U-238

C. Pu-239 and U-238

D. Pu-239 and U-235

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B850

The effective delayed neutron fraction ($\bar{\beta}_{eff}$) can be defined in fractional form as...

A. $\dfrac{\text{number of neutrons born delayed}}{\text{total number of neutrons born from fission}}$

B. $\dfrac{\text{number of neutrons born delayed}}{\text{number of neutrons born prompt}}$

C. $\dfrac{\text{number of fissions caused by delayed neutrons}}{\text{total number of fissions caused by fission neutrons}}$

D. $\dfrac{\text{number of fissions caused by delayed neutrons}}{\text{number of fissions caused by prompt neutrons}}$

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1050

Compared to the core effective delayed neutron fraction (β_{eff}), the core delayed neutron fraction (β)...

A. changes due to fuel depletion, whereas β_{eff} will remain constant over core life.

B. is based on a finite-sized reactor, whereas β_{eff} is based on an infinite-sized reactor.

C. describes the fraction of fission neutrons born delayed, whereas β_{eff} describes the fraction of fissions caused by delayed neutrons.

D. considers only the decay constant of the longest lived delayed neutron precursors, whereas β_{eff} considers the weighted average of all the decay constants.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1172 (P2272)

A reactor is operating at 100 percent power near the end of a fuel cycle. The greatest contribution to core heat production is being provided by the fission of...

A. U-235 and U-238.

B. U-238 and Pu-239.

C. U-235 and Pu-239.

D. U-238 and Pu-241.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1251

The effective delayed neutron fraction (β_{eff}) takes into account two factors not considered in calculating the delayed neutron fraction (β). These factors consider that:

Delayed neutrons are __________ likely to cause fast fission than prompt neutrons; and
Delayed neutrons are __________ likely to leak from the core than prompt neutrons.

A. less; more

B. less; less

C. more; more

D. more; less

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2250 (P2249)

Which one of the following distributions of fission percentages occurring in a reactor will result in the largest effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2349 (P2348)

Which one of the following distributions of fission percentages occurring in a reactor will result in the smallest effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2469

A refueling outage has just been completed in which the entire core was offloaded and replaced with new fuel. A reactor startup has been performed to mark the beginning of the next fuel cycle and power is being increased to 100 percent.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100 percent power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2950 (P2948)

A nuclear power plant is operating at steady-state 50 percent power when a control rod is ejected from the core. Which one of the following distributions of fission percentages in the core would result in the shortest reactor period? (Assume the reactivity worth of the ejected control rod is the same for each distribution.)

	U-235	U-238	Pu-239
A.	90%	8%	2%
B.	80%	7%	13%
C.	70%	7%	23%
D.	60%	8%	32%

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B4425 (P4425)

The following data is given for the fuel in an operating reactor:

Nuclide	Delayed Neutron Fraction	Fraction of Total Fuel Composition	Fraction of Total Fission Rate
U-235	0.0065	0.03	0.73
U-238	0.0148	0.96	0.07
Pu-239	0.0021	0.01	0.20

What is the delayed neutron fraction for this reactor?

A. 0.0052

B. 0.0054

C. 0.0062

D. 0.0068

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B5425 (P5425)

The following data is given for the fuel in an operating reactor:

Nuclide	Delayed Neutron Fraction	Fraction of Total Fuel Composition	Fraction of Total Fission Rate
U-235	0.0065	0.023	0.63
U-238	0.0148	0.965	0.07
Pu-239	0.0021	0.012	0.30

What is the delayed neutron fraction for this reactor?

A. 0.0052

B. 0.0058

C. 0.0072

D. 0.0078

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B5725 (P5725)

For an operating reactor, the effective delayed neutron fraction may differ from the delayed neutron fraction because, compared to prompt neutrons, delayed neutrons...

A. are less likely to leak out of the reactor core, and are less likely to cause fast fission.

B. are less likely to cause fast fission, and require more time to complete a neutron generation.

C. require more time to complete a neutron generation, and spend less time in the resonance absorption energy region.

D. spend less time in the resonance absorption energy region, and are less likely to leak out of the reactor core.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B5825 (P5825)

Given the following data for a reactor:

- The average delayed neutron fraction is 0.0068.
- The effective delayed neutron fraction is 0.0065.

The above data indicates that this reactor is operating near the __________ of a fuel cycle; and a typical delayed neutron is __________ likely than a typical prompt neutron to cause another fission in this reactor.

A. beginning; less

B. beginning; more

C. end; less

D. end; more

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B6525 (P6525)

Which one of the following is the major cause for the change in the delayed neutron fraction from the beginning to the end of a fuel cycle?

A. Burnup of the burnable poisons.

B. Changes in the fuel composition.

C. Buildup of fission product poisons.

D. Shift in the core axial power distribution.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B7025 (P7025)

Given the following data for the fuel in an operating reactor:

Nuclide	Delayed Neutron Fraction	Cross Section for Thermal Fission	Fraction of Total Fission Rate
U-235	0.0065	531 barns	0.58
U-238	0.0148	< 1 barn	0.06
Pu-239	0.0021	743 barns	0.32
Pu-241	0.0049	1009 barns	0.04

What is the delayed neutron fraction for this reactor?

A. 0.0044

B. 0.0055

C. 0.0063

D. 0.0071

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B7325 (P7325)

A nuclear reactor is operating at steady-state 100 percent power in the middle of a fuel cycle. Which one of the following changes would cause the core effective delayed neutron fraction to increase?

A. The fast nonleakage factor increases.

B. The fast nonleakage factor decreases.

C. The thermal utilization factor increases.

D. The thermal utilization factor decreases.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B7617 (P7617)

Given the following data for a reactor:

- The average delayed neutron fraction is 0.0052.
- The effective delayed neutron fraction is 0.0054.

The above data indicates that the reactor is operating near the __________ of a fuel cycle, and that a typical delayed neutron is __________ likely than a typical prompt neutron to cause another fission in this reactor.

A. beginning; less

B. beginning; more

C. end; less

D. end; more

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
K1.06 [3.7/3.7]
QID: B3551 (P3548)

Reactors A and B are identical except that the reactors are operating at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical with neutron flux level stable in the source range.

Given:

Reactor A K_{eff} = 0.999
Reactor B K_{eff} = 0.998

If positive 0.003 $\Delta K/K$ is suddenly added to each reactor, how will the resulting stable periods compare? (Consider only the reactor response while power is below the point of adding heat.)

A. Reactor A stable period will be shorter.

B. Reactor B stable period will be shorter.

C. Reactors A and B will have the same stable period because both reactors will remain subcritical.

D. Reactors A and B will have the same stable period because both reactors received the same amount of positive reactivity.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B250

Without delayed neutrons in the neutron cycle, when positive reactivity is added to a critical reactor, the reactor will...

A. experience a prompt jump in power level followed by a decrease to the initial power level.

B. experience a rapid but controllable power increase.

C. begin an uncontrollable rapid power increase.

D. not be able to attain criticality.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B451 (P47)

A small amount of positive reactivity is added to a reactor that is critical in the source range. The amount of reactivity added is much less than the effective delayed neutron fraction.

Which one of the following will have the most significant effect on the magnitude of the stable reactor period achieved for this reactivity addition while the reactor is in the source range?

A. Prompt neutron lifetime

B. Fuel temperature coefficient

C. Moderator temperature coefficient

D. Effective delayed neutron precursor decay constant

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1250 (P1548)

Two reactors are identical except that reactor A is near the end of a fuel cycle and reactor B is near the beginning of a fuel cycle. Both reactors are critical at 1.0×10^{-5} percent power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor __________ because it has a __________ effective delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1349 (P1248)

Two reactors are identical except that reactor A is near the end of a fuel cycle and reactor B is near the beginning of a fuel cycle. Both reactors are operating at 100 percent power when a reactor scram occurs at the same time on each reactor.

If no operator action is taken and the reactor systems for both reactors respond identically to the scram, reactor A will attain a negative __________ second stable period; and reactor B will attain a negative __________ second stable period.

A. 80; 56

B. 80; 80

C. 56; 56

D. 56; 80

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1649 (P1649)

Two reactors are identical except that reactor A is near the end of core life and reactor B is near the beginning of core life. Both reactors are operating at 100 percent power when a reactor scram occurs at the same time on each reactor. The scrams insert equal amounts of negative reactivity, and no operator actions are taken.

For the conditions above, a power level of 1.0×10^{-5} percent will be reached first by reactor __________ because it has the __________ effective delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1751 (P1749)

Which one of the following is the reason that delayed neutrons are so effective at controlling the rate of reactor power changes?

A. Delayed neutrons make up a large fraction of the fission neutrons compared to prompt neutrons.

B. Delayed neutrons have a long mean generation time compared to prompt neutrons.

C. Delayed neutrons produce a large amount of fast fission compared to prompt neutrons.

D. Delayed neutrons are born with high kinetic energy compared to prompt neutrons.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1950 (P48)

During a fuel cycle, plutonium isotopes are produced with delayed neutron fractions that are __________ than the delayed neutron fractions for uranium isotopes, thereby causing reactor power transients to be __________ near the end of a fuel cycle.

A. larger; slower

B. larger; faster

C. smaller; slower

D. smaller; faster

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2450 (P348)

Which one of the following statements describes the effect of changes in the delayed neutron fraction from the beginning of a fuel cycle (BOC) to the end of a fuel cycle (EOC)?

A. A given reactivity addition to a shutdown reactor at EOC yields a larger change in shutdown margin (SDM) than at BOC.

B. A given reactivity addition to a shutdown reactor at EOC yields a smaller change in SDM than at BOC.

C. A given reactivity addition to an operating reactor at EOC results in a longer reactor period than at BOC.

D. A given reactivity addition to an operating reactor at EOC results in a shorter reactor period than at BOC.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2651 (P1149)

Delayed neutrons are important for reactor control because...

A. they are produced with a higher average kinetic energy than prompt neutrons.

B. they prevent the moderator temperature coefficient from becoming positive.

C. they are the largest fraction of the neutrons produced from fission.

D. they greatly extend the average lifetime of each neutron generation.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2850 (P2849)

Two reactors are identical except that reactor A is near the beginning of core life and reactor B is near the end of core life. Both reactors are critical at 10^{-5} percent power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor __________ because it has a __________ effective delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3249 (P3248)

Two reactors are identical except that reactor A is near the end of core life and reactor B is near the beginning of core life. Both reactors are operating at 100 percent power when a reactor scram occurs at the same time on each reactor. No operator action is taken and the reactor systems for both reactors respond identically to the scram.

Ten minutes after the scram, the greater thermal neutron flux will exist in reactor __________ because it has a __________ effective delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3650 (P3648)

Two reactors are identical except that reactor A is near the beginning of core life and reactor B is near the end of core life. Both reactors are operating at 100 percent power when a reactor scram occurs at the same time on each reactor. No operator action is taken and the reactor systems for both reactors respond identically to the scram.

Ten minutes after the scram, the greater thermal neutron flux will exist in reactor __________ because it has a __________ effective delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3749 (P3748)

A step positive reactivity addition of 0.001 $\Delta K/K$ is made to a reactor with a stable neutron flux and an initial K_{eff} of 0.99. Consider the following two cases:

Case 1: The reactor is near the beginning of a fuel cycle.
Case 2: The reactor is near the end of a fuel cycle.

Assume the initial neutron flux is the same for each case.

Which one of the following correctly compares the prompt jump in neutron flux levels and the final stable neutron flux levels for the two cases?

A. The prompt jump will be greater for case 1, but the final stable neutron flux level will be the same for both cases.

B. The prompt jump will be greater for case 2, but the final stable neutron flux level will be the same for both cases.

C. The prompt jump will be the same for both cases, but the final stable neutron flux level will be greater for case 1.

D. The prompt jump will be the same for both cases, but the final stable neutron flux level will be greater for case 2.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B5525 (P5525)

Which characteristic of delayed neutrons is primarily responsible for enhancing the stability of a reactor following a reactivity change?

A. They are born at a lower average energy than prompt neutrons.

B. They are more likely to experience resonance absorption than prompt neutrons.

C. They comprise a smaller fraction of the total neutron flux than prompt neutrons.

D. They require more time to be produced following a fission event than prompt neutrons.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B5925 (P5925)

Initially, a reactor is critical at a stable power level well below the point of adding heat (POAH). When considering the following two cases, assume the reactor remains below the POAH.

Case 1: A step addition of positive 1.0×10^{-4} ΔK/K.
Case 2: A step addition of negative 1.0×10^{-4} ΔK/K.

The time required for reactor power to change by a factor of 10 will be greater for case _____, because delayed neutrons are more effective at slowing reactor power changes when reactor power is __________.

A. 1; increasing

B. 1; decreasing

C. 2; increasing

D. 2; decreasing

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B6225 (P6225)

Two identical reactors, A and B, are critical at 1.0×10^{-8} percent power near the beginning of a fuel cycle. Simultaneously, positive 0.001 ΔK/K is added to reactor A, and negative 0.001 ΔK/K is added to reactor B. One minute later, which reactor, if any, will have the shorter period and why?

A. Reactor A, because delayed neutrons are less effective at slowing down power changes when the fission rate is increasing.

B. Reactor B, because delayed neutrons are less effective at slowing down power changes when the fission rate is decreasing.

C. The periods in both reactors will be the same because their effective delayed neutron fractions are the same.

D. The periods in both reactors will be the same because the absolute values of the reactivity additions are the same.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B6325 (P6325)

The following data is given for the fuel in an operating reactor just prior to a refueling shutdown.

Nuclide	Delayed Neutron Fraction	Fraction of Total Fission Rate
U-235	0.0065	0.64
U-238	0.0148	0.07
Pu-239	0.0021	0.29

During the refueling, one-third of the fuel assemblies were offloaded and replaced with new fuel assemblies consisting of uranium having an average U-235 enrichment of 3.5 percent by weight.

Which one of the following describes how the above data will change as a result of completing the refueling outage?

A. The delayed neutron fraction for U-235 will decrease.

B. The delayed neutron fraction for Pu-239 will decrease.

C. The fraction of the total fission rate attributed to U-235 will increase.

D. The fraction of the total fission rate attributed to Pu-239 will increase.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B7697 (P7697)

A reactor core has a delayed neutron importance factor of 1.02. If the average delayed neutron fraction in the core is 0.0057, the effective delayed neutron fraction is...

A. equal to 0.0057.

B. less than 0.0057.

C. greater than 0.0057.

D. unpredictable without additional information.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B7707 (P7707)

Which one of the following is the primary reason that delayed neutrons are more effective than prompt neutrons at controlling the rate of reactor power changes?

A. Delayed neutrons have a longer mean generation time than prompt neutrons.

B. Delayed neutrons produce a larger amount of core fissions than prompt neutrons.

C. Delayed neutrons make up a larger fraction of fission neutrons than prompt neutrons.

D. Delayed neutrons are born with a lower average kinetic energy than prompt neutrons.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B7747 (P7747)

Two identical reactors, A and B, with identical fuel compositions, are initially critical at 1.0×10^{-8} percent power. Then, suddenly and simultaneously, positive 0.001 $\Delta K/K$ is added to reactor A while negative 0.001 $\Delta K/K$ is added to reactor B.

One minute later, which reactor will have the shorter period, and why? (Note: λ_{eff} is the effective delayed neutron precursor decay constant.)

A. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is positive.

B. Reactor A, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is positive.

C. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the shorter-lived delayed neutron precursors when reactivity is negative.

D. Reactor B, because the value of λ_{eff} shifts toward the value of the decay constant for the longer-lived delayed neutron precursors when reactivity is negative.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B7797 (P7797)

A reactor is critical at a constant power level of 1.0 x 10^{-8} percent. Consider the following two cases:

Case 1: A step addition of positive 0.001 $\Delta K/K$.
Case 2: A step addition of negative 0.001 $\Delta K/K$.

Which case will produce the faster rate of power change one minute after the reactivity addition, and why?

A. Case 1, because the effective delayed neutron fraction is smaller during a power increase.

B. Case 1, because the effective delayed neutron precursor decay constant is larger during a power increase.

C. Case 2, because the effective delayed neutron fraction is smaller during a power decrease.

D. Case 2, because the effective delayed neutron precursor decay constant is larger during a power decrease.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B251

As a reactor core ages, the amount of positive reactivity required to make the reactor prompt critical will __________ because the effective delayed neutron fraction __________.

A. increase; decreases

B. decrease; increases

C. decrease; decreases

D. increase; increases

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B551

A reactor is operating at 50 percent power with the following conditions:

Power defect	=	-0.03 %ΔK/K
Shutdown margin	=	-0.05 %ΔK/K
Effective delayed neutron fraction	=	0.007
Effective prompt neutron fraction	=	0.993

How much positive reactivity must be added to take this reactor <u>prompt</u> critical?

A. 0.03 %ΔK/K

B. 0.05 %ΔK/K

C. 0.7 %ΔK/K

D. 0.993 %ΔK/K

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B664

A critical reactor will become <u>prompt</u> critical if positive reactivity is added equal to the effective...

A. delayed neutron decay constant.

B. delayed neutron fraction.

C. prompt neutron decay constant.

D. prompt neutron fraction.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B950

A reactor is stable at 75 percent power with the following conditions:

Total control rod worth	=	-0.0753 ΔK/K
Shutdown margin	=	-0.0042 ΔK/K
Effective delayed neutron fraction	=	0.0058
Effective prompt neutron fraction	=	0.9942

How much positive reactivity must be added to make the reactor <u>prompt</u> critical?

A. 0.0042 ΔK/K

B. 0.0058 ΔK/K

C. 0.0753 ΔK/K

D. 0.9942 ΔK/K

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B1150 (P1948)

Which one of the following is the smallest listed value of K_{eff} that will result in a <u>prompt</u> critical reactor?

A. 1.0001

B. 1.001

C. 1.01

D. 1.1

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B1850

A reactor is critical at 10^{-5} percent power with a xenon-free core. The operator continuously withdraws control rods until a 60-second reactor period is reached, and then stops control rod motion.

When rod withdrawal is stopped, reactor period will immediately...

A. stabilize at 60 seconds until power reaches the point of adding heat (POAH).

B. lengthen, and then stabilize at a value greater than 60 seconds until power reaches the POAH.

C. shorten, and then slowly and continuously lengthen until power reaches the POAH.

D. lengthen, and then slowly and continuously shorten until power reaches the POAH.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2051

A reactor with a xenon-free core is critical at the point of adding heat. Reactor vessel temperature is 175°F. The operator inserts control rods until a negative 100-second period is attained, and then stops control rod motion.

When rod motion is stopped, reactor period will immediately __________ until power approaches the equilibrium subcritical multiplication source range level, where it will approach __________.

A. stabilize at negative 100 seconds; infinity

B. stabilize at negative 100 seconds; zero

C. lengthen and then stabilize; infinity

D. lengthen and then stabilize; zero

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2550 (P2549)

A reactor was stable at 80 percent power when the operator withdrew a control rod continuously for 2 seconds. Which one of the following affects the amount of "prompt jump" increase in reactor power for the control rod withdrawal?

A. The total control rod worth

B. The differential control rod worth

C. The duration of control rod withdrawal

D. The magnitude of the fuel temperature coefficient

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2951 (P2949)

A reactor is operating at steady-state 75 percent power with the following conditions:

Power defect	=	-0.0185 ΔK/K
Shutdown margin	=	-0.0227 ΔK/K
Effective delayed neutron fraction	=	0.0061
Effective prompt neutron fraction	=	0.9939

How much positive reactivity must be added to make the reactor prompt critical?

A. 0.0061 ΔK/K

B. 0.0185 ΔK/K

C. 0.0227 ΔK/K

D. 0.9939 ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3250 (P3249)

Refer to the partially labeled reactor response curve shown below for a reactor that was initially stable in the source range. Both axes have linear scales. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows __________ versus time for a reactor that was initially __________.

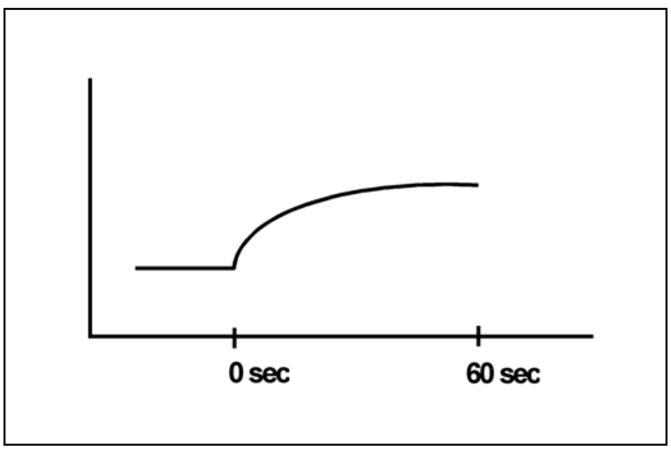
A. reactor period; subcritical

B. reactor period; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.



TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3351 (P549)

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. Fissions are occurring so rapidly that the effective delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the effective delayed neutron fraction.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3450 (P3449)

Two reactors are critical at the same power level well below the point of adding heat. The reactors are identical except that reactor A is near the beginning of a fuel cycle (BOC) and reactor B is near the end of a fuel cycle (EOC).

If a step addition of positive 0.001 $\Delta K/K$ is added to each reactor, the size of the prompt jump in power level observed in reactor B (EOC) will be __________ than in reactor A (BOC); and the stable reactor period observed in reactor B (EOC) will be __________ than in reactor A (BOC). (Assume the power level in each reactor remains below the point of adding heat.)

A. smaller; longer

B. smaller; shorter

C. larger; longer

D. larger; shorter

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.07 (3.3/3.3)
QID: B3651 (P3649)

Refer to the partially labeled reactor response curve shown below for a reactor that was initially subcritical in the source range and remained below the point of adding heat. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows __________ versus time for a reactor that is currently (at time = 60 sec) __________.

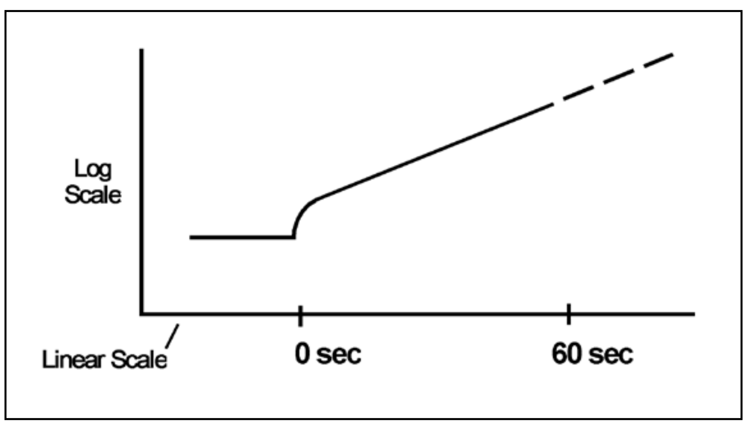
A. reactor period; exactly critical

B. reactor period; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.



TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3750 (P3749)

A reactor is operating at equilibrium 75 percent power with the following conditions:

Total power defect	=	-0.0176 ΔK/K
Shutdown margin	=	-0.0234 ΔK/K
Effective delayed neutron fraction	=	0.0067
Effective prompt neutron fraction	=	0.9933

How much positive reactivity must be added to make the reactor <u>prompt</u> critical?

A. 0.0067 ΔK/K

B. 0.0176 ΔK/K

C. 0.0234 ΔK/K

D. 0.9933 ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B7827 (P7827)

Given the following information for a reactor:

Reactivity (ρ)	= 0.0060
Average delayed neutron fraction ($\bar{\beta}$)	= 0.0058
Effective delayed neutron fraction ($\bar{\beta}_{eff}$)	= 0.0062

The reactor is __________, and the reactor fission rate is __________.

A. prompt critical; constant

B. prompt critical; increasing

C. not prompt critical; constant

D. not prompt critical; increasing

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B49

A reactor is initially critical with a stable source range count rate of 100 cps. Sufficient positive reactivity is added to establish a 120-second period. How much time will it take for the count rate to increase to 10,000 cps with <u>no</u> additional operator action?

A. 1.2 minutes

B. 4.0 minutes

C. 9.2 minutes

D. 15.8 minutes

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B127

A reactor is operating at a very low power level when a control rod is fully inserted, resulting in a stable negative 80-second period. If the initial power level was 120 watts, what will the approximate reactor power level be two minutes after rod insertion stops?

A. 27 watts

B. 32 watts

C. 49 watts

D. 54 watts

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B249

During a reactor startup, the intermediate range monitor readings increased from 30 percent to 65 percent in 2 minutes. What was the average reactor period during the power increase?

A. 357 seconds

B. 173 seconds

C. 155 seconds

D. 120 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B851

If reactor power changes from 10^{-5} percent to 10^{-6} percent in 5 minutes, the average reactor period is:

A. negative 80 seconds.

B. positive 80 seconds.

C. negative 130 seconds.

D. positive 130 seconds.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B1252

During a continuous rod withdrawal accident, reactor power increased from 387 MW to 553 MW in 10 seconds. What was the average reactor period for this power increase?

A. 3 seconds

B. 24 seconds

C. 28 seconds

D. 35 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
K1.05 [3.7/3.7]
QID: B1651

During a reactor startup, the intermediate range monitor readings increased from 30 percent to 50 percent in 2 minutes. What was the average reactor period during the power increase?

A. 357 seconds

B. 235 seconds

C. 155 seconds

D. 61 seconds

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B2351

During a reactor startup, the intermediate range monitor readings increased from 20 percent to 40 percent in 2 minutes. What was the average reactor period during the power increase?

A. 173 seconds

B. 235 seconds

C. 300 seconds

D. 399 seconds

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B2751 (P2748)

A reactor is critical at 1.0 x 10^{-8} percent power during a reactor startup. $\bar{\beta}_{eff}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to attain a stable reactor period of 26 seconds?

A. 0.2 %ΔK/K

B. 0.5 %ΔK/K

C. 1.0 %ΔK/K

D. 2.0 %ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3151 (P3148)

A reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle, $\bar{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to increase reactivity by 0.1 %ΔK/K. Assuming no other reactivity additions, what will the stable reactor period be for this reactor until the point of adding heat is reached?

A. 20 seconds

B. 40 seconds

C. 60 seconds

D. 80 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3451 (P3467)

A reactor is critical well below the point of adding heat during a plant startup. A small amount of positive reactivity is then added to the core, and a stable positive reactor period is established.

With the stable positive reactor period, the following power levels are observed:

Time	Power Level
0 sec	3.16×10^{-7} percent
90 sec	1.0×10^{-5} percent

Which one of the following will be the reactor power level at time = 120 seconds?

A. 3.16×10^{-5} percent

B. 5.0×10^{-5} percent

C. 6.32×10^{-5} percent

D. 1.0×10^{-4} percent

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3851

A reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The effective delayed neutron fraction is 0.007. The operator adds positive reactivity to establish a stable positive 60-second reactor period.

Later in core life, with an effective delayed neutron fraction of 0.005, what will be the approximate stable reactor period after an addition of the same amount of positive reactivity?

A. 28 seconds

B. 32 seconds

C. 36 seconds

D. 40 seconds

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B4625

During a reactor startup, source range count rate is observed to double every 30 seconds with <u>no</u> operator action. Which one of the following is the approximate reactor period?

A. 80 seconds

B. 67 seconds

C. 56 seconds

D. 43 seconds

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B5025

A reactor has a stable positive period of 140 seconds with core neutron flux level currently in the source range.

Given the following:

Initial reactor water temperature is 150°F.
Moderator temperature coefficient is -0.5×10^{-4} $\Delta K/K/°F$.
Effective delayed neutron fraction is 0.006.

If the reactor water is allowed to heat up, at what approximate reactor water temperature will the reactor period reach infinity? (Ignore any reactivity effects from changes in fission product poisons and fuel temperature.)

A. 151°F

B. 158°F

C. 200°F

D. 230°F

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B6825 (P6825)

Given the following stable initial conditions for a reactor:

Power level = 1.0×10^{-8} percent
K_{eff} = 0.999
Core $\bar{\beta}_{eff}$ = 0.006

What will the stable reactor period be following an addition of positive 0.15 %ΔK/K reactivity to the reactor? (Assume the stable reactor period occurs before the reactor reaches the point of adding heat.)

A. 30 seconds

B. 50 seconds

C. 80 seconds

D. 110 seconds

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B7125

Given the following stable initial conditions for a reactor:

Power level = 1.0×10^{-8} percent
K_{eff} = 0.999
Core $\bar{\beta}_{eff}$ = 0.006

What will the stable reactor period be following an addition of positive 0.2 %ΔK/K reactivity to the reactor? (Assume the stable reactor period occurs before the reactor reaches the point of adding heat.)

A. 20 seconds

B. 50 seconds

C. 80 seconds

D. 110 seconds

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B7607

A nuclear power plant has just completed a refueling outage and a reactor startup is in progress. Reactor engineers have determined that during the upcoming fuel cycle, $\bar{\beta}_{eff}$ will range from a minimum of 0.0052 to a maximum of 0.0064.

After the reactor becomes critical, control rods are withdrawn further to increase reactivity by an additional 0.1 %ΔK/K. Assuming <u>no</u> other reactivity changes occur, what will the stable reactor period be for this reactor until the point of adding heat is reached?

A. 26 seconds

B. 42 seconds

C. 54 seconds

D. 80 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B50

During a reactor startup, the reactor is critical at 3,000 cps. A control rod is then notched out, resulting in a stable doubling time of 85 seconds. How much time is required for the reactor to reach 888,000 cps?

A. 341 seconds

B. 483 seconds

C. 697 seconds

D. 965 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B352

If reactor power increases at a constant rate from 50 kW to 370 kW in 2 minutes, what is the approximate doubling time?

A. 42 seconds

B. 60 seconds

C. 86 seconds

D. 120 seconds

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1451

During a startup, a reactor has a stable doubling time of 115.2 seconds. What is the approximate reactor period?

A. 56 seconds

B. 80 seconds

C. 126 seconds

D. 166 seconds

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B5125

A reactor is initially critical in the source range during a reactor startup when a control rod is notched inward. Reactor period stabilizes at -180 seconds. Assuming reactor period remains constant, how long will it take for source range count rate to decrease by one-half?

A. 90 seconds

B. 125 seconds

C. 180 seconds

D. 260 seconds

ANSWER: B.

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: B651

A reactor is currently near the end of its fuel cycle and 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 reactor is operating at 100 percent power immediately following a refueling outage. In comparison to the moderator temperature coefficient (MTC) at 100 percent power just prior to the refueling outage, the current MTC is...

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: C.

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 percent rod density to 75 percent rod density.

B. Fuel temperature decreases from 1,500°F to 1,200°F.

C. Recirculation flow increases by 10 percent.

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 percent 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 generally becomes ___________ negative over core life because 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

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

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

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

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

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

ANSWER: C.

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

A 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 reactor most likely to have a <u>positive</u> moderator temperature coefficient?

A. Low coolant temperature at the beginning of a fuel cycle.

B. Low coolant temperature at the end of a fuel cycle.

C. High coolant temperature at the beginning of a fuel cycle.

D. High coolant temperature at the end of a fuel cycle.

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

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: 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 while operating at a constant 100 percent power level?

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

B. 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 decreases.

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 increases.

ANSWER: B.

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

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 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

How does control rod withdrawal affect the moderator temperature coefficient 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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B3652 (P3650)

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

A 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 K_{eff} if the reactor is at the end of core life, but will decrease K_{eff} if the reactor is at the beginning 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: K1.02 [2.5/2.6]
QID: B6526

Consider a one month period of 100 percent power operation near the beginning of a fuel cycle.

During this period of operation, the depletion of U-235 in the fuel tends to make the moderator temperature coefficient __________ negative; and the incremental withdrawal of control rods tends to make the moderator temperature coefficient __________ negative.

A. less; less

B. less; more

C. more; less

D. more; more

ANSWER: A.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B6926 (P6926)

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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B7608

A reactor is shut down near the end of a fuel cycle with the shutdown cooling system in service. The initial reactor vessel water temperature is 100°F. In this condition, the reactor is overmoderated.

Then, a heatup and pressurization is performed to bring the reactor 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: C.

TOPIC: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B7637 (P7637)

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: 292004
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B7667

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

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

During the heatup, Keff will…

A. increase continuously.

B. decrease continuously.

C. initially increase, and then decrease.

D. initially decrease, and then increase.

ANSWER: B.

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

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

As fuel temperature increases, the 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 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: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B652 (P1650)

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: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B1553

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 <u>direct</u> 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 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: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B3352 (P2050)

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: 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 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 __________.

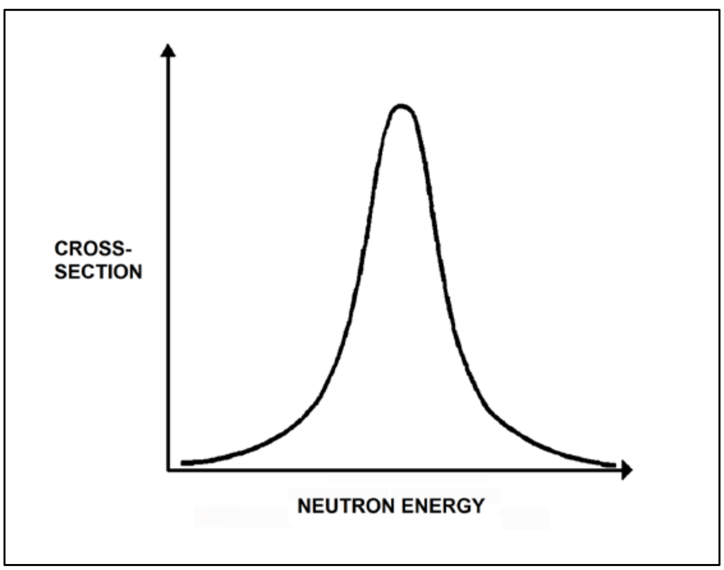
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: D.



TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B3852 (P3850)

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 __________.

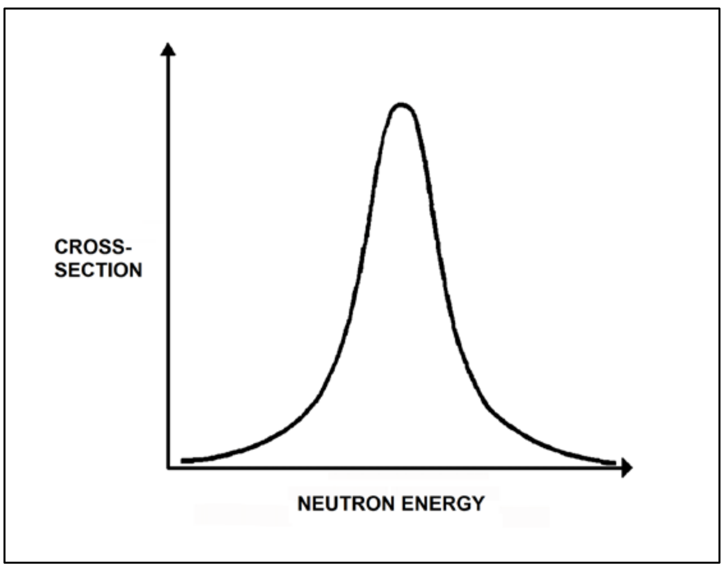
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.



TOPIC: 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: K1.04 [2.6/2.7]
QID: B6627 (P6626)

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: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B7648 (P7648)

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 ________.

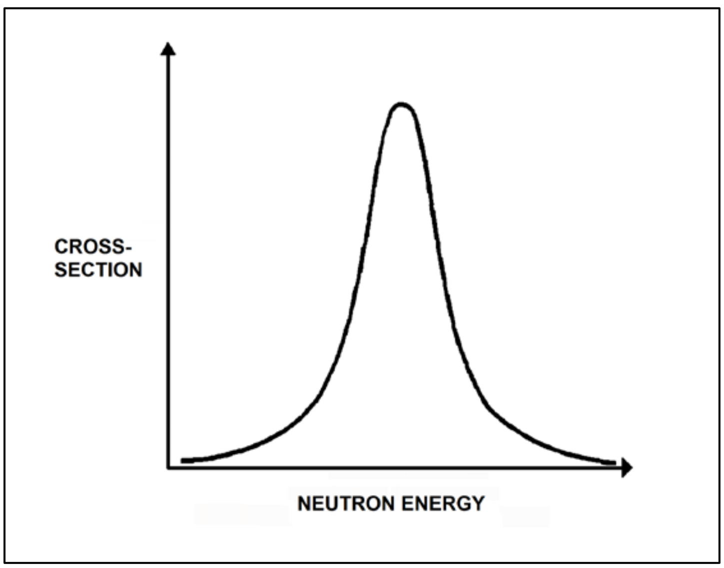
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: A.



TOPIC: 292004
KNOWLEDGE: K1.04 [2.6/2.7]
QID: B7678 (P7678)

A reactor has an initial effective fuel temperature of 800EF. If the effective fuel temperature increases to 1,000EF, the fuel temperature coefficient will become __________ negative; because at higher effective fuel temperatures, a 1EF 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: 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

Which one of the following describes how the magnitude of the fuel temperature 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 burnup, 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 the beginning of a fuel cycle, at the end of a fuel cycle the fuel temperature coefficient is __________ negative due to __________. (Assume the same initial fuel temperature throughout the fuel cycle.)

A. less; burnup of U-238

B. less; buildup of fission products

C. more; burnup of gadolinium

D. more; buildup of Pu-240

ANSWER: D.

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

Compared to operating at a low power level, the fuel temperature 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 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: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2453 (P2352)

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 __________.

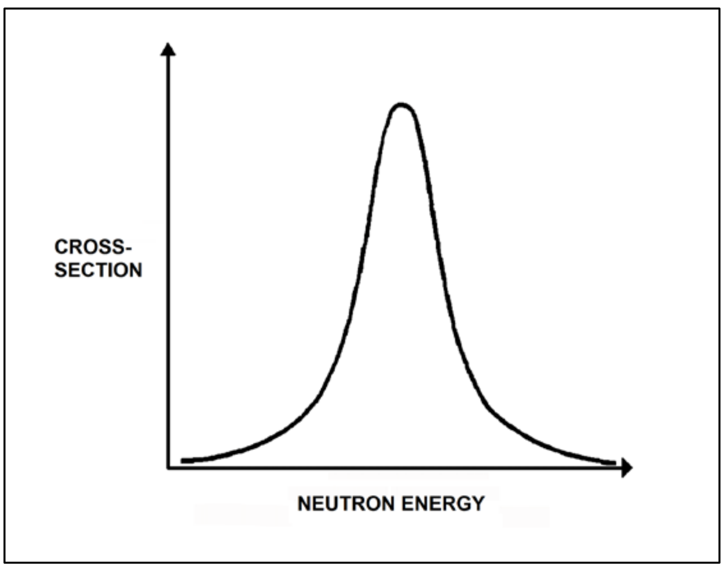
A. increase; neutrons of a wider range of energies will be absorbed by U-238

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

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

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 __________.

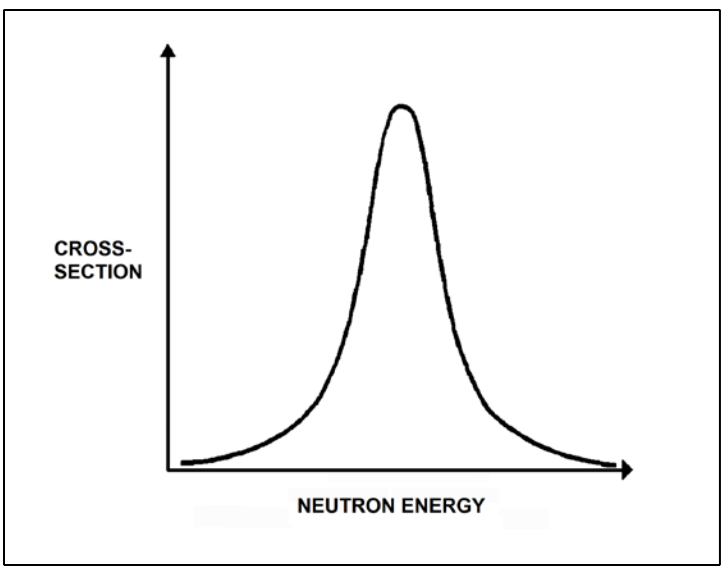
A. decrease; fewer neutrons will be absorbed by U-238 overall

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

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 __________.

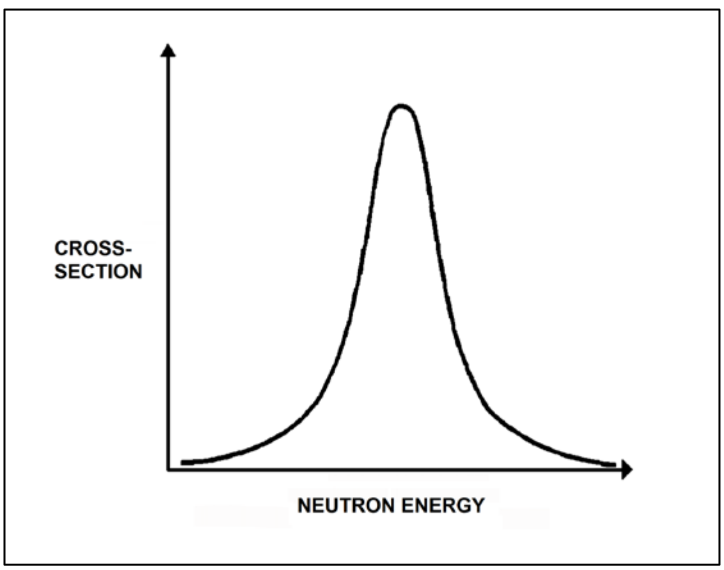
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: D.



TOPIC: 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 toward the end of a fuel cycle?

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 more power is produced in the lower half of a reactor core (versus the upper half) that has been operating at 100 percent power for several weeks near the beginning of a fuel cycle?

A. Xenon-135 concentration is smaller in the lower half of the core.

B. The moderator-to-fuel ratio is smaller in the lower half of the core.

C. Control rods are adding less negative reactivity in the lower half of the core.

D. The void coefficient is adding less negative reactivity in the lower half of the core.

ANSWER: D.

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 80 percent 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 one percent void increase at higher void fractions.

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.11 [2.5/2.6]
QID: B7717

A reactor is operating at 60 percent power with the core coolant flow consisting of 80 percent water by volume and 20 percent steam by volume. In this condition, the core void fraction is __________ percent; and if the core void fraction increases by 5 percent, the void coefficient of reactivity will become __________ negative.

A. 20; less

B. 20; more

C. 25; less

D. 25; more

ANSWER: B.

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

During a 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 power increase?

A. Pressure

B. Void

C. Moderator

D. Doppler

ANSWER: D.

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

During a reactor power increase from steady-state 20 percent to steady-state 100 percent, the smallest addition of negative reactivity will be caused by the change in…

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) left to right from most negative to least negative for a reactor at 50 percent 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 reactor power decrease from steady-state 100 percent to steady-state 20 percent, the <u>smallest</u> addition of positive reactivity will be caused by the change in...

A. void percentage.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
QID: B653

A notch movement of a control rod represents a rod travel of __________ inches.

A. 2

B. 3

C. 6

D. 12

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
QID: B854

If a control rod is being moved from position 16 to 22, it is being...

A. inserted 18 inches.

B. withdrawn 18 inches.

C. inserted 36 inches.

D. withdrawn 36 inches.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
QID: B1255

A reactor core consists of fuel bundles and control rods that are 12 feet in length. A new rod position is indicated for every 3 inches of rod motion.

If a control rod is inserted 75 percent into the core, it will be located at rod position...

A. 9.

B. 12.

C. 27.

D. 36.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
QID: B3054

If a control rod is moved from position 22 to position 12, it is being...

A. inserted 30 inches.

B. withdrawn 30 inches.

C. inserted 60 inches.

D. withdrawn 60 inches.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.01 [3.2/3.3]
K1.11 [2.4/2.5]
QID: B3554

A control rod that was initially at position 06 is being withdrawn three more notches. After the withdrawal, the control rod will be classified as a __________ rod; and the blade tip for this control rod will be positioned 36 inches from the __________ position.

A. shallow; fully inserted

B. shallow; fully withdrawn

C. deep; fully inserted

D. deep; fully withdrawn

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.02 [2.5/2.6]
QID: B754

Which one of the following materials is used in control rods primarily for thermal neutron absorption?

A. Boron

B. Carbon

C. Gadolinium

D. Stainless Steel

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B54

The reverse power effect (or reverse reactivity effect) occasionally observed when a shallow control rod is withdrawn one or two notches is due to a relatively...

A. small local power decrease due to increased local Doppler effects.

B. small local power decrease due to the shadowing effect of nearby control rods.

C. large local power increase being offset by a void-related power decrease.

D. large local power increase being offset by a moderator temperature-related power decrease.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
K1.12 [2.6/2.9]
QID: B134

Withdrawal of a deep control rod will <u>significantly</u> affect which one of the following?

A. Axial flux shape

B. Rod shadowing

C. Radial power distribution

D. Reverse power effect

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B254

A reactor is operating at steady-state 50 percent power. A control rod is inserted a short distance (from 08 to 02 notches). Assuming that recirculation flow remains constant, reactor power will...

A. increase and stabilize at a higher value.

B. increase temporarily, then return to the original value.

C. decrease and stabilize at a lower value.

D. decrease temporarily, then return to the original value.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B356

A reactor is initially critical below the point of adding heat with stable reactor vessel temperature and pressure. If control rods are manually inserted for 5 seconds, reactor power will decrease...

A. to a shutdown power level determined by subcritical multiplication.

B. temporarily, then return to the original power level due to the resulting decrease in moderator temperature.

C. until inherent positive reactivity feedback causes the reactor to become critical at a lower power level.

D. temporarily, then return to the original power level due to subcritical multiplication.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B755 (P754)

A reactor is initially critical below the point of adding heat (POAH) during a reactor startup. If control rods are manually withdrawn for 5 seconds, reactor power will initially increase and then...

A. stabilize at a critical power level below the POAH.

B. decrease and stabilize at the original value.

C. stabilize at a critical power level at the POAH.

D. decrease and stabilize below the original value.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B954 (P1955)

A reactor has been shut down for three weeks with all control rods fully inserted. If a center control rod is fully withdrawn from the core, neutron flux level will… (Assume the reactor remains subcritical.)

A. remain the same.

B. increase and stabilize at a new higher level.

C. increase temporarily then return to the original level.

D. increase exponentially until the operator reinserts the center control rod.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B1954

Initially, the following plant conditions exist during a reactor startup:

- Reactor power is stable at the point of adding heat.
- The main steam isolation valves are open.
- Reactor vessel pressure is stable at 600 psig.
- The steam bypass system pressure setpoint is 920 psig.

Then, two control rods are manually withdrawn a few notches. When the plant conditions stabilize, reactor power will be __________; and reactor vessel pressure will be __________. (Assume the reactor does not scram.)

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B2155 (P1854)

A reactor has been shut down for three weeks with all control rods fully inserted. If a single control rod is fully withdrawn from the core, neutron flux level will… (Assume the reactor remains subcritical.)

A. increase and stabilize above the original level.

B. increase, then decrease and stabilize at the original level.

C. increase, then decrease and stabilize above the original level.

D. remain the same during and after the withdrawal.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B2254

A reactor is critical below the point of adding heat (POAH) during a hot reactor startup in the middle of a fuel cycle. Control rods are withdrawn for 20 seconds to establish a positive 30-second reactor period.

In response to the control rod withdrawal, reactor power will increase...

A. continuously until control rods are reinserted.

B. and stabilize at a level slightly below the POAH.

C. temporarily, and then stabilize at the original level.

D. and stabilize at a level equal to or slightly above the POAH.

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B2554

A reactor is operating steady-state at the point of adding heat (POAH) during a reactor startup near the beginning of a fuel cycle. Reactor pressure is stable at 600 psig and the main steam isolation valves are closed. There is a small but significant heat loss from the reactor vessel to the surroundings.

If a control rod is manually inserted for 5 seconds and the reactor does <u>not</u> scram, when conditions stabilize reactor power will be __________; and reactor vessel pressure will be __________.

A. at the POAH; 600 psig

B. at the POAH; less than 600 psig

C. less than the POAH; 600 psig

D. less than the POAH; less than 600 psig

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B3856

Criticality has been achieved during a xenon-free reactor startup with core neutron flux level low in the intermediate range. A stable positive 60-second reactor period has been established. Now the operator begins inserting control rods in an effort to stabilize the core neutron flux level near its current value. The operator stops inserting control rods exactly when the reactor period indicates infinity.

Immediately after the operator stops inserting the control rods, the reactor period will become __________; and the core neutron flux level will __________.

A. positive; increase exponentially

B. positive; increase linearly

C. negative; decrease exponentially

D. negative; decrease linearly

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.05 [2.5/2.6]
QID: B555

Rod density is a measure of the total number of control rod notches __________ the core divided by the total number of control rod notches __________ the core.

A. inserted into; available in

B. inserted into; withdrawn from

C. withdrawn from; available in

D. withdrawn from; inserted into

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B7777

Which one of the following describes how a one- or two-notch withdrawal of a shallow control rod can cause a power decrease in the associated fuel bundle?

A. The control rod withdrawal may increase its own differential control rod reactivity worth enough to cause a bundle power decrease.

B. The control rod withdrawal may cause a local power increase that increases the void content in the bundle enough to cause a bundle power decrease.

C. The control rod withdrawal may expose fresh burnable poisons having enough negative reactivity to cause a bundle power decrease.

D. The control rod withdrawal may permit enough neutron-absorbing moderator to fill the volume vacated by the control rod to cause a bundle power decrease.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.05 [2.5/2.6]
QID: B955

How is control rod density affected as control rods are inserted during a reactor shutdown?

A. Increases continuously during rod insertion.

B. Decreases continuously during rod insertion.

C. Initially increases, then decreases after 50 percent of the rods are inserted.

D. Initially decreases, then increases after 50 percent of the rods are inserted.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.05 [2.5/2.6]
QID: B1055

Control rod density is a measure of the...

A. percentage of control rods inserted into the core.

B. percentage of control rods withdrawn from the core.

C. number of control rods fully inserted divided by the number of control rods fully withdrawn.

D. number of control rods fully withdrawn divided by the number of control rods fully inserted.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.05 [2.5/2.6]
QID: B1355

During a reactor startup, as control rods are being withdrawn, control rod density...

A. decreases until 50 percent of the rods are withdrawn, then increases.

B. increases until 50 percent of the rods are withdrawn, then decreases.

C. decreases whenever any of the rods are withdrawn.

D. increases whenever any of the rods are withdrawn.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.5/2.6]
QID: B756 (P755)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1×10^{12} neutrons/cm^2-sec
Control rod tip thermal neutron flux = 5×10^{12} neutrons/cm^2-sec

If the control rod is slightly withdrawn such that the tip of the control rod is located in a thermal neutron flux of 1×10^{13} neutrons/cm^2-sec, the differential control rod worth will increase by a factor of __________. (Assume the core average thermal neutron flux is constant.)

A. 0.5

B. 1.4

C. 2.0

D. 4.0

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B856 (P555)

The total amount of reactivity added by a control rod position change from a reference height to any other rod height is called...

A. differential rod worth.

B. excess reactivity.

C. integral rod worth.

D. reference reactivity.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1057 (P1554)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1.0×10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 5.0×10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.0×10^{13} n/cm^2-sec, the differential control rod worth will increase by a factor of __________. (Assume the core average thermal neutron flux is constant.)

A. 2

B. 4

C. 10

D. 100

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1555

As a control rod is withdrawn from notch position 00 to notch position 48, the absolute value of integral rod worth will...

A. decrease, then increase.

B. increase, then decrease.

C. decrease continuously.

D. increase continuously.

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1657 (P1555)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A. IRW is the slope of the DRW curve.

B. IRW is the inverse of the DRW curve.

C. IRW is the sum of the DRWs between the initial and final control rod positions.

D. IRW is the sum of the DRWs of all control rods at a specific control rod position.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1755 (P134)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A. DRW is the area under the IRW curve at a given rod position.

B. DRW is the slope of the IRW curve at a given rod position.

C. DRW is the IRW at a given rod position.

D. DRW is the square root of the IRW at a given rod position.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1855 (P1755)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1.0×10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 4.0×10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.2×10^{13} n/cm^2-sec, the differential control rod worth will increase by a factor of __________. (Assume the core average thermal neutron flux is constant.)

A. 1/3

B. 3

C. 9

D. 27

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1955

Which one of the following describes the change in magnitude (positive value) of integral rod worth during the complete withdrawal of a fully inserted control rod?

A. Increases, then decreases.

B. Decreases, then increases.

C. Increases continuously.

D. Decreases continuously.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2055

Which one of the following describes the change in magnitude (absolute value) of differential control rod worth during the complete withdrawal of a fully inserted control rod?

A. Increases, then decreases.

B. Decreases, then increases.

C. Increases continuously.

D. Decreases continuously.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2255 (P655)

Which one of the following parameters typically has the greatest influence on the shape of a differential rod worth curve?

A. Core radial neutron flux distribution

B. Core axial neutron flux distribution

C. Core xenon distribution

D. Burnable poison distribution

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2655 (P2554)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1.0×10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 4.0×10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.6×10^{13} n/cm^2-sec, the differential control rod worth will increase by a factor of __________. (Assume the core average thermal neutron flux is constant.)

A. 2

B. 4

C. 8

D. 16

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2755 (P1354)

Integral rod worth is the...

A. change in reactivity per unit change in rod position.

B. rod worth associated with the most reactive control rod.

C. change in worth of a control rod per unit change in reactor power.

D. reactivity added by moving a control rod from a reference point to another point.

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2856

During normal full power operation, the differential control rod worth is small near the top and bottom of the core compared to the center regions due to the effects of...

A. fuel enrichment.

B. neutron flux distribution.

C. xenon concentration.

D. fuel temperature distribution.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2956

A reactor is operating at steady-state 50 percent power near the end of a fuel cycle with all control systems in manual. The radial power distribution is symmetric and peaked in the center of the core, and the axial power distribution is peaked slightly below the core midplane.

The tip of the most centrally-located control rod is currently located at the core midplane. The control rod is constructed of a homogeneous neutron absorber and the active neutron absorber length is exactly as long as the adjacent fuel assembly. The rod is manually inserted fully into the core, and reactor power stabilizes at a lower power level in the power range.

If, instead, the control rod had been withdrawn fully from its core midplane position, the reactor would have experienced**...**

A. a larger absolute change in integral control rod reactivity.

B. a smaller absolute change in integral control rod reactivity.

C. a larger absolute change in reactor shutdown margin.

D. a smaller absolute change in reactor shutdown margin.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B53

Which one of the following statements describes how changes in core parameters affect control rod worth (CRW)?

A. CRW increases with an increase in void fraction.

B. CRW increases with an increase in fast neutron flux.

C. CRW decreases when approaching the end of a fuel cycle.

D. CRW decreases when the temperature of the fuel decreases.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B357

If the void fraction surrounding several centrally located fuel bundles increases, the worth of the associated control rods will...

A. decrease, because the average neutron energy in the fuel bundles will decrease, resulting in fewer neutrons traveling from within the fuel bundles to the affected control rods.

B. decrease, because more neutrons will be resonantly absorbed in the fuel while they are slowing down, resulting in fewer thermal neutrons available to be absorbed by the affected control rods.

C. increase, because the diffusion length of the thermal neutrons will increase, resulting in more thermal neutrons traveling from within the fuel bundles to the affected control rods.

D. increase, because neutrons will experience a longer slowing down length, resulting in a smaller fraction of thermal neutrons being absorbed by the fuel and more thermal neutrons available to be absorbed by the affected control rods.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1157

Which one of the following conditions will cause the associated differential control rod worth(s) to become more negative? (Consider only the direct effect of the indicated changes.)

A. During a small power change, fuel temperature increases.

B. With the reactor shut down, reactor coolant temperature increases from 100°F to 200°F.

C. During a small power change, the percentage of voids increases.

D. During a control pattern adjustment, the local thermal neutron flux surrounding a control rod decreases while the core average thermal neutron flux remains the same.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1556

If the void fraction surrounding several centrally-located fuel bundles decreases, the worth of the associated control rods will...

A. increase, because the average neutron energy in the area of the affected control rods increases.

B. increase, because fewer neutrons are resonantly absorbed in the fuel while they are being thermalized, resulting in more thermal neutrons available to be absorbed by the affected control rods.

C. decrease, because the diffusion length of the thermal neutrons decreases, resulting in fewer thermal neutrons reaching the affected control rods.

D. decrease, because neutrons will experience a shorter slowing down length, resulting in a larger fraction of thermal neutrons being absorbed by the fuel and fewer thermal neutrons available to be absorbed by the affected control rods.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2656 (P1556)

As moderator temperature increases, the differential rod worth becomes...

A. more negative due to longer neutron diffusion lengths.

B. more negative due to decreased resonance absorption of neutrons.

C. less negative due to reduced moderation of neutrons.

D. less negative due to decreased moderator absorption of neutrons.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2857

A reactor is operating at 85 percent power with control rod X-Y inserted 20 percent. Which one of the following will cause the differential rod worth of control rod X-Y to become more negative? (Assume that control rod X-Y remains 20 percent inserted for each case.)

A. Core Xe-135 builds up in the lower half of the core.

B. An adjacent control rod is fully withdrawn from the core.

C. Reactor vessel pressure drifts from 900 psig to 880 psig.

D. Fuel temperature increases as fission product gases accumulate in nearby fuel rods.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.10
QID: B179

Which one of the following is a reason for neutron flux shaping?

A. To minimize the worth of individual control rods by evenly distributing the flux radially.

B. To reduce the reverse power effect during rod withdrawal by peaking the flux at the top of the core.

C. To equalize control rod drive mechanism wear and control rod burnup.

D. To increase the effectiveness of the power control rods by peaking the flux at the bottom of the core.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B255

Neutron flux shaping within a reactor core is designed to...

A. prevent the effects of rod shadowing during control rod motion.

B. generate more power in the top portion of the core early in core life.

C. ensure that local core thermal power limits are not exceeded.

D. minimize the reverse power effect during control rod motion.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B1557

Which one of the following is a reason for neutron flux shaping?

A. To minimize local power peaking by more evenly distributing the core thermal neutron flux.

B. To reduce the reverse power effect during rod withdrawal by peaking the thermal neutron flux at the top of the core.

C. To equalize control rod drive mechanism wear and control rod burnup.

D. To increase control rod worth by peaking the thermal neutron flux at the bottom of the core.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B1656

The <u>primary</u> purpose for performing control rod program changes is to...

A. evenly burn up the fuel.

B. evenly burn up the control rods.

C. reduce excessive localized reactor vessel neutron irradiation.

D. reduce control rod shadowing.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B2457 (P2456)

Which one of the following is a reason for neutron flux shaping in a reactor core?

A. To minimize local power peaking by more evenly distributing the core thermal neutron flux.

B. To reduce thermal neutron leakage by decreasing the neutron flux at the periphery of the reactor core.

C. To reduce the size and number of control rods needed to shut down the reactor during a reactor scram.

D. To increase differential control rod worth by peaking the thermal neutron flux at the top of the reactor core.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B3356 (P857)

The main reason for designing and operating a reactor with a flattened neutron flux distribution is to...

A. provide even burnup of control rods.

B. reduce neutron leakage from the core.

C. achieve a higher average power density.

D. provide more accurate nuclear power indication.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.11 [2.4/2.5]
QID: B557

A control rod located at notch position __________ is considered a __________ control rod.

A. 36; deep

B. 36; intermediate

C. 12; intermediate

D. 12; deep

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B358 (P356)

A reactor is operating at steady-state 100 percent power when a single control rod fully inserts from the fully withdrawn position. After the initial transient, the operator returns the reactor to 100 percent power with the control rod still fully inserted.

Compared to the initial core axial neutron flux shape, the current core axial neutron flux shape will have a...

A. minor distortion, because the fully inserted control rod has nearly zero reactivity worth.

B. minor distortion, because the fully inserted control rod is an axially uniform poison.

C. major distortion, because the upper and lower core halves are tightly coupled in the vicinity of the control rod.

D. major distortion, because the power production will be drastically reduced in the vicinity of the control rod.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B454

Which one of the following control rods, when repositioned by two notches, will have the greatest effect on the axial neutron flux shape?

A. Deep rod near the center of the core.

B. Deep rod near the edge of the core.

C. Shallow rod near the center of the core.

D. Shallow rod near the edge of the core.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B656

During reactor power operations, the axial neutron flux shape is affected most by withdrawal of __________ control rods; and the radial neutron flux shape is affected most by withdrawal of __________ control rods.

A. shallow; shallow

B. deep; shallow

C. shallow; deep

D. deep; deep

ANSWER: C

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1357

During reactor power operations, the radial neutron flux shape is affected most by the withdrawal of ___________ control rods.

A. shallow

B. deep

C. peripheral

D. intermediate

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1457

A reactor is operating at 60 percent power with thermal neutron flux peaked in the bottom half of the core. Partial withdrawal of a deep control rod will primarily affect total (versus local) core power because ___________ is relatively high in the area of withdrawal.

A. fuel enrichment

B. thermal neutron flux

C. void content

D. moderator temperature

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1757

Which one of the following control rods, when repositioned by 2 notches, will have the smallest effect on the axial neutron flux shape?

A. Deep rods at the center of the core

B. Deep rods at the periphery of the core

C. Shallow rods at the center of the core

D. Shallow rods at the periphery of the core

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1856

A reactor was operating at steady-state 50 percent power near the beginning of a fuel cycle when a centrally-located shallow control rod dropped out of the core. The reactor stabilized without a scram, and no operator actions were taken.

If the dropped control rod had been a deep control rod, it would have produced a __________ change in the __________. (Again, assume the reactor stabilizes without a scram, and no operator actions are taken.)

A. smaller; shutdown margin.

B. greater; shutdown margin.

C. smaller; radial power distribution.

D. greater; radial power distribution.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B558

Fission fragments or daughters that have a substantial neutron absorption cross section and are <u>not</u> fissionable are called...

A. fissile materials.

B. fission product poisons.

C. fissionable nuclides.

D. burnable poisons.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B1558 (P2858)

A fission product poison can be differentiated from all other fission products because a fission product poison...

A. has a higher microscopic cross section for thermal neutron capture.

B. has a longer half-life.

C. is produced in a greater percentage of thermal fissions.

D. is formed as a gas and is contained in the fuel pellets.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B1858 (P858)

Fission product poisons can be differentiated from other fission products in that fission product poisons...

A. have a longer half-life.

B. are stronger absorbers of thermal neutrons.

C. are produced in a larger percentage of fissions.

D. have a higher fission cross section for thermal neutrons.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B2061 (P2058)

A fission product poison can be differentiated from all other fission products in that a fission product poison will...

A. be produced in direct proportion to the fission rate in the core.

B. remain radioactive for thousands of years after the final reactor criticality.

C. depress the power production in some core locations and cause peaking in others.

D. migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B55

Which one of the following lists the proper order of substances from the <u>largest</u> to the <u>smallest</u> microscopic cross section for absorption of thermal neutrons?

A. B-10, U-235, Xe-135

B. B-10, Xe-135, U-235

C. Xe-135, U-235, B-10

D. Xe-135, B-10, U-235

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B256 (P2658)

Compared to other reactor poisons, the two characteristics that make xenon-135 a <u>major</u> reactor poison are its relatively __________ thermal neutron absorption cross section and its relatively __________ variation in concentration for large reactor power changes.

A. small; large

B. small; small

C. large; small

D. large; large

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1058 (P1858)

Which one of the following is a characteristic of xenon-135?

A. Thermal neutron flux level affects both the production and removal of xenon-135.

B. Thermal neutrons interact with xenon-135 primarily through scattering reactions.

C. Xenon-135 is primarily a resonance absorber of epithermal neutrons.

D. Xenon-135 is produced from the radioactive decay of barium-135.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1259

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

A. Uranium-235

B. Uranium-238

C. Plutonium-239

D. Xenon-135

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1658 (P2458)

Which one of the following has the greatest microscopic cross section for absorption of a thermal neutron?

A. Uranium-235

B. Boron-10

C. Samarium-149

D. Xenon-135

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B3458

Reactors A and B are operating at steady-state 100 percent power with equilibrium xenon-135. The reactors are identical except that reactor A is operating near the end of core life (EOL) and reactor B is operating near the beginning of core life (BOL).

Which reactor has the smaller <u>concentration</u> of xenon-135?

A. Reactor A (EOL), due to the smaller 100 percent power thermal neutron flux.

B. Reactor A (EOL), due to the larger 100 percent power thermal neutron flux.

C. Reactor B (BOL), due to the smaller 100 percent power thermal neutron flux.

D. Reactor B (BOL), due to the larger 100 percent power thermal neutron flux.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B257 (P1859)

What is the major contributor to the production of Xe-135 in a reactor that has been operating at full power for two weeks?

A. Radioactive decay of I-135.

B. Radioactive decay of Cs-135.

C. Direct production from fission of U-235.

D. Direct production from fission of U-238.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B362 (P358)

Xenon-135 is produced in a reactor by two primary methods. One is directly from fission; the other is from the decay of...

A. cesium-135.

B. iodine-135.

C. xenon-136.

D. iodine-136.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B458 (P1359)

A reactor has been operating at full power for several weeks. Xenon-135 is being directly produced as a fission product in approximately __________ percent of all fissions.

A. 100

B. 30

C. 3

D. 0.3

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B859 (P1559)

Which one of the following describes the production mechanisms of xenon-135 in a reactor that is operating at steady-state 100 percent power?

A. Primarily from fission, secondarily from iodine decay

B. Primarily from fission, secondarily from promethium decay

C. Primarily from iodine decay, secondarily from fission

D. Primarily from promethium decay, secondarily from fission

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B2558 (P2558)

Reactors A and B are operating at steady-state 100 percent power with equilibrium xenon-135. The reactors are identical except that reactor A is operating near the end of a fuel cycle (EOC) and reactor B is operating near the beginning of a fuel cycle (BOC).

Which reactor has the greater concentration of xenon-135, and why?

A. Reactor A (EOC), due to the smaller 100 percent power thermal neutron flux.

B. Reactor A (EOC), due to the larger 100 percent power thermal neutron flux.

C. Reactor B (BOC), due to the smaller 100 percent power thermal neutron flux.

D. Reactor B (BOC), due to the larger 100 percent power thermal neutron flux.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B7818 (P7818)

One minute after a reactor scram from steady-state 100 percent reactor power, the greatest rate of xenon-135 production will be from __________; and the greatest rate of xenon-135 removal will be caused by __________.

A. fission; xenon-135 decay

B. fission; neutron capture

C. iodine-135 decay; xenon-135 decay

D. iodine-135 decay; neutron capture

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B128

Which one of the following describes the change in xenon-135 concentration immediately following a power increase from equilibrium xenon-135 conditions?

A. Initially decreases, due to the decreased rate of xenon-135 production from fission.

B. Initially decreases, due to the increased rate of thermal neutron absorption by xenon-135.

C. Initially increases, due to the increased rate of xenon-135 production from fission.

D. Initially increases, due to the decreased rate of thermal neutron absorption by xenon-135.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B258

The two methods of xenon-135 <u>removal</u> from a reactor operating at full power are...

A. gamma decay and beta decay.

B. neutron absorption and fission.

C. fission and gamma decay.

D. beta decay and neutron absorption.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B359 (P1059)

Xenon-135 undergoes radioactive decay to...

A. iodine-135.

B. cesium-135.

C. tellurium-135.

D. lanthanum-135.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B462 (P460)

Reactor power is increased from 50 percent to 60 percent in one hour. What is the most significant contributor to the initial change in xenon-135 reactivity?

A. Production of xenon-135 from fission.

B. Production of xenon-135 from iodine-135 decay.

C. Loss of xenon-135 due to absorption of neutrons.

D. Loss of xenon-135 due to decay to cesium-135.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B860

Which one of the following is the approximate half-life of xenon-135?

A. 19 seconds

B. 6.6 hours

C. 9.1 hours

D. 30 hours

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B959

Which one of the following describes the primary method of xenon-135 removal at steady-state 100 percent power?

A. Decay of xenon-135 to cesium-135.

B. Decay of xenon-135 to iodine-135.

C. Absorption of thermal neutrons.

D. Absorption of fast neutrons.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B3358 (P2659)

A nuclear power plant has been operating at 100 percent power for several months. Which one of the following describes the relative contributions of beta decay and neutron capture to xenon-135 removal from the reactor?

A. Primary is neutron capture; secondary is beta decay.

B. Primary is beta decay; secondary is neutron capture.

C. Beta decay and neutron capture contribute equally.

D. Not enough information is given to make a comparison.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B58 (P61)

A reactor was operating at 50 percent power for one week when power was ramped to 100 percent. Which one of the following describes the equilibrium xenon-135 concentration at 100 percent power?

A. Twice the 50 percent power concentration.

B. Less than twice the 50 percent power concentration.

C. More than twice the 50 percent power concentration.

D. Remains the same, because it is independent of power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B259 (P1459)

Following a two-week shutdown, a reactor is taken critical and ramped to 100 percent power in 6 hours. How long will it take to achieve an equilibrium xenon-135 condition after the reactor reaches 100 percent power?

A. 70 to 80 hours

B. 40 to 50 hours

C. 8 to 10 hours

D. 1 to 2 hours

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B658 (P660)

A reactor was operating at 100 percent power for one week when power was decreased to 50 percent. Which one of the following describes the equilibrium xenon-135 concentration at 50 percent power?

A. The same as the 100 percent power equilibrium concentration.

B. More than one-half the 100 percent power equilibrium concentration.

C. One-half the 100 percent power equilibrium concentration.

D. Less than one-half the 100 percent power equilibrium concentration.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1160 (P1158)

A reactor has been operating at 25 percent power for 24 hours following a two-hour power reduction from steady-state 100 percent power. Which one of the following describes the current status of the xenon-135 concentration?

A. At equilibrium.

B. Decreasing toward an upturn.

C. Decreasing toward equilibrium.

D. Increasing toward a peak.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1363

Which one of the following indicates that core Xe-135 is in equilibrium?

A. Xe-135 is being removed equally by neutron capture and decay.

B. The reactor has been operated at a steady-state power level for five days.

C. Xe-135 is being produced equally by fission and I-135 decay.

D. The reactor is currently operating at 100 percent power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1859

A reactor was operating for 42 weeks at a steady-state 30 percent power when a reactor scram occurred. The reactor was returned to critical after 12 hours and then ramped to 60 percent power over the next 6 hours.

How much time at steady-state 60 percent power will be required to reach an equilibrium xenon-135 concentration?

A. 20 to 30 hours

B. 40 to 50 hours

C. 70 to 80 hours

D. 90 to 100 hours

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1960 (P1360)

A reactor has been operating at a constant 50 percent power level for 15 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Decreasing toward an upturn.

C. Increasing toward equilibrium.

D. Decreasing toward equilibrium.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2659 (P2159)

Which one of the following indicates that core Xe-135 concentration is in equilibrium?

A. Xe-135 production and removal rates are momentarily equal five hours after a power increase.

B. A reactor has been operated at 80 percent power for five days.

C. Xe-135 is being produced equally by fission and I-135 decay.

D. A reactor is currently operating at 100 percent power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2760 (P2859)

Reactors A and B are operating at steady-state 100 percent power with equilibrium xenon-135. The reactors are identical except that reactor A is operating near the end of a fuel cycle (EOC) and reactor B is operating near the beginning of a fuel cycle (BOC).

Which reactor is experiencing the most negative reactivity from equilibrium xenon-135?

A. Reactor A (EOC), due to a greater equilibrium concentration of xenon-135.

B. Reactor A (EOC), due to lower competition from the fuel for thermal neutrons.

C. Reactor B (BOC), due to a greater thermal neutron flux in the core.

D. Reactor B (BOC), due to a smaller accumulation of fission product poisons.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B59

A reactor has been operating at 50 percent power for 1 week. If a reactor power increase to 100 percent is initiated, the xenon-135 concentration will initially…

A. decrease, and then build up to a higher equilibrium concentration.

B. increase, and then build up to a higher equilibrium concentration.

C. decrease, and then return to the same equilibrium concentration.

D. increase, and then return to the same equilibrium concentration.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B660

A reactor was operating at 75 percent power for one week when a power decrease to 50 percent is initiated. How will the xenon-135 concentration initially respond?

A. Decreases, because the xenon-135 production rate from fission has decreased.

B. Increases, because the rate of xenon-135 burnout has increased.

C. Decreases, because the rate of xenon-135 decay exceeds the rate of production from fission.

D. Increases, because the concentration of iodine-135 has increased.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B961

A reactor was operating at 100 percent power for two weeks when power was reduced to 50 percent in one hour. How will the xenon-135 concentration change during the next 24 hours?

A. Increase and stabilize at a higher concentration.

B. Initially increase, and then decrease and stabilize at a lower concentration.

C. Decrease and stabilize at a lower concentration.

D. Initially decrease, and then increase and stabilize at a higher concentration.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B1262 (P1960)

A reactor was operating at 100 percent power for two weeks when power was decreased to 10 percent in one hour. Immediately following the power decrease, xenon-135 concentration will __________ for a period of __________.

A. decrease; 4 to 6 hours

B. increase; 4 to 6 hours

C. decrease; 8 to 11 hours

D. increase; 8 to 11 hours

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B1860

A reactor has been operating at 50 percent power for 15 hours following a rapid power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Decreasing toward an upturn.

C. Increasing toward equilibrium.

D. Decreasing toward equilibrium.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2559 (P3362)

A reactor has been operating at 70 percent power for 20 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Decreasing toward an upturn.

C. Decreasing toward equilibrium.

D. At equilibrium.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2761 (P2261)

A reactor has been operating at 50 percent power for 12 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Decreasing toward an upturn.

C. Increasing toward equilibrium.

D. Decreasing toward equilibrium.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2960 (P2961)

A reactor has been operating at 30 percent power for three hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Increasing toward equilibrium.

C. Decreasing toward an upturn.

D. Decreasing toward equilibrium.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B132

What is the difference in peak xenon-135 concentration following a reactor scram after one week at 100 percent power as compared to a scram after one week at 50 percent power?

A. The time to reach the peak is shorter after a scram from 100 percent power, due to the higher iodine-135 decay rate.

B. The peak concentration after a scram from 50 percent power is smaller in magnitude, due to the lower xenon-135 burnout rate.

C. The peaks are equal, because the decay rate of iodine-135 remains constant.

D. The peak from 100 percent power has a larger magnitude, due to the larger initial iodine-135 concentration.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B260

A reactor has been operating at 25 percent power for five days when a scram occurs. Xenon-135 will peak in approximately...

A. 2 hours.

B. 5 hours.

C. 10 hours.

D. 20 hours.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B861

Which one of the following equilibrium reactor pre-scram conditions produces the greater amount of negative reactivity from peak xenon-135 conditions after a reactor scram? (BOC -- beginning of a fuel cycle; EOC -- end of a fuel cycle.)

A. BOC and 100 percent power

B. EOC and 100 percent power

C. BOC and 20 percent power

D. EOC and 20 percent power

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1361 (P1358)

A reactor has been operating at 75 percent power for two months. A manual reactor scram is required for a test. The scram will be followed immediately by a reactor startup with criticality scheduled to occur 12 hours after the scram.

The greatest assurance that fission product poison reactivity will permit criticality during the startup will exist if the reactor is operated at __________ power for 48 hours prior to the scram; and if criticality is rescheduled for __________ hours after the scram.

A. 100 percent; 8

B. 100 percent; 16

C. 50 percent; 8

D. 50 percent; 16

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1561

The amount of negative reactivity associated with peak xenon-135 is smaller after a reactor scram from equilibrium __________ reactor power at the __________ of a fuel cycle.

A. 20 percent; beginning

B. 20 percent; end

C. 100 percent; beginning

D. 100 percent; end

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B3861 (P3860)

A reactor has been operating at 80 percent power for two months. A manual reactor scram is required for a test. The scram will be followed by a reactor startup with criticality scheduled to occur 24 hours after the scram.

The greater assurance that xenon-135 reactivity will permit criticality during the reactor startup will exist if the reactor is operated at __________ power for 48 hours prior to the scram; and if criticality is rescheduled for __________ hours after the scram.

A. 60 percent; 18

B. 60 percent; 30

C. 100 percent; 18

D. 100 percent; 30

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B6031

A reactor scram occurred one hour ago following several months of operation at 100 percent power. Reactor vessel pressure is being maintained at 800 psia, and the source range count rate is currently 400 cps. If no operator action is taken, how will the source range count rate respond during the next 24 hours? (Assume a constant source neutron flux.)

A. The count rate will remain about the same.

B. The count rate will decrease for the entire period.

C. The count rate will decrease initially, and then increase.

D. The count rate will increase initially, and then decrease.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B7807 (P7807)

A reactor scram occurred 16 hours ago following several months of operation at 100 percent power. Reactor pressure is being maintained at 1,000 psia. The source range count rate is 400 cps, and the source neutron production rate is constant. Assume that no operator action is taken during the next 24 hours.

During the next 24 hours, the source range count rate will…

A. increase for the entire period.

B. decrease for the entire period.

C. initially increase, and then decrease for the rest of the period.

D. initially decrease, and then increase for the rest of the period.

ANSWER: A.

TOPIC 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B135

When comparing control rod worth (CRW) during a reactor startup from 100 percent peak xenon-135 concentration and a reactor startup from xenon-free conditions...

A. center CRW will be higher during the peak xenon startup than during the xenon-free startup.

B. peripheral CRW will be higher during the peak xenon startup than during the xenon-free startup.

C. center and peripheral CRWs will be the same regardless of xenon-135 concentration.

D. it is impossible to determine how xenon-135 will affect the worth of center and peripheral control rods.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B261

A reactor has been operating at full power for several weeks when a scram occurs. When the reactor is brought critical 5 hours later, xenon-135 concentration will be <u>highest</u> in the ___________ of the core, which causes thermal neutron flux to shift toward the ___________ of the core.

A. center; periphery

B. periphery; periphery

C. center; center

D. periphery; center

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B1062

A reactor is operating at 100 percent power with equilibrium xenon-135 near the beginning of a fuel cycle when a scram occurs. When the reactor is taken critical 5 hours later, xenon-135 distribution will be maximum at the __________ of the core.

A. bottom and center

B. bottom and outer circumference

C. top and center

D. top and outer circumference

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2454

Sustained operation at 100 percent power requires periodic withdrawal of control rods to compensate for...

A. buildup of fission product poisons and decreasing control rod worth.

B. fuel depletion and buildup of fission product poisons.

C. decreasing control rod worth and burnable poison burnout.

D. burnable poison burnout and fuel depletion.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2660 (P2359)

Which one of the following explains why xenon-135 oscillations are a concern in a reactor?

A. They can adversely affect core power distribution, and they can require operation below full rated power.

B. They can adversely affect core power distribution, and they can prevent reactor criticality during a reactor startup.

C. They can cause excessively short reactor periods during power operation, and they can require operation below full rated power.

D. They can cause excessively short reactor periods during power operation, and they can prevent reactor criticality during a reactor startup.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2860

A reactor has been operating at 50 percent power for several weeks near the middle of core life with core axial power distribution evenly divided above and below the core midplane. Reactor power is to be increased to 65 percent over a two-hour period using shallow control rods only.

During the power increase, core axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. remain evenly divided above and below the core midplane.

D. have peaks near the top and the bottom of the core.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B3061 (P3060)

A reactor has been operating at 100 percent power for one month following a refueling outage with axial neutron flux distribution peaked in the bottom half of the core. An inadvertent reactor scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. Reactor power is increased to 60 percent over the next 4 hours and then stabilized.

During the one-hour period immediately after power level is stabilized at 60 percent, the core axial neutron flux peak will be located __________ in the core than the pre-scram peak location; and the core axial neutron flux peak will be moving __________.

A. higher; upward

B. higher; downward

C. lower; upward

D. lower; downward

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B262

Following a one-month outage, a reactor is being started up and taken to 100 percent power using a constant ramp rate. To compensate for the effect of xenon-135 while <u>increasing</u> reactor power, it will be necessary to __________ rods and __________ recirculation flow.

A. insert; decrease

B. insert; increase

C. withdraw; increase

D. withdraw; decrease

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B355 (P353)

A nuclear power plant is being returned to operation following a refueling outage. Fuel preconditioning procedures require reactor power to be increased from 10 percent to 100 percent gradually over a one-week period.

During this slow power increase, most of the positive reactivity added by the operator is required to overcome the negative reactivity from...

A. uranium-235 burnup.

B. xenon-135 buildup.

C. fuel temperature increase.

D. moderator temperature increase.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B562 (P561)

Following a 7 day shutdown, a reactor startup is performed and the reactor is taken to 100 percent power over a 16-hour period. After reaching 100 percent power, what type of reactivity addition will be needed to compensate for xenon-135 changes over the next 24 hours?

A. Negative only

B. Negative, then positive

C. Positive only

D. Positive, then negative

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B2861 (P2260)

A reactor is initially shut down with no xenon-135 in the core. Over the next 4 hours, the reactor is made critical and power level is increased to10 percent. The shift supervisor has directed that power be maintained constant at this level for 12 hours.

To accomplish this objective, control rods will have to be...

A. inserted periodically for the duration of the 12 hours.

B. withdrawn periodically for the duration of the 12 hours.

C. inserted periodically for 4 to 6 hours, and then withdrawn periodically.

D. withdrawn periodically for 4 to 6 hours, and then inserted periodically.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B6930

A nuclear power plant was operating at 100 percent power for 3 months near the end of a fuel cycle when a reactor scram occurred. Eighteen hours later, the reactor is critical at the point of adding heat with normal operating reactor vessel temperature and pressure. Power level will be raised to 100 percent over the next 3 hours.

During this power level increase, most of the positive reactivity added by the operator will be required to overcome the negative reactivity from...

A. fuel burnup.

B. xenon-135 buildup.

C. fuel temperature increase.

D. moderator temperature increase.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B57

Following a reactor scram from a long steady-state 100 percent power run, a reactor is to be taken critical. The calculated estimated critical conditions (position) are based on having a xenon-free core.

Which one of the following is the shortest time after the initial scram that a xenon-free core will exist?

A. 8 to 10 hours

B. 15 to 25 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B5631 (P5631)

A reactor was shut down for 7 days to perform maintenance. Then, a reactor startup was performed, and reactor power was increased from 1 percent to 50 percent over a 2 hour period.

Ten hours after reactor power reaches 50 percent, the xenon-135 concentration will be…

A. increasing toward a downturn.

B. increasing toward an equilibrium value.

C. decreasing toward an equilibrium value.

D. decreasing toward an upturn.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1162

A reactor scram recently occurred from steady-state 100 percent power and a reactor startup is currently in progress. Which one of the following sets of initial startup conditions will require the most control rod withdrawal to achieve criticality? (BOC -- beginning of fuel cycle; EOC -- end of fuel cycle.)

	Core Age	Time Since Reactor Scram
A.	BOC	12 hours
B.	BOC	40 hours
C.	EOC	12 hours
D.	EOC	40 hours

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1461

A reactor had been operating at 100 percent power for 2 months when a reactor scram occurred. Four hours later with a startup in progress, reactor power is currently stable at 10 percent. Which one of the following operator actions is required to maintain reactor power at 10 percent over the next 18 hours?

A. Incremental control rod withdrawals throughout the entire period.

B. Incremental control rod insertions throughout the entire period.

C. Incremental control rod withdrawals for several hours, then incremental insertions for the rest of the period.

D. Incremental control rod insertions for several hours, then incremental withdrawals for the rest of the period.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1763 (P1762)

A reactor had been operating for two months at 100 percent power when a scram occurred. Fifteen hours later, during a reactor startup, the reactor has achieved criticality and reactor power is currently 1.0×10^{-4} percent.

Which one of the following describes the response of reactor power over the next 2 hours without any further operator actions?

A. Power increases toward the point of adding heat, due to the decay of Xe-135.

B. Power increases toward the point of adding heat, due to the decay of Sm-149.

C. Power decreases toward a stable shutdown neutron level, due to the buildup of Xe-135.

D. Power decreases toward a stable shutdown neutron level, due to the buildup of Sm-149.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B4430

A reactor scram occurred from steady-state 100 percent power and a reactor startup is currently in progress. Which one of the following sets of initial startup conditions will require the smallest amount of control rod withdrawal to achieve criticality? (BOC-- beginning of fuel cycle; EOC -- end of fuel cycle.)

	Core Age	Time Since Reactor Scram
A.	BOC	12 hours
B.	BOC	40 hours
C.	EOC	12 hours
D.	EOC	40 hours

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B173

A reactor has been operating at 50 percent power for 4 days. Power level is then increased to 100 percent over a one-hour period. After power level reaches 100 percent, how much time will be required for xenon-135 concentration to reach a <u>minimum</u> value?

A. 4 to 8 hours

B. 10 to 15 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B459 (P260)

Two identical reactors have been operating at a constant power level for one week. Reactor A is at 50 percent power and reactor B is at 100 percent power. If both reactors scram at the same time, the xenon-135 negative reactivity will peak first in reactor _____; and the highest xenon-135 reactivity peak will occur in reactor _____.

A. B; B

B. B; A

C. A; B

D. A; A

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1362

A reactor has been operating at 100 percent power for two weeks when power is reduced to 50 percent over 2 hours. To maintain power level stable at 50 percent during the next 2 hours, the operator must add __________ reactivity because xenon-135 concentration is __________.

A. positive; decreasing

B. negative; decreasing

C. positive; increasing

D. negative; increasing

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1759

Which one of the following describes the change in xenon-135 concentration immediately following a 10 percent power increase from equilibrium 70 percent power over a two-hour period?

A. Xe-135 concentration will initially decrease, due to the increased rate of decay of Xe-135 to Cs-135.

B. Xe-135 concentration will initially decrease, due to the increased absorption of thermal neutrons by Xe-135.

C. Xe-135 concentration will initially increase, due to the increased I-135 production rate from fission.

D. Xe-135 concentration will initially increase, due to the increased Xe-135 production rate from fission.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1761 (P1159)

Two identical reactors have been operating at a constant power level for one week. Reactor A is at 100 percent power and reactor B is at 50 percent power. If both reactors scram at the same time, xenon-135 concentration will peak first in reactor _____; and the highest peak xenon-135 concentration will occur in reactor _____.

A. B; B

B. B; A

C. A; B

D. A; A

ANSWER: B.

TOPIC: 292006
KNOWLEDGE K1.11 [2.6/2.7]
QID: B2063

A reactor had been operating at 50 percent power for two weeks when power was increased to 100 percent over a three-hour period. To maintain reactor power stable during the next 24 hours, which one of the following incremental control rod manipulations will be required?

A. Insert rods slowly during the entire period.

B. Insert rods slowly at first, and then withdraw rods slowly.

C. Withdraw rods slowly during the entire period.

D. Withdraw rods slowly at first, and then insert rods slowly.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2158 (P2061)

A reactor had been operating at 100 percent power for two weeks when power was reduced to 50 percent over a one-hour period. To maintain reactor power stable during the next 24 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, and then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, and then withdraw rods slowly.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2259 (P1860)

Which one of the following describes the <u>initial</u> change in xenon-135 concentration immediately following a power increase from steady-state power operation?

A. Decreases, due to the increased rate of xenon-135 radioactive decay.

B. Decreases, due to the increased rate of neutron absorption by xenon-135.

C. Increases, due to the increased xenon-135 production rate from fission.

D. Initially increases, due to the increased iodine-135 production rate from fission.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2561

A reactor is initially operating at 100 percent power with equilibrium xenon-135. Power is decreased to 50 percent over a one-hour period. No subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes reactor power 10 hours after the power change is completed?

A. Less than 50 percent and decreasing slowly.

B. Less than 50 percent and increasing slowly.

C. Greater than 50 percent and decreasing slowly.

D. Greater than 50 percent and increasing slowly.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2762

A reactor is initially operating at 60 percent power with equilibrium xenon-135. Power is increased to 80 percent over a two-hour period. No subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes reactor power 24 hours after the power change is completed?

A. Greater than 80 percent and decreasing slowly.

B. Greater than 80 percent and increasing slowly.

C. Less than 80 percent and decreasing slowly.

D. Less than 80 percent and increasing slowly.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2862

A reactor has been operating at 50 percent power for 3 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current xenon-135 concentration?

A. Increasing toward a peak.

B. Decreasing toward an upturn.

C. Increasing toward equilibrium.

D. Decreasing toward equilibrium.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B3259

A reactor is initially operating at equilibrium 100 percent power. An operator inserts control rods intermittently over a period of 30 minutes. At the end of this time period, reactor power is 70 percent.

Assuming no additional operator actions are taken, what will power level be after an additional 60 minutes?

A. 70 percent and stable.

B. Less than 70 percent and slowly increasing.

C. Less than 70 percent and slowly decreasing.

D. Less than 70 percent and stable.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B7657 (P7657)

With xenon-135 initially at equilibrium, which one of the following power changes will produce the greater change in equilibrium xenon-135 negative reactivity?

A. 0 percent to 10 percent

B. 30 percent to 40 percent

C. 60 percent to 70 percent

D. 90 percent to 100 percent

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B463

A reactor has been operating at 100 percent power for several weeks. Following a reactor scram, the reactor will <u>first</u> be considered xenon-free after...

A. 40 to 50 hours.

B. 70 to 80 hours.

C. 100 to 110 hours.

D. 130 to 140 hours.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B1462

A reactor scram has occurred following two months of operation at steady-state 100 percent power. How soon after the scram will the reactor first be considered xenon-free?

A. 8 to 10 hours

B. 24 to 30 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2159 (P1063)

A reactor had operated at 100 percent power for three weeks when a reactor scram occurred. Which one of the following describes the concentration of xenon-135 in the core 24 hours after the scram?

A. At least twice the concentration at the time of the scram and decreasing.

B. Less than one-half the concentration at the time of the scram and decreasing.

C. At or approaching a peak concentration.

D. Approximately the same as the concentration at the time of the scram.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2262 (P863)

Twenty-four hours after a reactor scram from 100 percent power with equilibrium xenon-135, the xenon-135 concentration will be approximately...

A. the same as the concentration at the time of the scram and decreasing.

B. the same as the concentration at the time of the scram and increasing.

C. 50 percent lower than the concentration at the time of the scram and decreasing.

D. 50 percent higher than the concentration at the time of the scram and increasing.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2461 (P2262)

Fourteen hours after a reactor scram from 100 percent power with equilibrium xenon-135, the concentration of xenon-135 will be __________ than the 100 percent power equilibrium xenon-135 concentration; and xenon-135 will have added a net __________ reactivity since the scram.

A. less; positive

B. less; negative

C. greater; positive

D. greater; negative

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2662

Given:

- A reactor was operating at 100 percent power for 6 weeks when a scram occurred.
- A reactor startup was performed and criticality was reached 16 hours after the scram.
- Two hours later, the reactor is currently at 30 percent power.

If no operator actions occur during the next hour, reactor power will ___________ because the xenon-135 concentration is ___________.

A. increase; decreasing

B. increase; increasing

C. decrease; decreasing

D. decrease; increasing

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2763 (P2762)

A reactor that had been operating at 100 percent power for about two months was shut down over a two-hour period. Following the shutdown, xenon-135 will reach a steady-state concentration in ___________ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.13 [2.6/2.6]
QID: B63

If a reactor that has operated at 100 percent power for 10 days is shut down rapidly, the xenon-135 concentration will...

A. slowly decrease to almost zero in 3 days.

B. increase to a new equilibrium concentration in 3 days.

C. peak in about a half day, and then decrease to almost zero in 3 days.

D. decrease directly with reactor power.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.13 [2.6/2.6]
QID: B1463

Which one of the following describes a reason for the direction of change in xenon-135 reactivity immediately after a reactor shutdown from long-term power operation?

A. The production rate of Xe-135 from I-135 decay significantly decreases.

B. The production rate of Xe-135 directly from fission significantly decreases.

C. The removal rate of Xe-135 by decay to I-135 significantly decreases.

D. The removal rate of Xe-135 by neutron absorption significantly decreases.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B56

A reactor has been shut down for two weeks after six months of 100 percent power operation. A reactor startup is performed and reactor power is stabilized at 10 percent. What control rod movements are required to maintain power level stable at 10 percent over the next two hours?

A. Rod insertions to compensate for samarium-149 burnout.

B. Rod withdrawals to compensate for samarium-149 buildup.

C. Rod insertions to compensate for xenon-135 burnout.

D. Rod withdrawals to compensate for xenon-135 buildup.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B62

A reactor had been operating at 100 percent power for about two weeks when power level was reduced to 50 percent in one hour. To compensate for changing xenon-135 concentration during the next 4 hours, the operator must add...

A. positive reactivity, because the xenon-135 concentration is decreasing.

B. negative reactivity, because the xenon-135 concentration is decreasing.

C. positive reactivity, because the xenon-135 concentration is increasing.

D. negative reactivity, because the xenon-135 concentration is increasing.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B263

A reactor had been operating at 100 percent power for 10 weeks when a scram occurred. The reactor was made critical 24 hours later, and power level is currently being maintained low in the intermediate range.

To maintain a constant power level for the next several hours, control rods must be...

A. inserted, because xenon-135 burnout will cause increased neutron flux peaking near the periphery of the core.

B. maintained at the present position as xenon-135 establishes equilibrium for the current power level.

C. inserted, because xenon-135 will essentially follow its normal decay curve.

D. withdrawn, because xenon-135 concentration is increasing toward equilibrium.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B363

Initially, a reactor is shut down with no xenon-135 in the core. Then, the reactor is taken critical, and 4 hours later power level is low in the intermediate range. The maintenance department has asked that power be maintained constant at this level for approximately 12 hours.

To maintain a constant power level, the control rods will have to be periodically...

A. withdrawn for the duration of the 12 hours.

B. inserted for the duration of the 12 hours.

C. withdrawn for 4 to 6 hours, and then inserted.

D. inserted for 4 to 6 hours, and then withdrawn.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B461

Four hours after a reactor scram from 100 percent power with equilibrium xenon-135, the reactor has been taken critical and is currently at 10 percent power. To maintain power level at 10 percent during the next two hours, the operator must add __________ reactivity because the xenon-135 concentration is __________.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B964

Sixteen hours after a reactor scram from 100 percent power with equilibrium xenon-135, the concentration of xenon-135 will be...

A. less than 100 percent equilibrium xenon-135, and will have added a net positive reactivity since the scram.

B. greater than 100 percent equilibrium xenon-135, and will have added a net positive reactivity since the scram.

C. less than 100 percent equilibrium xenon-135, and will have added a net negative reactivity since the scram.

D. greater than 100 percent equilibrium xenon-135, and will have added a net negative reactivity since the scram.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1164

A reactor was operating at 100 percent power with equilibrium xenon-135 at the beginning of a fuel cycle when a reactor scram occurred. If the reactor is taken critical 4 hours later, which one of the following describes the effect of xenon-135 on control rod worth when the reactor becomes critical?

A. Increasing xenon-135 concentration at the periphery of the core is causing periphery control rods to exhibit increasing worth.

B. Increasing thermal neutron flux at the periphery of the core is causing periphery control rods to exhibit increasing worth.

C. Increasing thermal neutron flux at the center of the core is causing center control rods to exhibit increasing worth.

D. Decreasing xenon-135 concentration at the center of the core is causing center control rods to exhibit increasing worth.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1663

Initially, a reactor is operating at 50 percent power with equilibrium xenon-135. Then, power level is increased to 75 percent over a one-hour period, and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes reactor power 6 hours after the power change?

A. Greater than 75 percent, and decreasing slowly.

B. Greater than 75 percent, and increasing slowly.

C. Lower than 75 percent, and decreasing slowly.

D. Lower than 75 percent, and increasing slowly.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1762

A reactor is operating at 100 percent power with equilibrium xenon-135 at the beginning of a fuel cycle when a reactor scram occurs. The reactor is taken critical 4 hours later.

Which one of the following describes the effect of xenon-135 on control rod worth when the reactor becomes critical?

A. High xenon-135 concentration at the periphery of the core will cause peripheral rods to exhibit higher worth.

B. High xenon-135 concentration at the periphery of the core will cause central rods to exhibit higher worth.

C. High xenon-135 concentration at the center of the core will cause peripheral rods to exhibit higher worth.

D. High xenon-135 concentration at the center of the core will cause central rods to exhibit higher worth.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1862 (P361)

A nuclear power plant has been operating at 100 percent power for two months when a reactor scram occurs. Shortly after the reactor scram, a reactor startup is commenced. Four hours after the scram, reactor power is at 5 percent. To maintain reactor power at 5 percent over the next hour, the operator must add...

A. positive reactivity, because the xenon-135 concentration is increasing.

B. negative reactivity, because the xenon-135 concentration is increasing.

C. positive reactivity, because the xenon-135 concentration is decreasing.

D. negative reactivity, because the xenon-135 concentration is decreasing.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2062

A reactor is initially operating at 100 percent power with equilibrium xenon-135. Power level is decreased to 75 percent over a one-hour period and stabilized. No subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes reactor power 10 hours after the power change?

A. Greater than 75 percent and decreasing slowly.

B. Greater than 75 percent and increasing slowly.

C. Less than 75 percent and decreasing slowly.

D. Less than 75 percent and increasing slowly.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2263

A reactor is currently operating at 80 percent power immediately after a one-hour power reduction from steady-state 100 percent power. To maintain reactor power at 80 percent over the next 3 hours, the operator must __________ control rods or __________ reactor recirculation flow rate.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2361 (P2360)

A reactor had been operating at 70 percent power for two weeks when power was increased to 100 percent over a two-hour period. To offset xenon-135 reactivity changes during the next 12 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, and then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, and then withdraw rods slowly.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2964

A reactor is currently operating at 60 percent power immediately after a one-hour power increase from steady-state 40 percent power. To maintain reactor power at 60 percent over the next 2 hours, the operator must __________ control rods or __________ reactor recirculation flow rate.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3063

A reactor is initially operating at 100 percent power with equilibrium xenon-135. Power level is decreased to 75 percent over a one-hour period and stabilized. No subsequent operator actions are taken.

Considering <u>only</u> the reactivity effects of xenon-135 changes, which one of the following describes reactor power 30 hours after the power change?

A. Less than 75 percent and increasing slowly.

B. Less than 75 percent and decreasing slowly.

C. Greater than 75 percent and increasing slowly.

D. Greater than 75 percent and decreasing slowly.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3563 (P3563)

A nuclear power plant had been operating at 100 percent power for two months when a reactor scram occurred. Soon afterward, a reactor startup was performed. Twelve hours after the scram, the startup has been paused with reactor power at 5 percent.

To maintain reactor power at 5 percent over the next hour, the operator must add __________ reactivity because the xenon-135 concentration will be __________.

A. positive; increasing

B. negative; increasing

C. positive; decreasing

D. negative; decreasing

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3863

A reactor has been operating at steady-state 100 percent power for three weeks. The operator slowly adds negative reactivity over a period of 20 minutes to reduce reactor power to 90 percent.

Which one of the following describes reactor power 60 minutes after power level reaches 90 percent if no additional operator action is taken?

A. Greater than 90 percent and increasing slowly.

B. Greater than 90 percent and decreasing slowly.

C. Less than 90 percent and increasing slowly.

D. Less than 90 percent and decreasing slowly.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B4631

Six hours after a reactor scram from steady-state 100 percent power operation, a reactor is taken critical and power is immediately stabilized low in the intermediate range. To maintain the reactor critical at a constant power level for the next hour, the operator must add __________ reactivity because the xenon-135 concentration is __________.

A. negative; increasing

B. negative; decreasing

C. positive; increasing

D. positive; decreasing

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B6831 (P6831)

A reactor has been shut down for 7 days following 2 months of steady-state 100 percent power operation. A reactor startup is then performed and the reactor is taken to 100 percent power over a 12-hour period. After 100 percent power is reached, what incremental control rod positioning will be needed to compensate for xenon-135 changes over the next 24 hours?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, and then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, and then withdraw rods slowly.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B7431 (P7431)

A nuclear power plant was initially operating at steady-state 100 percent power at the end of a fuel cycle (EOC) when the plant was shut down for refueling. After refueling, the reactor was restarted and the plant is currently operating at steady-state 100 percent power at the beginning of a fuel cycle (BOC). Assume the average energy released by each fission did <u>not</u> change.

Compared to the equilibrium xenon-135 concentration at 100 percent power just prior to the refueling, the <u>current</u> equilibrium xenon-135 concentration is…

A. greater, because the higher fission rate at BOC produces xenon-135 at a faster rate.

B. greater, because the lower thermal neutron flux at BOC removes xenon-135 at a slower rate.

C. smaller, because the lower fission rate at BOC produces xenon-135 at a slower rate.

D. smaller, because the higher thermal neutron flux at BOC removes xenon-135 at a faster rate.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B7531

A nuclear power plant had been shut down for two weeks near the middle of a fuel cycle when a reactor startup was commenced. Twelve hours later, reactor power is 100 percent, where it is being maintained. Which one of the following is the primary reason for periodically withdrawing control rods during the next 36 hours?

A. To offset the buildup of xenon-135.

B. To offset the depletion of the reactor fuel.

C. To maintain an adequate shutdown margin.

D. To maintain reactor heat flux below the critical heat flux.

ANSWER: A.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B64

Which one of the following describes burnable poisons?

A. Fuel mixtures containing isotopes with large macroscopic cross sections for scattering to improve neutron thermalization.

B. Thermal neutron absorbing material added to the fuel during manufacturing to increase allowable core fuel load.

C. Thermal neutron absorbing material produced in the non-fissionable fuel isotopes by fast neutron absorption.

D. Fast neutron absorbing material loaded into the upper one-third of the core to aid in flattening the thermal neutron flux.

ANSWER: B.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B136

Burnable poisons are placed in a reactor to...

A. increase the amount of fuel that can be loaded into the core.

B. accommodate control rod depletion that occurs over core life.

C. compensate for the buildup of xenon-135 that occurs over core life.

D. ensure the reactor will always operate in an undermoderated condition.

ANSWER: A.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B264

Burnable poisons are loaded into a reactor to...

A. reduce the rod shadowing effect between shallow rods early in core life.

B. provide for flux shaping in areas of deep rods during high power operation.

C. increase the excess reactivity that can be loaded into the core during refueling.

D. ensure the moderator temperature coefficient of reactivity remains negative throughout core life.

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B364 (P362)

Which one of the following is <u>not</u> a function performed by burnable poisons in an operating reactor?

A. Provide neutron flux shaping.

B. Provide more uniform power density.

C. Offset the effects of control rod burnout.

D. Allow higher enrichment of new fuel assemblies.

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B1265

Gadolinium (Gd-155, Gd-157) is used instead of boron (B-10) as the __________ material; when compared to boron, gadolinium has a much __________ cross section for absorbing thermal neutrons.

A. control rod; larger

B. burnable poison; larger

C. control rod; smaller

D. burnable poison; smaller

ANSWER: B.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B2564

Why are burnable poisons installed in a reactor?

A. To compensate for control rod burnout during a fuel cycle.

B. To flatten the radial thermal neutron flux distribution near the end of a fuel cycle.

C. To ensure a negative moderator temperature coefficient exists early in a fuel cycle.

D. To shield some of the reactor fuel from thermal neutron flux until later in a fuel cycle.

ANSWER: D.

TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B564

At the beginning of a fuel cycle (BOC), the control rods are inserted relatively deep into the core at 100 percent power. At the end of a fuel cycle (EOC), the control rods are nearly fully withdrawn at 100 percent power.

Which one of the following is the primary reason for the change in the full power control rod position?

A. Reactivity from the power defect is much less at EOC.

B. Reactivity from the void coefficient is much greater at EOC.

C. The excess reactivity in the core is much less at EOC.

D. The integral control rod worth is much greater at EOC.

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1163 (P1264)

Refer to the drawing of K_{eff} versus core age (see figure below).

The major cause for the change in K_{eff} from point 1 to point 2 is the…

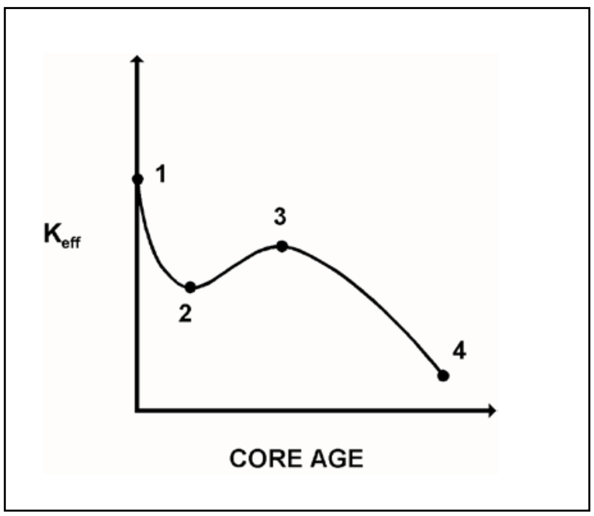
A. depletion of fuel.

B. burnout of burnable poisons.

C. initial heatup of the reactor.

D. buildup of fission product poisons.

ANSWER: D.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1364

Refer to the drawing of K_{eff} versus core age (see figure below).

The major cause for the change in K_{eff} from point 2 to point 3 is the...

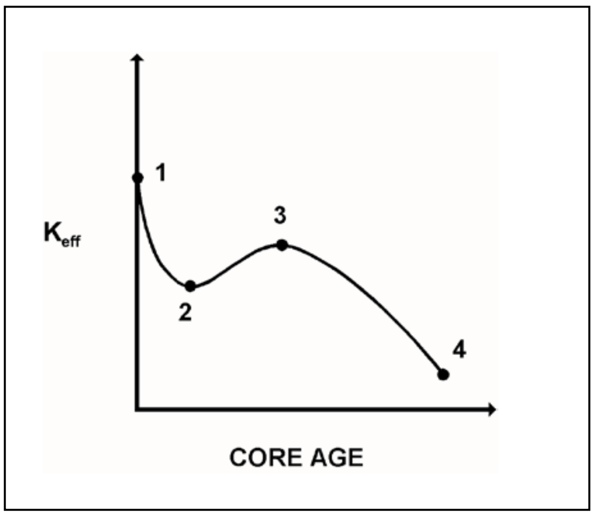
A. depletion of fuel.

B. depletion of control rods.

C. burnout of burnable poisons.

D. burnout of fission product poisons.

ANSWER: C.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1563

Refer to the drawing of K_{eff} versus core age (see figure below).

The major cause for the change in K_{eff} from point 3 to point 4 is the...

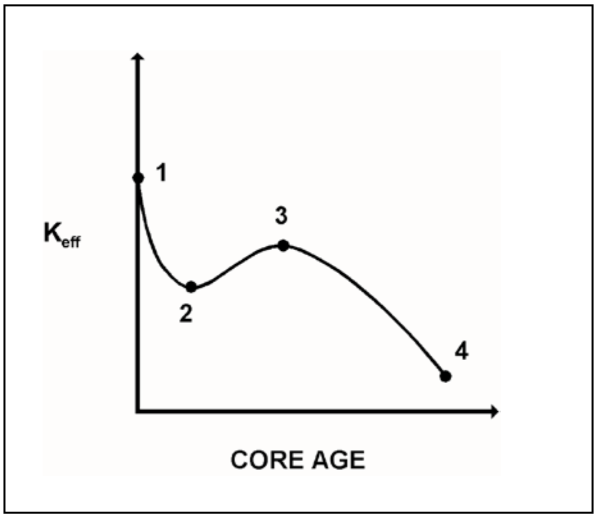
A. depletion of U-235.

B. depletion of U-238.

C. burnout of burnable poisons.

D. buildup of fission product poisons.

ANSWER: A.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B3264

Refer to the curve of K_{eff} versus core age for an operating reactor (see figure below).

The reactor has been operating at 100 percent power for several weeks and is currently operating between points 2 and 3 on the curve.

Assuming reactor recirculation flow rate remains the same, what incremental control rod operation(s) will be needed to maintain 100 percent power until point 3 is reached?

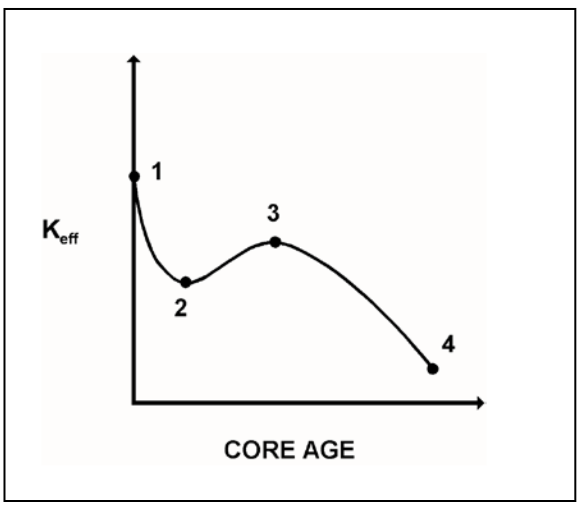
A. Withdrawal for the entire period.

B. Withdrawal at first, then insertion.

C. Insertion for the entire period.

D. Insertion at first, then withdrawal.

ANSWER: C.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B4832

Which one of the following contributes to the need for a much greater control rod density at 100 percent power near the beginning of a fuel cycle (BOC) compared to the end of a fuel cycle (EOC)?

A. The negative reactivity from burnable poisons is greater at BOC.

B. The negative reactivity from fission product poisons is smaller at BOC.

C. The positive reactivity contained in the fuel bundles is smaller at BOC.

D. The positive reactivity from a one-notch withdrawal of a typical control rod is greater at BOC.

ANSWER: B.

TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B7788

Which one of the following contributes to the need for a much smaller control rod density at steady-state 100 percent power near the end of a fuel cycle (EOC) compared to the beginning of a fuel cycle (BOC)?

A. The negative reactivity from burnable poisons is smaller at EOC.

B. The negative reactivity from fission product poisons is smaller at EOC.

C. The positive reactivity contained in the fuel bundles is smaller at EOC.

D. The positive reactivity from a one-notch withdrawal of a typical control rod is greater at EOC.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.02 [3.8/3.8]
QID: B1065

A refueling outage has just been completed, and a reactor startup is being commenced. Which one of the following lists the method(s) typically used to add positive reactivity during the approach to criticality?

A. Control rods only

B. Recirculation flow only

C. Control rods and recirculation flow

D. Recirculation flow and steaming rate

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B266 (P65)

While withdrawing control rods during a reactor startup, the stable source range count rate doubled. If the same amount of reactivity that caused the first doubling is added again, the stable count rate will __________; and the reactor will be __________.

A. more than double; subcritical

B. more than double; critical

C. double; subcritical

D. double; critical

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1449 (P1348)

A reactor is shut down by 1.8 %ΔK/K. Positive reactivity is added that increases the stable source range count rate from 15 cps to 300 cps.

What is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1565 (P1065)

During a reactor startup, equal amounts of positive reactivity are being sequentially added, and the source range count rate is allowed to reach equilibrium after each addition. Which one of the following statements applies for each successive reactivity addition?

A. The time required to reach equilibrium count rate is the same.

B. The time required to reach equilibrium count rate is shorter.

C. The numerical change in equilibrium count rate is greater.

D. The numerical change in equilibrium count rate is the same.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1766 (P2468)

A reactor startup is in progress with a current K_{eff} of 0.95 and a stable source range count rate of 150 cps. Which one of the following stable count rates will occur when K_{eff} becomes 0.98?

A. 210 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1849 (P1448)

A subcritical reactor has a stable source range count rate of 150 cps with a shutdown reactivity of -2.0 %ΔK/K. Approximately how much positive reactivity must be added to establish a stable count rate of 600 cps?

A. 0.5 %ΔK/K

B. 1.0 %ΔK/K

C. 1.5 %ΔK/K

D. 2.0 %ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1949 (P448)

A subcritical reactor has a stable source range count rate of 150 cps with a shutdown reactivity of −2.0 %ΔK/K. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5 %ΔK/K

B. 1.0 %ΔK/K

C. 1.5 %ΔK/K

D. 2.0 %ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1964

A reactor startup is in progress and the reactor is slightly subcritical with a stable source range count rate. Assuming the reactor remains subcritical, a short control rod withdrawal will cause the reactor period to become positive, and then...

A. gradually lengthen and stabilize at a negative 80-second period.

B. gradually lengthen and stabilize at infinity.

C. gradually lengthen until reactor power reaches the point of adding heat, then stabilize at infinity.

D. gradually lengthen until the neutron population reaches equilibrium, then stabilize at a negative 80-second period.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2069

A reactor startup is in progress with a current K_{eff} of 0.95 and a stable source range count rate of 120 cps. Which one of the following stable count rates will occur when K_{eff} becomes 0.98?

A. 210 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2149 (P848)

A subcritical reactor has an initial K_{eff} of 0.8 with a stable source range count rate of 100 cps. If positive reactivity is added until K_{eff} equals 0.95, at what value will the count rate stabilize?

A. 150 cps

B. 200 cps

C. 300 cps

D. 400 cps

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2165 (P1766)

A reactor startup is in progress with the reactor currently subcritical.

Which one of the following describes the change in source range count rate resulting from a short control rod withdrawal with K_{eff} at 0.95 compared to an identical control rod withdrawal with K_{eff} at 0.98? (Assume the reactivity additions are equal and the reactor remains subcritical.)

A. Both the prompt jump in count rate and the increase in stable count rate will be the same for both values of K_{eff}.

B. Both the prompt jump in count rate and the increase in stable count rate will be smaller with K_{eff} at 0.95.

C. The prompt jump in count rate will be smaller with K_{eff} at 0.95, but the increase in stable count rates will be the same.

D. The prompt jump in count rates will be the same, but the increase in stable count rate will be smaller with K_{eff} at 0.95.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2365 (P2366)

A reactor startup is in progress with a current K_{eff} of 0.95 and a stable source range count rate of 120 cps. Which one of the following stable count rates will occur when K_{eff} becomes 0.97?

A. 200 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2465 (P2466)

A reactor startup is being performed by adding equal amounts of positive reactivity and waiting for source range count rate to stabilize. As the reactor approaches criticality, the numerical change in stable count rate resulting from each reactivity addition will __________; and the time required for the count rate to stabilize after each reactivity addition will __________.

A. increase; remain the same

B. increase; increase

C. remain the same; remain the same

D. remain the same; increase

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2566

A reactor startup is in progress with a current K_{eff} of 0.95 and a stable source range count rate of 120 cps. Which one of the following stable count rates will occur when K_{eff} becomes 0.985?

A. 250 cps

B. 300 cps

C. 350 cps

D. 400 cps

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2649 (P2448)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995 and source range count rate stabilizes at 1,000 cps. No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A. Less than 1,000 cps and decreasing toward the prestartup count rate.

B. Less than 1,000 cps and stable above the prestartup count rate.

C. Greater than 1,000 cps and increasing toward criticality.

D. 1,000 cps and constant.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2949

A nuclear power plant is being cooled down from 400°F to 250°F. Just prior to commencing the cooldown, the stable source range count rate was 32 cps. When reactor coolant temperature is 300°F, the stable count rate is 64 cps.

Assuming the moderator temperature coefficient remains constant throughout the cooldown, what will be the status of the reactor when reactor coolant temperature reaches 250°F?

A. Subcritical, with a source range count rate below 150 cps.

B. Subcritical, with a source range count rate above 150 cps.

C. Critical, with a source range count rate below 150 cps.

D. Critical, with a source range count rate above 150 cps.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B3049 (P3048)

A reactor startup is being commenced with the initial source range count rate stable at 20 cps. After a period of control rod withdrawal, the count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal was 4.5 %ΔK/K, how much additional positive reactivity must be inserted to make the reactor critical?

A. 1.5 %ΔK/K

B. 2.0 %ΔK/K

C. 2.5 %ΔK/K

D. 3.0 %ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [3.8/3.9]
QID: B3365

A nuclear power plant was operating at steady-state 100 percent power near the end of a fuel cycle when a reactor scram occurred. Four hours after the scram, reactor pressure is currently being maintained at 600 psig in anticipation of commencing a reactor startup.

Which one of the following will cause the core fission rate to increase?

A. The operator fully withdraws the first group of control rods.

B. Reactor vessel pressure is allowed to increase by 20 psig.

C. Reactor coolant temperature is allowed to increase by 3°F.

D. An additional 2 hours are allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [3.8/3.9]
QID: B3465

A nuclear power plant was operating at steady-state 100 percent power near the end of a fuel cycle when a reactor scram occurred. Four hours after the scram, reactor pressure is currently being maintained at 600 psig in anticipation of commencing a reactor startup.

Which one of the following will cause the core fission rate to decrease?

A. Core void fraction is decreased by 2 percent.

B. Reactor coolant temperature is allowed to decrease by 3°F.

C. The operator fully withdraws the first group of control rods.

D. An additional 2 hours are allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B3925 (P3925)

A reactor startup is in progress with K_{eff} initially equal to 0.90. By what factor will the core neutron level increase if the reactor is stabilized when K_{eff} equals 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B4225 (P4225)

A reactor is shutdown with a K_{eff} of 0.96 and a stable source range count rate of 50 cps when a reactor startup is commenced. Which one of the following will be the stable count rate when K_{eff} reaches 0.995?

A. 400 cps

B. 800 cps

C. 4,000 cps

D. 8,000 cps

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B4525 (P4525)

A nuclear power plant is being cooled down from 500°F to 190°F. Just prior to commencing the cooldown, the source range count rate was stable at 32 cps. After two hours, with reactor water temperature at 350°F, the source range count rate is stable at 64 cps.

Assume the moderator temperature coefficient remains constant throughout the cooldown and reactor power remains below the point of adding heat.

Without additional operator action, what will the status of the reactor be when reactor water temperature reaches 190°F?

A. Subcritical, with source range count rate below 150 cps.

B. Subcritical, with source range count rate above 150 cps.

C. Exactly critical.

D. Supercritical.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B4533

A reactor is critical in the source range during a reactor startup with a core effective delayed neutron fraction of 0.007. The operator then adds positive reactivity to establish a stable 60-second reactor period.

If the core effective delayed neutron fraction had been 0.005, what would the approximate stable reactor period be after the addition of the same amount of positive reactivity?

A. 28 seconds

B. 32 seconds

C. 36 seconds

D. 40 seconds

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B5225 (P5225)

Initially, a reactor was shut down with a stable source range count rate of 30 cps. Using many small positive reactivity additions, a total of 0.1 %ΔK/K was added to the reactor. Currently, the source range count rate is stable at 60 cps.

What was the stable source range count rate after only 0.05 %ΔK/K was added to the reactor during the above process?

A. 40 cps

B. 45 cps

C. 50 cps

D. 55 cps

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B5625

A reactor startup is in progress at a BWR nuclear power plant. The following stable conditions currently exist:

Reactor coolant temperature	= 180°F
Control rod density	= 50 percent
Source range count rate	= 32 cps

Control rods are withdrawn to a control rod density of 45 percent, where the source range count rate stabilizes at 48 cps.

Assume that control rod differential reactivity worth remains constant during the withdrawal, reactor coolant temperature remains constant, and no reactor protection actuations occur.

If control rods are withdrawn further to a control rod density of 40 percent, what will be the status of the reactor?

A. Subcritical, with a stable source range count rate of approximately 64 cps.

B. Subcritical, with a stable source range count rate of approximately 96 cps.

C. Critical, with a stable source range count rate of approximately 64 cps.

D. Critical, with a stable source range count rate of approximately 96 cps.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B7433 (P5025)

Initially, a nuclear power plant was shut down with a K_{eff} of 0.92, and a stable source range count rate of 200 cps. Then, a reactor startup was initiated. All control rod motion was stopped when K_{eff} reached 0.995. The instant that control rod motion stopped, the source range count rate was 1,800 cps.

When the source range count rate stabilizes, the count rate will be approximately...

A. 1,800 cps

B. 3,200 cps

C. 3,400 cps

D. 5,000 cps

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B7627 (P7627)

Refer to the drawing that shows a graph of fission rate versus time (see figure below). Both axes have linear scales.

Which one of the following events, initiated at 0 seconds, could cause the reactor response shown on the graph?

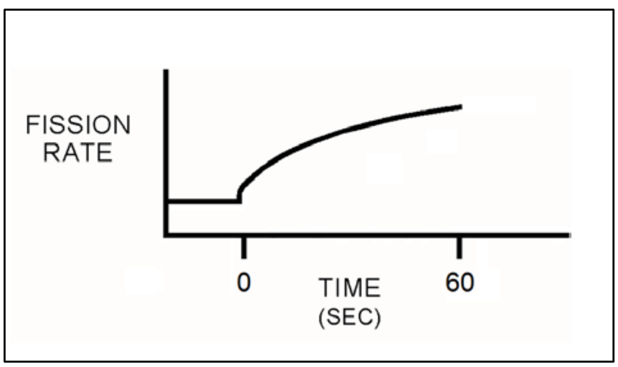
A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range, and remains subcritical for the duration of the 60-second interval shown.

B. A step addition of positive reactivity to a reactor that is initially critical in the source range, and remains below the point of adding heat for the duration of the 60-second interval shown.

C. A continuous addition of positive reactivity at a constant rate to a reactor that is initially subcritical in the source range, and remains subcritical for the duration of the 60-second interval shown.

D. A continuous addition of positive reactivity at a constant rate to a reactor that is initially critical in the source range, and remains below the point of adding heat for the duration of the 60-second interval shown.

ANSWER: A.



TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B7668 (P7668)

At the beginning of a reactor startup, K_{eff} was 0.97 and the stable source range count rate was 40 cps. After several incremental control rod withdrawals, the stable source range count rate was 400 cps. The next incremental control rod withdrawal resulted in a stable source range count rate of 600 cps. What is the current K_{eff}?

A. 0.98

B. 0.988

C. 0.998

D. There is not enough information given to calculate the current K_{eff}.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B67

As a reactor approaches criticality during a reactor startup, it takes longer to reach a stable source range count rate after each control rod withdrawal due to the increased...

A. fraction of fission neutrons leaking from the core.

B. number of neutron generations required to reach a stable neutron level.

C. length of time from neutron generation to absorption.

D. fraction of delayed neutrons appearing as criticality is approached.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B365 (P365)

A reactor startup is in progress with a stable source range count rate and the reactor is near criticality. Which one of the following statements describes count rate characteristics during and after a 5-second control rod withdrawal? (Assume the reactor remains subcritical.)

A. There will be no change in count rate until criticality is achieved.

B. The count rate will rapidly increase (prompt jump) to a stable higher value.

C. The count rate will rapidly increase (prompt jump), then gradually increase and stabilize at a higher value.

D. The count rate will rapidly increase (prompt jump), then gradually decrease and stabilize at the original value.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B366 (P2265)

With K_{eff} at 0.95 during a reactor startup, source range indication is stable at 100 cps. After a number of control rods have been withdrawn, source range indication stabilizes at 270 cps. What is the current value of K_{eff}?

A. 0.963

B. 0.972

C. 0.981

D. 0.990

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B865

Which one of the following is a significant factor when calculating the critical rod position for a reactor startup?

A. Core flow rate

B. Source range initial count rate

C. Recirculation ratio

D. Core age

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1067 (P1972)

With K_{eff} at 0.92 during a reactor startup, the stable source range count rate is noted to be 780 cps. Later in the same startup, the stable count rate is 4,160 cps.

What is the current value of K_{eff}?

A. 0.945

B. 0.950

C. 0.975

D. 0.985

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1566 (P266)

During a reactor startup, the operator adds 1.0 %ΔK/K of positive reactivity by withdrawing control rods, thereby increasing the stable source range count rate from 220 cps to 440 cps.

Approximately how much additional positive reactivity is required to raise the stable count rate to 880 cps?

A. 4.0 %ΔK/K

B. 2.0 %ΔK/K

C. 1.0 %ΔK/K

D. 0.5 %ΔK/K

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2167 (P1867)

During a reactor startup, the first reactivity addition caused the stable source range count rate to increase from 20 cps to 40 cps. The second reactivity addition caused the stable count rate to increase from 40 cps to 80 cps. K_{eff} was 0.92 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

A. The first reactivity addition was approximately twice as large as the second.

B. The second reactivity addition was approximately twice as large as the first.

C. The first and second reactivity additions were approximately the same.

D. There is not enough data given to determine the relationship between reactivity values.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2249 (P2248)

Two reactors are currently shut down with reactor startups in progress. The reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B has a source neutron strength of 200 neutrons per second. The control rods are stationary and K_{eff} is 0.98 in both reactors. Core neutron levels have stabilized in both reactors.

Which one of the following lists the core neutron levels (neutrons per second) in reactors A and B?

	Reactor A (n/sec)	Reactor B (n/sec)
A.	5,000	10,000
B.	10,000	20,000
C.	10,000	40,000
D.	20,000	40,000

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2266 (P1866)

As a reactor approaches criticality during a reactor startup, it takes longer to reach an equilibrium source range count rate after each control rod withdrawal due to the increased...

A. length of time required to complete a neutron generation.

B. number of neutron generations required to reach a stable neutron level.

C. length of time from neutron birth to absorption.

D. fraction of delayed fission neutrons being produced.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2449

Two reactors are currently shut down with reactor startups in progress. The reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B has a source neutron strength of 80 neutrons per second. The control rods are stationary and K_{eff} is 0.98 in both reactors. Core neutron level has stabilized in both reactors.

Which one of the following lists the core neutron levels (neutrons per second) in reactors A and B?

	Reactor A (n/sec)	Reactor B (n/sec)
A.	5,000	4,000
B.	5,000	1,600
C.	2,000	1,600
D.	2,000	400

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2765 (P2766)

With K_{eff} at 0.95 during a reactor startup, source range indication is stable at 120 cps. After a period of control rod withdrawal, source range indication stabilizes at 600 cps.

What is the current value of K_{eff}?

A. 0.96

B. 0.97

C. 0.98

D. 0.99

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B3849 (P3848)

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10 percent

B. 20 percent

C. 80 percent

D. 100 percent

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B6134 (P6133)

A subcritical reactor has a stable source range count rate of 2.0×10^5 cps with a K_{eff} of 0.98. Positive reactivity is added to the core until a stable count rate of 5.0×10^5 cps is achieved. What is the current value of K_{eff}?

A. 0.984

B. 0.988

C. 0.992

D. 0.996

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B7233

A nuclear power plant is shutdown with the following stable initial conditions:

Reactor coolant temperature: 200°F
Reactor vessel pressure: 300 psia
Source range count rate: 140 cps

Control rods are withdrawn to commence a reactor startup. After 50 units of control rod withdrawal, the equilibrium source range count rate is 280 cps.

Assume that each unit of control rod withdrawal has the same reactivity worth. Also assume that the reactor coolant temperature remains constant, reactor power remains below the point of adding heat, and no reactor protection actuations occur.

What will be the status of the reactor after the control rods are withdrawn a total of 75 units?

A. Subcritical, with equilibrium source range count rate less than 600 cps.

B. Subcritical, with equilibrium source range count rate greater than 600 cps.

C. Critical, with equilibrium source range count rate less than 600 cps.

D. Critical, with equilibrium source range count rate greater than 600 cps.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B7628 (P7628)

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron-induced fission?

A. 10 percent

B. 20 percent

C. 80 percent

D. 100 percent

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B7638 (P4734)

During a reactor startup, positive reactivity addition X caused the stable source range count rate to increase from 20 cps to 40 cps. Later in the startup, after several more additions of positive reactivity, positive reactivity addition Y caused the stable source range count rate to increase from 320 cps to 640 cps.

Which one of the following statements describes how the magnitudes of the two positive reactivity additions (X and Y) compare?

A. Reactivity addition X was several times greater in magnitude than reactivity addition Y.

B. Reactivity addition X was several times smaller in magnitude than reactivity addition Y.

C. Reactivity additions X and Y were about equal in magnitude.

D. There is not enough information given to determine the relationship between the reactivity additions.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B7698 (P7698)

A reactor is shutdown with a K_{eff} of 0.96. The source range count rate is stable at 480 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 4 percent

B. 50 percent

C. 96 percent

D. 100 percent

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: B7718 (P7718)

During a reactor startup, positive reactivity addition X caused the stable source range count rate to increase from 15 cps to 30 cps. Later in the startup, after several more positive reactivity additions, positive reactivity addition Y caused the stable source range count rate to increase from 60 cps to 120 cps.

With the reactor still subcritical, which one of the following statements describes how the magnitudes of positive reactivity additions X and Y compare?

A. Positive reactivity addition X was smaller than positive reactivity addition Y.

B. Positive reactivity addition X was greater than positive reactivity addition Y.

C. Positive reactivity additions X and Y were about equal in magnitude.

D. There is not enough information given to compare the positive reactivity additions.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B267

A reactor startup is in progress with K_{eff} at 0.999 and reactor period stable at infinity. If a control rod is withdrawn one notch, reactor period will initially become __________ and then __________. (Assume K_{eff} remains less than 1.0.)

A. positive; approach infinity

B. positive; stabilize at a positive value

C. negative; approach infinity

D. negative; stabilize at a negative value

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B966

During an initial reactor fuel load, the 1/M factor decreases from 1.0 to 0.5 after the first 100 fuel assemblies are loaded. What is the current value of K_{eff}?

A. 0.2

B. 0.5

C. 0.875

D. 1.0

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B1365 (P267)

As criticality is approached during a reactor startup, equal insertions of positive reactivity result in a __________ numerical change in the stable source range count rate and a __________ time to reach each new stable count rate.

A. larger; longer

B. larger; shorter

C. smaller; longer

D. smaller; shorter

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B1665 (P1770)

Refer to the drawing of three 1/M plots labeled A, B, and C (see figure below). Each axis has linear units.

The least conservative approach to criticality is represented by plot __________; which could possibly result from recording source range count rates at __________ time intervals after incremental fuel loading steps as compared to the conditions represented by the other plots.

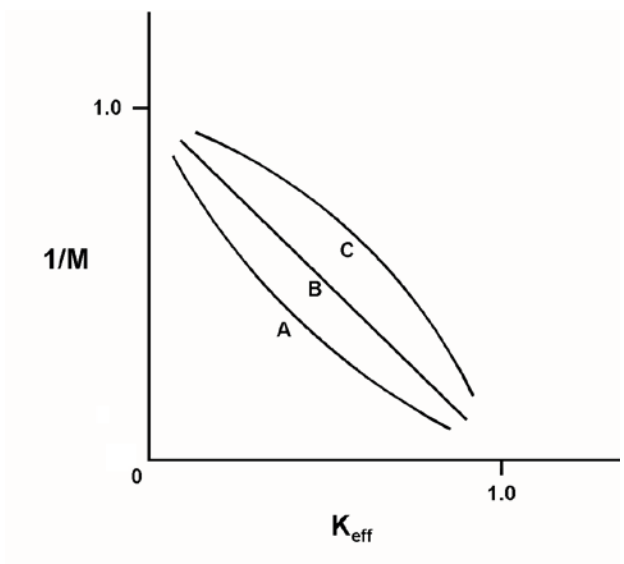
A. A; shorter

B. A; longer

C. C; shorter

D. C; longer

ANSWER: C.



TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B1967 (P1265)

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 4.0 as the first 100 fuel assemblies are loaded. What is K_{eff} after the first 100 fuel assemblies are loaded?

A. 0.25

B. 0.5

C. 0.75

D. 1.0

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B3566

A reactor startup is in progress for a reactor that is in the middle of a fuel cycle. The reactor is at normal operating temperature and pressure. The main steam isolation valves are open and the main turbine bypass (also called steam dump) valves are closed. The reactor is near criticality.

Reactor period is stable at infinity when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser. The operator immediately ensures no control motion is occurring and takes no further action. Assume the reactor vessel water level remains stable, the reactor does not scram, and no other protective actions occur.

As a result of the valve failure, reactor period will initially become __________; and reactor power will stabilize __________ the point of adding heat.

A. positive; below

B. positive; above

C. negative; below

D. negative; above

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B3665 (P3665)

Refer to the drawing of a 1/M plot with curves A and B (see figure below). Each axis has linear units.

Curve A would result if each fuel assembly loaded during the early stages of the refueling caused a relatively __________ fractional change in source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal __________.

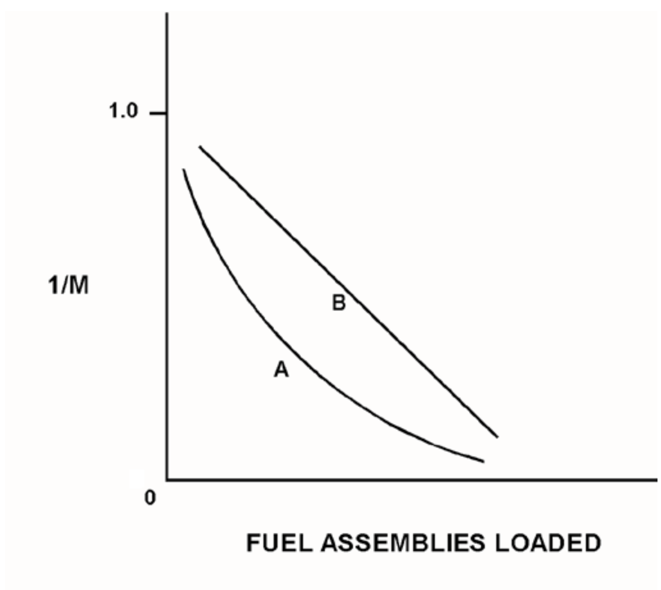
A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: D.



TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B5733 (P5733)

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 8.0. What is the current value of K_{eff}?

A. 0.125

B. 0.5

C. 0.75

D. 0.875

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B6033 (P6034)

Refer to the drawing of a 1/M plot with curves A and B (see figure below). Each axis has linear units.

Curve A would result if each fuel assembly loaded during the early stages of core refueling caused a relatively __________ fractional change in stable source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal __________.

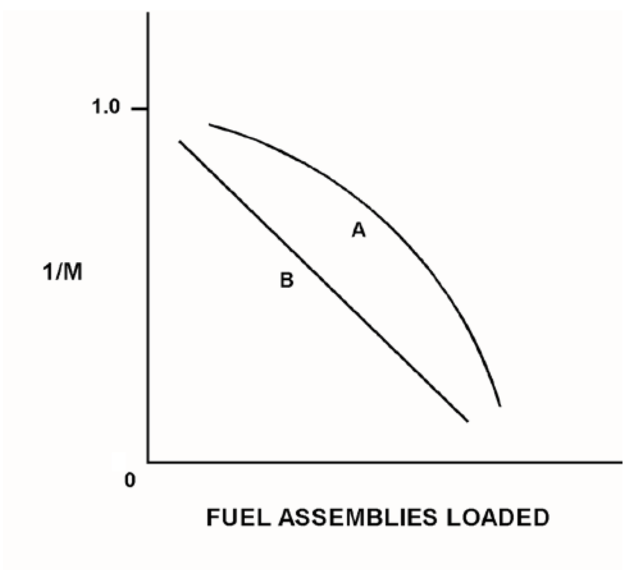
A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: B.



TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1567 (P1667)

The following data was obtained under stable conditions during a reactor startup:

Control Rod Position (units withdrawn)	Source Range Count Rate (cps)
0	180
5	200
10	225
15	257
20	300
25	360
30	450

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A. 40 units withdrawn

B. 50 units withdrawn

C. 60 units withdrawn

D. 70 units withdrawn

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1767 (P1966)

The following data was obtained under stable conditions during a reactor startup:

Control Rod Position (units withdrawn)	Source Range Count Rate (cps)
10	360
15	400
20	450
25	514
30	600
35	720
40	900

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A. 50 units withdrawn

B. 60 units withdrawn

C. 70 units withdrawn

D. 80 units withdrawn

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1866

A reactor has just achieved criticality during a xenon-free reactor startup. Instead of stabilizing source range count rate at 1.0×10^3 cps per the startup procedure, the operator inadvertently allows count rate to increase to 1.0×10^4 cps.

Assuming reactor vessel coolant temperature and pressure do not change, the critical rod height at 1.0×10^4 cps will be ___________ the critical rod height at 1.0×10^3 cps. (Neglect any effects of changes in fission product poisons.)

A. different, but unpredictable compared to

B. less than

C. greater than

D. equal to

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B2767 (P1167)

The following data was obtained under stable conditions during a reactor startup:

Control Rod Position (units withdrawn)	Source Range Count Rate (cps)
0	180
10	210
15	250
20	300
25	360
30	420

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A. 35 to 45 units withdrawn

B. 46 to 55 units withdrawn

C. 56 to 65 units withdrawn

D. 66 to 75 units withdrawn

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B123 (P68)

With K_{eff} at 0.985, how much reactivity must be added to make a reactor exactly critical?

A. 1.48 %ΔK/K

B. 1.50 %ΔK/K

C. 1.52 %ΔK/K

D. 1.54 %ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B667

When a reactor is critical, reactivity is...

A. greater than 1.0 %ΔK/K.

B. equal to 1.0 %ΔK/K.

C less than 1.0 %ΔK/K.

D. undefined.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B867 (P2267)

When a reactor is critical, reactivity is...

A. infinity.

B. undefined.

C. 0.0 $\Delta K/K$.

D. 1.0 $\Delta K/K$.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B269

A reactor startup is in progress. A stable positive 30-second reactor period has been established, and no further reactivity changes occur. The reactor is...

A. critical.

B. supercritical.

C. subcritical.

D. prompt critical.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B868

Which one of the following indicates that a reactor has achieved criticality during a normal reactor startup?

A. Constant positive period with no control rod motion.

B. Increasing positive period with no control rod motion.

C. Constant positive period during control rod withdrawal.

D. Increasing positive period during control rod withdrawal.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B1069

A reactor is critical just below the point of adding heat (POAH) at a temperature of 160°F in the middle of a fuel cycle. Which one of the following will result in reactor power increasing and stabilizing at the POAH?

A. Reactor recirculation flow increases 10 percent.

B. Reactor coolant temperature increases 3°F.

C. A single control rod is inserted one notch.

D. Core xenon-135 concentration decreases.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B2668

A reactor is critical at 1.0×10^{-6} percent power. Control rods are withdrawn for 5 seconds and then stopped, resulting in a stable reactor period of positive 100 seconds.

If control rods had been inserted (instead of withdrawn) for 5 seconds with the reactor initially critical at 1.0×10^{-6} percent power, the stable reactor period would have been… (Assume equal absolute values of reactivity are added in both cases.)

A. longer than negative 100 seconds, because reactor power decreases are more limited by delayed neutrons than power increases.

B. shorter than negative 100 seconds, because reactor power decreases are less limited by delayed neutrons than power increases.

C. longer than negative 100 seconds, because reactor power decreases result in smaller delayed neutron fractions than power increases.

D. shorter than negative 100 seconds, because reactor power decreases result in larger delayed neutron fractions than power increases.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [3.3/3.4]
QID: B2966

A reactor startup is in progress. Control rod withdrawal was stopped several minutes ago to assess criticality. Which one of the following is a combination of indications that together support a declaration that the reactor has reached criticality?

A. Period is stable at positive 200 seconds; source range count rate is stable.

B. Period is stable at infinity; source range count rate is stable.

C. Period is stable at positive 200 seconds; source range count rate is slowly increasing.

D. Period is stable at infinity; source range count rate is slowly increasing.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B5334 (P5334)

Given:

- Reactors A and B are identical except that reactor A has an effective delayed neutron fraction of 0.0068 and reactor B has an effective delayed neutron fraction of 0.0052.
- Reactor A has a stable period of 45 seconds and reactor B has a stable period of 42 seconds.
- Both reactors reach 1.0×10^{-8} percent power at the same instant.

The reactor that is supercritical by the greater amount of positive reactivity is reactor __________; and the first reactor to reach 1.0×10^{-1} percent power will be reactor __________.

A A; A

B. A; B

C. B; A

D. B; B

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B5534 (P5535)

A reactor is currently operating in the source range with a stable positive 90-second period. The core effective delayed neutron fraction ($\bar{\beta}_{eff}$) is 0.006. How much additional positive reactivity is needed to establish a stable positive 60-second period?

A. 0.026 %ΔK/K

B. 0.033 %ΔK/K

C. 0.067 %ΔK/K

D. 0.086 %ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B6434 (P6435)

A reactor is critical near the end of a fuel cycle with power level stable at 1.0×10^{-10} percent. Which one of the following is the smallest listed amount of positive reactivity that is capable of increasing reactor power level to the point of adding heat?

A. 0.001 %ΔK/K

B. 0.003 %ΔK/K

C. 0.005 %ΔK/K

D. 0.007 %ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B7688 (P7688)

Given:

- Reactors A and B are identical except that reactor A has an effective delayed neutron fraction of 0.0055 and reactor B has an effective delayed neutron fraction of 0.0052.
- Reactor A has a stable period of 42 seconds and reactor B has a stable period of 45 seconds.
- Both reactors pass through 1.0×10^{-8} percent power at the same instant.

The reactor that is supercritical by the greater amount of positive reactivity is reactor __________; and the first reactor to reach 1.0×10^{-1} percent power will be reactor __________.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B7757

Reactors A and B are identical except that reactor A is operating near the beginning of a fuel cycle, while reactor B is operating near the end of a fuel cycle. Both reactors have the same slightly positive value for K_{eff}.

If both reactors pass through 1.0×10^{-6} percent reactor power at the same time, which reactor, if any, will reach the point of adding heat (POAH) first, and why?

A. Reactor A, because it has the shorter reactor period.

B. Reactor B, because it has the shorter reactor period.

C. Both reactors will reach the POAH at the same time because they both have the same value for reactor period.

D. Both reactors will reach the POAH at the same time because they are both supercritical by the same amount of positive reactivity.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
KNOWLEDGE: K1.11 [3.7/3.8]
QID: B7778

A reactor and plant startup is in progress. Reactor power is currently 5.0×10^{-5} percent and increasing, with a constant period of 130 seconds. Reactivity is <u>not</u> changing.

The reactor is currently __________, at a power level that is __________ the point of adding heat.

A. critical; less than

B. critical; greater than

C. supercritical; less than

D. supercritical; greater than

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B468

A reactor is being started up from cold shutdown conditions and currently has a stable positive 100-second reactor period in the intermediate range. Assuming no operator action is taken that affects reactivity, which one of the following describes how reactor period will respond?

A. Remain constant until void production begins in the core.

B. Remain constant until saturation temperature is reached in the core.

C. Increase to infinity after heat production in the core exceeds ambient heat loss.

D. Decrease to zero as the fuel temperature increase adds negative reactivity to the core.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B2168 (P1870)

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a positive 80-second period and stops control rod motion.

After an additional five minutes, reactor power will be __________; and reactor period will be __________. (Assume reactor power remains below the point of adding heat.)

A. constant; constant

B. constant; increasing

C. increasing; constant

D. increasing; increasing

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B2671

A reactor is being started up under cold shutdown conditions. The reactor has a stable positive 100-second period and power is entering the intermediate range. Assuming no operator action is taken that affects reactivity, reactor period will remain constant until...

A. void production begins in the core, then reactor period will increase toward infinity.

B. core heat production exceeds ambient losses, then reactor period will increase toward infinity.

C. xenon-135 production becomes significant, then reactor period will decrease toward zero.

D. fuel temperature begins to increase, then reactor period will decrease toward zero.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.11 [3.7/3.8]
QID: B568

After recording critical data during a cold reactor startup with main steam isolation valves open, the operator withdraws the control rods to continue the startup. Which one of the following pairs of parameters will provide the first indications of reaching the point of adding heat?

A. Reactor pressure and reactor water level

B. Reactor power and reactor period

C. Reactor pressure and turbine load

D. Reactor water level and core flow rate

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.11 [3.7/3.8]
QID: B3934 (P3935)

After taking critical data during a reactor startup, the operator establishes a stable 50-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize reactor power at the POAH? (Assume $\bar{\beta}_{eff}$ = 0.006.)

A. -0.01 %ΔK/K

B. -0.06 %ΔK/K

C. -0.10 %ΔK/K

D. -0.60 %ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B133

A reactor is critical well below the point of adding heat when a small amount of positive reactivity is added to the core. If the same amount of negative reactivity is added to the core approximately one minute later, reactor power will stabilize at...

A. the initial power level.

B. somewhat higher than the initial power level.

C. somewhat lower than the initial power level.

D. the subcritical multiplication equilibrium level.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B1467

Initially, a reactor is critical just below the point of adding heat when a small amount of negative reactivity is added to the reactor. If an equal amount of positive reactivity is added to the reactor 5 minutes later, reactor power will...

A. increase, and then stabilize at the initial power level.

B. increase, and then stabilize at the point of adding heat.

C. stabilize at a critical power level below the initial power level.

D. continue to decrease on a negative 80-second period until it stabilizes at a power level determined by the source neutron flux.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2268

A reactor startup is in progress and criticality has just been achieved. After recording critical rod heights, the operator withdraws control rods for 20 seconds to establish a stable positive 30-second reactor period. One minute later (well before to the point of adding heat) the operator inserts the same control rods for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the rod insertion, the reactor period will become...

A. negative during the entire period of control rod insertion.

B. negative shortly after the control rods pass through the critical rod height.

C. negative just as the control rods pass through the critical rod height.

D. negative shortly before the control rods pass through the critical rod height.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2467

Criticality has just been achieved during a reactor startup at 160°F. The main steam isolation valves are closed (*i.e.*, no steam flow from reactor). The operator withdraws control rods as necessary to establish a stable positive 60-second reactor period. No additional operator actions are taken.

How will reactor power and reactor period respond after the control rod withdrawal is completed? (Assume a negative moderator temperature coefficient.)

A. Reactor power will increase and stabilize at the POAH; reactor period will remain nearly constant until the POAH is reached and then stabilize at infinity.

B. Reactor power will increase and stabilize at the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

C. Reactor power will increase and stabilize above the POAH; reactor period will remain nearly constant until the POAH is reached and then stabilize at infinity.

D. Reactor power will increase and stabilize above the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2568 (P2568)

A reactor was operating at 1.0×10^{-3} percent power with a positive 60-second reactor period when an amount of negative reactivity was inserted that caused reactor power to decrease with a negative 40-second reactor period.

If an equal amount of positive reactivity is added 5 minutes later, reactor power will...

A. increase and stabilize at the point of adding heat.

B. increase and stabilize at 1.0×10^{-3} percent power.

C. continue to decrease with a negative 40-second period until an equilibrium shutdown neutron level is reached.

D. continue to decrease with an unknown period until an equilibrium shutdown neutron level is reached.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2969

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable positive 60-second reactor period. One minute later (well before reaching the point of adding heat), the operator inserts the same control rod for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the control rod insertion, when will the reactor period become negative?

A. Immediately when the control rod insertion is initiated.

B. After the control rod passes through the critical rod height.

C. Just as the control rod passes through the critical rod height.

D. Prior to the control rod passing through the critical rod height.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B3668

Initially, a reactor is critical in the source range when a short control rod withdrawal is performed to establish the desired reactor period. Assume that reactor power remains well below the point of adding heat.

Immediately after the control rod withdrawal is stopped, the reactor period will initially lengthen and then...

A. stabilize at a positive value.

B. turn and slowly shorten.

C. stabilize at infinity.

D. continue to slowly lengthen.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B4034

Initially, a reactor is critical in the source range when a constant rate of positive reactivity addition commences and lasts for 120 seconds. Assume that reactor power remains below the point of adding heat for the entire 120-second addition of positive reactivity.

During the 120-second addition of positive reactivity, the reactor period will initially shorten and then continue to shorten at a/an ___________ rate; and reactor power will initially increase and then continue to increase at a/an ___________ rate.

A. decreasing; increasing

B. decreasing; decreasing

C. increasing; increasing

D. increasing; decreasing

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B271

Upon reaching criticality during a reactor startup, the operator establishes a positive reactor period. Upon reaching the point of adding heat, the period will become __________ due to the __________ reactivity feedback from the moderator and fuel temperatures.

A. shorter; negative

B. shorter; positive

C. longer; negative

D. longer; positive

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B5833 (P5834)

Refer to the drawing that shows a graph of fission rate versus time (see figure below). Both axes have linear scales.

Which one of the following events, initiated at 0 seconds, would cause the reactor response shown on the graph?

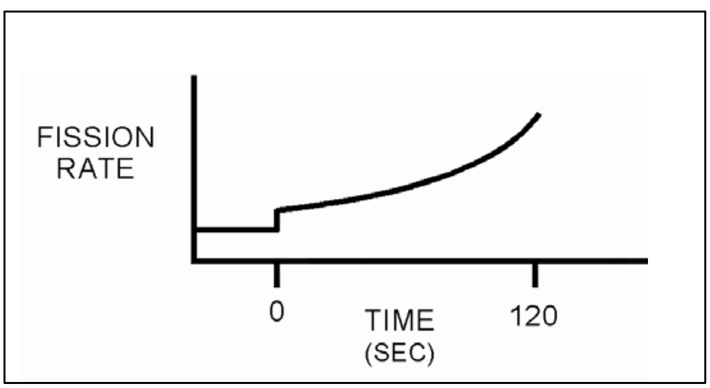
A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range and remains subcritical for the duration of the 120-second interval shown.

B. A step addition of positive reactivity to a reactor that is initially critical in the source range and remains below the point of adding heat for the duration of the 120-second interval shown.

C. A step addition of positive reactivity to a reactor that is initially critical in the power range and remains in the power range for the duration of the 120-second interval shown.

D. A constant rate of positive reactivity addition to a reactor that is initially critical in the power range and remains in the power range for the duration of the 120-second interval shown.

ANSWER: B.



TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B6734 (P6734)

Reactors A and B are identical, except that reactor A has an effective delayed neutron fraction of 0.007, while reactor B has an effective delayed neutron fraction of 0.006. Initially, both reactors are critical at 1.0×10^{-8} percent power when +0.1 %ΔK/K is instantly added to both reactors.

Five minutes after the reactivity additions, reactor _____ will be at the higher power level; and reactor _____ will have the shorter period.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B7768 (P7768)

Initially, a reactor was critical just below the point of adding heat during a normal reactor startup when a reactivity event caused a rapid insertion of negative reactivity. No subsequent changes to reactivity occurred.

Ten seconds after the completion of the negative reactivity insertion, the reactor period was observed to be stable at – 110 seconds. Was the reactivity event a reactor scram or the uncontrolled rapid insertion of a fully-withdrawn control rod, and why?

A. Reactor scram, because the uncontrolled rapid insertion of a fully-withdrawn control rod will <u>not</u> produce a stable negative reactor period 10 seconds after the completion of the negative reactivity insertion.

B. Reactor scram, because the uncontrolled rapid insertion of a fully-withdrawn control rod will produce a <u>more</u> negative stable reactor period 10 seconds after the completion of the negative reactivity insertion.

C. The uncontrolled rapid insertion of a fully-withdrawn control rod, because a reactor scram will <u>not</u> produce a stable negative reactor period 10 seconds after the completion of the negative reactivity insertion.

D. The uncontrolled rapid insertion of a fully-withdrawn control rod, because a reactor scram will produce a <u>less</u> negative stable reactor period 10 seconds after the completion of the negative reactivity insertion.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B670 (P670)

After taking critical data during a reactor startup, the operator establishes a positive 26-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize reactor power at the POAH? (Assume that $\bar{\beta}_{eff}$ = 0.00579.)

A. -0.16 %ΔK/K

B. -0.19 %ΔK/K

C. -0.23 %ΔK/K

D. -0.29 %ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B968

After taking critical data during a reactor startup, the operator establishes a positive 26-second reactor period to increase power to the point of adding heat (POAH). How much negative reactivity must be added to stabilize power at the POAH? (Assume $\bar{\beta}_{eff}$ = 0.00579.)

A. 0.10 %ΔK/K

B. 0.16 %ΔK/K

C. 1.0 %ΔK/K

D. 1.6 %ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B1667

After taking critical data during a reactor startup, the operator establishes a 38-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate negative reactivity required to stop the power increase at the POAH? (Assume that $\bar{\beta}_{eff}$ = 0.00579.)

A. 0.01 %ΔK/K

B. 0.12 %ΔK/K

C. 0.16 %ΔK/K

D. 0.21 %ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B1769

After taking critical data during a reactor startup, the operator establishes a positive 31-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize power at the POAH? (Assume $\bar{\beta}_{eff}$ = 0.00579.)

A. -0.14 %ΔK/K

B. -0.16 %ΔK/K

C. -1.4 %ΔK/K

D. -1.6 %ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B2369 (P2370)

After taking critical data during a reactor startup, the operator establishes a positive 48-second reactor period to increase reactor power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize power at the POAH? (Assume $\bar{\beta}_{eff}$ = 0.00579.)

A. +0.10 %ΔK/K

B. +0.12 %ΔK/K

C. -0.10 %ΔK/K

D. -0.12 %ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B3068 (P3068)

After taking critical data during a reactor startup, the operator establishes a positive 34-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize reactor power at the POAH? (Assume $\bar{\beta}_{eff}$ = 0.0066.)

A. -0.10 %ΔK/K

B. -0.12 %ΔK/K

C. -0.15 %ΔK/K

D. -0.28 %ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B769

During a reactor heatup, if a center control rod is notched outward with no subsequent operator action, the heatup rate will...

A. increase initially, then gradually decrease.

B. decrease initially, then gradually increase.

C. increase and stabilize at a new higher value.

D. decrease and stabilize at a new lower value.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B1071

A reactor heatup from 180°F to 500°F is in progress. To maintain a constant heatup rate as reactor temperature increases, reactor power will have to...

A. increase, due to increasing density of water.

B. decrease, due to decreasing specific heat of water.

C. increase, due to increasing heat losses to ambient.

D. decrease, due to decreasing heat of vaporization of water.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B1468

A nuclear power plant is undergoing a startup with the reactor coolant initially saturated at 508°F. The main steam isolation valves are closed and reactor criticality has been achieved. The reactor currently has a stable positive 100-second reactor period with reactor power well below the point of adding heat (POAH).

Which one of the following will occur first when reactor power reaches the POAH?

A. Reactor period will shorten.

B. Reactor pressure will increase.

C. Reactor coolant temperature will decrease.

D. Intermediate range power level will decrease.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B6335

A nuclear power plant is undergoing a startup with the reactor water initially saturated at 508°F. The main steam isolation valves are closed. Currently, the reactor has a stable positive 100-second reactor period and reactor power is well below the point of adding heat (POAH).

Which one of the following will occur first when reactor power reaches the POAH?

A. Reactor power will decrease.

B. Reactor period will lengthen.

C. Reactor pressure will increase.

D. Reactor water temperature will increase.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B469

A reactor is stable at the point of adding heat (POAH) with a reactor coolant temperature of 160°F. Control rods are about to be withdrawn a few notches to establish a small heatup rate.

When the control rods are withdrawn, reactor power will increase initially, and then...

A. stabilize until voiding begins to occur.

B. continue to increase until voiding begins to occur.

C. decrease and stabilize at a subcritical power level.

D. decrease and stabilize at the POAH.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B669

A reactor has a stable positive 100-second period, with reactor power entering the intermediate range. Assuming no operator action, which one of the following describes the future response of reactor period? (Ignore any changes in fission product poison reactivity.)

A. Prior to reaching the point of adding heat, the fuel temperature increase will add negative reactivity and reactor period will approach infinity.

B. When heat production in the reactor exceeds ambient heat losses, the temperature of the fuel and moderator will increase, adding negative reactivity, and reactor period will approach infinity.

C. The heat produced by the reactor when operating in the intermediate range is insufficient to raise the fuel or moderator temperatures, and reactor period will remain nearly constant throughout the entire intermediate range.

D. When heat production in the reactor exceeds ambient losses, positive reactivity from a fuel temperature increase will offset the negative reactivity from a moderator temperature increase, and reactor period will remain nearly constant throughout the entire intermediate range.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B1966

A reactor startup is in progress at the beginning of core life. Reactor power is 5.0×10^{-3} percent and increasing slowly with a stable period of 87 seconds. Assuming no operator action, no reactor scram, and no steam release, what will reactor power be after 10 minutes?

A. Below the point of adding heat (POAH).

B. At the POAH.

C. Above the POAH but less than 49 percent.

D. 50 percent.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B2569

A reactor is at 1.0×10^{-3} percent power with a stable period of positive 60 seconds at the beginning of a fuel cycle. Assuming no operator action, no reactor scram, and no steam release, what will reactor power be after 10 minutes?

A. Below the point of adding heat (POAH).

B. At the POAH.

C. Approximately 22 percent.

D. Greater than 100 percent.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B7808 (P7808)

Given the following:

- Initially, reactor power is 1.0 x 10^{-3} percent and increasing with a constant period of 260 seconds.
- The turbine bypass system is maintaining reactor pressure at 1,000 psia.
- The point of adding heat is 1.0 percent power.
- The power coefficient is −1.0 x 10^{-4} ΔK/K/percent power.
- The effective delayed neutron fraction is 0.006.
- No operator actions or automatic protective actions occur.

In 40 minutes, reactor power will be approximately...

A. 3 percent and stable.

B. 3 percent and increasing.

C. 10 percent and stable.

D. 10 percent and increasing.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.16 [3.6/3.7]
QID: B870

During a reactor heatup, reactor pressure was increased from 5 psig to 50 psig in a 2-hour period. What was the average heatup rate?

A. 35°F/hr

B. 60°F/hr

C. 70°F/hr

D. 120°F/hr

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.16 [3.6/3.7]
QID: B1972

A reactor is critical and a reactor coolant heatup is in progress with coolant temperature currently at 140°F. If the point of adding heat is initially 0.1 percent reactor power, and reactor power is held constant at 1.0 percent during the heatup, which one of the following describes the coolant heatup rate (HUR) from 140°F to 200°F?

A. HUR will initially decrease and then increase.

B. HUR will slowly decrease during the entire period.

C. HUR will slowly increase during the entire period.

D. HUR will remain the same during the entire period.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1270

Which one of the following will add the <u>most</u> positive reactivity during a power decrease from 100 percent to 65 percent over a one-hour period? (Assume the power change is performed <u>only</u> by changing core recirculation flow rate.)

A. Fuel temperature change

B. Moderator temperature change

C. Fission product poison change

D. Core void fraction change

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1371 (P1470)

With a reactor on a constant period, which one of the following power changes requires the <u>longest</u> time to occur?

A. 1.0×10^{-8} percent to 4.0×10^{-8} percent

B. 5.0×10^{-8} percent to 1.5×10^{-7} percent

C. 2.0×10^{-7} percent to 3.5×10^{-7} percent

D. 4.0×10^{-7} percent to 6.0×10^{-7} percent

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1570 (P1567)

With a reactor on a constant period, which one of the following power changes requires the <u>least</u> amount of time to occur?

A. 1.0×10^{-8} percent to 6.0×10^{-8} percent

B. 1.0×10^{-7} percent to 2.0×10^{-7} percent

C. 2.0×10^{-7} percent to 3.5×10^{-7} percent

D. 4.0×10^{-7} percent to 6.0×10^{-7} percent

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1671 (P1672)

A refueling outage has just been completed, during which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to begin the sixth fuel cycle, and reactor power is being increased to 100 percent.

Which one of the following pairs of reactor fuels will provide the greatest contribution to core heat production when the reactor reaches 100 percent power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1765

Which one of the following lists the method(s) used to add positive reactivity during a normal power increase from 10 percent to 100 percent?

A. Control rod withdrawal only.

B. Recirculation pump flow increase only.

C. Control rod withdrawal and recirculation pump flow increase.

D. Recirculation pump flow increase and steaming rate increase.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2070 (P2071)

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 5 percent

B. 5 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 60 percent

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2072 (P2069)

With a reactor on a constant period, which one of the following power changes requires the longest amount of time to occur?

A. 3.0×10^{-8} percent to 5.0×10^{-8} percent

B. 5.0×10^{-8} percent to 1.5×10^{-7} percent

C. 1.5×10^{-7} percent to 3.0×10^{-7} percent

D. 3.0×10^{-7} percent to 6.0×10^{-7} percent

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2166

A reactor is operating at 80 percent power near the end of a fuel cycle. Which one of the following lists the typical method(s) used to increase power to 100 percent?

A. Withdrawal of deep control rods and increasing recirculation flow rate.

B. Withdrawal of deep control rods only.

C. Withdrawal of shallow control rods and increasing recirculation flow rate.

D. Withdrawal of shallow control rods only.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2270

With a reactor on a constant period, which one of the following power changes requires the <u>shortest</u> time to occur?

A. 1.0×10^{-8} percent to 4.0×10^{-8} percent

B. 5.0×10^{-8} percent to 1.5×10^{-7} percent

C. 2.0×10^{-7} percent to 3.5×10^{-7} percent

D. 4.0×10^{-7} percent to 6.0×10^{-7} percent

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2470 (P2851)

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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2669 (P2169)

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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2770 (P2770)

With a reactor on a constant period, which one of the following power changes requires the least amount of time to occur?

A. 3.0×10^{-8} percent to 5.0×10^{-8} percent

B. 5.0×10^{-8} percent to 1.5×10^{-7} percent

C. 1.5×10^{-7} percent to 3.0×10^{-7} percent

D. 3.0×10^{-7} percent to 6.0×10^{-7} percent

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B3769 (P3753)

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.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B5034 (P2953)

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: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B69

With a nuclear power plant operating at steady-state 45 percent power, for which one of the following events will the Doppler coefficient act first to change the reactivity of the core?

A. A control rod drop.

B. The loss of one feedwater heater (extraction steam isolated).

C. Tripping of the main turbine.

D. A safety relief valve opening.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B367

Reactor power was increased from 20 percent to 30 percent in one hour using only control rod withdrawal. Which one of the following describes the response of void fraction during the power increase?

A. Void fraction initially decreases, then increases back to the original value.

B. Void fraction initially increases, then decreases back to the original value.

C. Void fraction decreases and stabilizes below the original value.

D. Void fraction increases and stabilizes above the original value.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B1169

Which one of the following describes the core void fraction response that accompanies a reactor power increase from 20 percent to 30 percent using only control rod withdrawal?

A. Decreases and stabilizes at a lower void fraction.

B. Increases and stabilizes at a higher void fraction.

C. Initially decreases, then increases and stabilizes at the initial void fraction.

D. Initially increases, then decreases and stabilizes at the initial void fraction.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B1368

A reactor is operating at 90 percent power near the end of a fuel cycle. When an operator withdraws a shallow control rod two notches, a power decrease occurs. This power decrease can be attributed to a relatively __________ differential rod worth and a relatively __________ increase in bundle void content.

A. large; small

B. large; large

C. small; small

D. small; large

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2354

Initially, a reactor is operating at steady-state 20 percent power when power is increased to 40 percent. In comparison to the operating conditions at 20 percent power, when the plant stabilizes at 40 percent power, reactor vessel pressure will be __________, and reactor vessel water temperature will be __________.

A. the same; the same

B. the same; higher

C. higher; the same

D. higher; higher

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2670

A reactor was operating with the following initial conditions:

Power level = 100 percent
Control rod density = 60 percent

After a power decrease, current reactor conditions are as follows:

Power level = 80 percent
Control rod density = 62 percent

All parameters attained steady-state values before and after the power change.

Given the following:

Total control rod reactivity change = -2.2×10^{-1} %ΔK/K
Power coefficient = -1.5×10^{-2} %ΔK/K/% power

How much reactivity was added by changes in core recirculation flow rate during the load decrease? (Assume fission product poison reactivity does not change.)

A. 0.0 %ΔK/K

B. -5.2×10^{-1} %ΔK/K

C. -2.0×10^{-1} %ΔK/K

D. -8.0×10^{-2} %ΔK/K

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2970

Which one of the following increases in void fraction would produce the greatest amount of negative reactivity?

A. From 5 percent to 10 percent near the beginning of a fuel cycle.

B. From 5 percent to 10 percent near the end of a fuel cycle.

C. From 40 percent to 45 percent near the beginning of a fuel cycle.

D. From 40 percent to 45 percent near the end of a fuel cycle.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B3051 (P3050)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.3 %ΔK/K reactivity.

Given:

- All control rod motion has been stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.04 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.006.

What is the reactor power level increase required to offset the reactivity added by the inadvertent control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

A. 3.0 percent

B. 5.0 percent

C. 6.7 percent

D. 7.5 percent

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B4325 (P4327)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.2 %ΔK/K reactivity.

Given:

- All control rod motion has been stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.04 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.006.

What is the reactor power level increase required to offset the reactivity added by the inadvertent control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

A. 3.3 percent

B. 5.0 percent

C. 6.7 percent

D. 7.5 percent

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B6736 (P6727)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes a short rod withdrawal that increases reactivity by 0.14 %ΔK/K.

Given:

- All control rod motion has stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.028 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.006.

What is the reactor power level increase required to offset the reactivity added by the control rod withdrawal? (Ignore any reactivity effects from changes in fission product poisons.)

A. 2.0 percent

B. 5.0 percent

C. 20 percent

D. 50 percent

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.20 [3.3/3.4]
QID: B70

Initially, a nuclear power plant is operating at steady-state 100 percent power and 100 percent core flow rate. Then, reactor power is reduced to 90 percent by inserting control rods. (Assume that recirculation pump speed and valve positions do not change.)

What is the effect of the power reduction on core flow rate?

A. Core flow rate will increase, due to a decrease in recirculation ratio.

B. Core flow rate will increase, due to a decrease in two-phase flow resistance.

C. Core flow rate will decrease, due to an increase in recirculation ratio.

D. Core flow rate will decrease, due to an increase in two-phase flow resistance.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.20 [3.3/3.4]
QID: B1469

Which one of the following parameter changes will occur if reactor power is increased from 70 percent to 90 percent by changing recirculation flow?

A. Core void fraction will increase.

B. Feedwater temperature will decrease.

C. Reactor vessel outlet steam pressure will increase.

D. Condensate depression in the main condenser hotwell will increase.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B270

A nuclear power plant has been operating at steady-state 100 percent power for several months. Following a normal reactor shutdown, the rate of core decay heat production will depend on the...

A. rate of reactor power decrease from 100 percent to the point of adding heat.

B. pressure being maintained in the reactor pressure vessel (RPV).

C. pre-shutdown power level and the time elapsed since shutdown.

D. recirculation flow rate and the water level being maintained in the RPV.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B1372 (P1272)

Following a reactor shutdown from three months of operation at 100 percent power, the core decay heat production rate will depend on the...

A. amount of fuel that has been depleted.

B. decay rate of the fission product poisons.

C. time elapsed since K_{eff} decreased below 1.0.

D. decay rate of the photoneutron source.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B3169

Initially, a nuclear power plant is operating at steady-state 60 percent power in the middle of a fuel cycle when a turbine control system malfunction closes the turbine steam inlet valves an additional 5 percent. Which one of the following describes the initial reactor power change and the cause for the power change?

A. Decrease, because the rate of neutron absorption in the moderator initially increases.

B. Decrease, because the rate of neutron absorption at U-238 resonance energies initially increases.

C. Increase, because the rate of neutron absorption in the moderator initially decreases.

D. Increase, because the rate of neutron absorption at U-238 resonance energies initially decreases.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B4036

A nuclear power plant is operating at 60 percent power in the middle of a fuel cycle when a turbine control system malfunction opens the turbine steam inlet valves an additional 5 percent. Which one of the following describes the initial reactor power change and the cause for the power change?

A. Decrease, because the rate of neutron absorption in the moderator initially increases.

B. Decrease, because the rate of neutron absorption at U-238 resonance energies initially increases.

C. Increase, because the rate of neutron absorption in the moderator initially decreases.

D. Increase, because the rate of neutron absorption at U-238 resonance energies initially decreases.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B4735

Initially, a nuclear power plant is operating at steady-state 60 percent power when a main steam line break occurs. The break releases 5 percent of rated main steam mass flow rate.

Given the following:

- No operator or automatic protective actions occur.
- Automatic pressure control returns reactor pressure to its initial value.
- Feedwater injection temperature returns to its initial value.
- The break continues to release 5 percent of rated main steam mass flow rate.

Compared to the initial operating conditions, current reactor power is approximately __________; and current turbine power is approximately __________.

A. the same; 5 percent lower

B. the same; the same

C. 5 percent higher; 5 percent lower

D. 5 percent higher; the same

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B7798

Initially, a nuclear power plant is operating at steady-state 85 percent power when a failure of the turbine control system partially closes the turbine control valves, which reduces the main steam mass flow rate to the main turbine by 10 percent.

Given:

- No operator actions are taken.
- No protective system actuations occur.
- The turbine control valves remain in their failed positions.
- The turbine bypass valves remain closed.

In response to the turbine control system failure, reactor power will initially…

A. decrease, and then stabilize at a critical power level above the point of adding heat.

B. decrease, and then stabilize at a critical power level below the point of adding heat.

C. increase, and then decrease and stabilize at a critical power level above the point of adding heat.

D. increase, and then decrease and stabilize at a critical power level below the point of adding heat.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B570

Initially, a nuclear power plant is operating at steady-state 50 percent power when a steam line break occurs that releases a constant 5 percent of rated steam flow.

- No operator or protective actions occur.
- Automatic pressure control returns reactor pressure to its initial value.
- Feedwater injection temperature remains the same.

In response to the steam line break, reactor power will…

A. decrease and stabilize at a lower power level.

B. increase and stabilize at a higher power level.

C. decrease at first, then increase and stabilize near the initial power level.

D. increase at first, then decrease and stabilize near the initial power level.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B971

A nuclear power plant is operating at steady-state 85 percent power when a failure of the turbine control system positions the turbine control valves to admit 10 percent more steam flow to the main turbine. No operator actions are taken and <u>no</u> protective system actuations occur. The turbine control valves remain in the failed position.

In response to the above, reactor power will…

A. increase until power level matches the new steam demand.

B. increase continuously and exceed reactor protection set points.

C. decrease and stabilize at a lower power level above the point of adding heat.

D. decrease and stabilize at a critical power level below the point of adding heat.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B1670

A nuclear power plant is operating normally at 50 percent of rated power when a main steam line break occurs that continuously releases 5 percent of rated steam flow. Assume no operator or protective actions occur, automatic pressure control returns reactor pressure to its initial value, and feedwater injection temperature remains the same.

How will turbine power respond to the main steam line break?

A. Decrease and stabilize at a lower power level.

B. Increase and stabilize at a higher power level.

C. Initially decrease, then increase and stabilize at the previous power level.

D. Initially increase, then decrease and stabilize at the previous power level.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B2371

A nuclear power plant is operating at steady-state 90 percent power. If a turbine control system malfunction opens the turbine steam inlet valves an additional 5 percent, reactor power will initially...

A. increase, due to positive reactivity addition from the void coefficient only.

B. increase, due to positive reactivity addition from the void and moderator temperature coefficients.

C. decrease, due to negative reactivity addition from the void coefficient only.

D. decrease, due to negative reactivity addition from the void and moderator temperature coefficients.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B2571

A nuclear power plant is operating at steady-state 50 percent power. If a steam break occurs that releases 5 percent of rated steam flow, reactor power will initially...

A. increase, due to positive reactivity addition from the void coefficient only.

B. increase, due to positive reactivity addition from the void and moderator temperature coefficients.

C. decrease, due to negative reactivity addition from the void coefficient only.

D. decrease, due to negative reactivity addition from the void and moderator temperature coefficients.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B7748

A reactor is operating at steady-state 60 percent power in the middle of a fuel cycle when, suddenly, one main turbine bypass valve fails open and remains open. The operator immediately verifies that no control rod motion is occurring and takes no further action.

In addition,

- The reactor vessel water level remains stable.
- The automatic pressure control system returns reactor pressure to its initial value.
- The reactor does not scram and no other protective actions occur.

In response to the main turbine bypass valve failure, reactor power will…

A. decrease, and then stabilize at a lower power level.

B. increase, and then stabilize at a higher power level.

C. decrease, and then increase and stabilize near the initial power level.

D. increase, and then decrease and stabilize near the initial power level.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.23 [2.6/3.1]
QID: B368

Which one of the following is the purpose of a rod sequence exchange?

A. Ensures proper rod coupling.

B. Prevents rod shadowing.

C. Promotes even fuel burnout.

D. Minimizes water hole peaking.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.23 [2.6/3.1]
QID: B2572

During continuous reactor power operation, rod sequence exchanges are performed periodically to...

A. ensure some control rods remain inserted as deep control rods until late in the fuel cycle.

B. allow the local power range monitoring nuclear instruments to be asymmetrically installed in the core.

C. increase the rod worth of control rods that are nearly fully withdrawn.

D. prevent the development of individual control rods with very high reactivity worths.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B72 (P71)

Shortly after a reactor scram, reactor power indicates 5.0×10^{-2} percent when a stable negative reactor period is attained. Approximately how much additional time is required for reactor power to decrease to 5.0×10^{-3} percent?

A. 90 seconds

B. 180 seconds

C. 270 seconds

D. 360 seconds

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B771 (P770)

Which one of the following determines the value of the stable negative reactor period observed shortly after a reactor scram?

A. The shortest-lived delayed neutron precursors.

B. The longest-lived delayed neutron precursors.

C. The shutdown margin just prior to the scram.

D. The worth of the inserted control rods.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B1369 (P1965)

Shortly after a reactor scram, reactor power indicates 1.0 x 10^{-3} percent when a stable negative period is attained. Reactor power will decrease to 1.0 x 10^{-4} percent in approximately _______ seconds.

A. 380

B. 280

C. 180

D. 80

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B1770 (P2171)

Following a reactor scram, reactor power indicates 0.1 percent when the typical stable post-scram reactor period is observed. Approximately how much additional time is required for reactor power to decrease to 0.05 percent?

A. 24 seconds

B. 55 seconds

C. 173 seconds

D. 240 seconds

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B2071

A nuclear power plant is operating at 100 percent power near the end of core life when a single main steam isolation valve suddenly closes. Prior to a reactor scram, reactor power will initially...

A. increase, due to positive reactivity addition from the void coefficient only.

B. increase, due to positive reactivity addition from the void and moderator coefficients.

C. decrease, due to negative reactivity addition from the Doppler coefficient only.

D. decrease, due to negative reactivity addition from the Doppler and moderator temperature coefficients.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B2769 (P2768)

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor scram occurs simultaneously on both reactors. All control rods fully insert, except for one reactor B control rod that remains fully withdrawn.

Which reactor, if any, will have the longer reactor period five minutes after the scram, and why?

A. Reactor A, due to the greater shutdown reactivity.

B. Reactor B, due to the smaller shutdown reactivity.

C. Both reactors will have the same reactor period because both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3271 (P3271)

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn, but all others fully insert.

Five minutes after the scram, when compared to reactor B the fission rate in reactor A will be __________; and the reactor period in reactor A will be __________.

A. the same; shorter

B. the same; the same

C. smaller; shorter

D. smaller; the same

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3472

A reactor is critical just below the point of adding heat when an inadvertent reactor scram occurs. All control rods fully insert except for one rod, which remains fully withdrawn. Five minutes after the reactor scram, with reactor period stable at approximately -80 seconds, the remaining withdrawn control rod suddenly and rapidly fully inserts.

Which one of the following describes the reactor response to the insertion of the last control rod?

A. The negative period will remain stable at approximately -80 seconds.

B. The negative period will immediately become shorter, and then stabilize at a value significantly shorter than -80 seconds.

C. The negative period will immediately become shorter, and then lengthen and stabilize at approximately -80 seconds.

D. The negative period will immediately become longer, and then shorten and stabilize at approximately -80 seconds.

ANSWER: C.

OPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3771

A nuclear power plant has been operating at 100 percent power for two months when a reactor scram occurs. Five minutes after the scram, with all control rods still fully inserted, a count rate of 5,000 cps is indicated on the source range nuclear instruments with a reactor period of negative 80 seconds.

Currently, the majority of the source range detector output is being caused by detector interactions with…

A. intrinsic source neutrons.

B. fission gammas from previous power operation.

C. fission neutrons from subcritical multiplication.

D. delayed fission neutrons from previous power operation.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B4736

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod remains fully withdrawn, but all others fully insert.

When compared to reactor A at 10 minutes after the scram, the fission rate in reactor B will be __________; and the reactor period in reactor B will be __________.

A. higher; longer

B. higher; the same

C. the same; longer

D. the same; the same

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7036

A nuclear power plant is operating at steady-state 100 percent power when a reactor scram occurs. As a result of the scram, the core neutron flux will initially decrease on a period that is much __________ than -80 seconds; and the period will become approximately -80 seconds about __________ minutes after the scram.

A. longer; 3

B. longer; 30

C. shorter; 3

D. shorter; 30

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7618 (P7618)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant reactor that experienced a reactor scram from extended full power operation at 0 seconds.

Which section(s) of the curve has/have a slope that is primarily determined by the production rate of delayed neutrons?

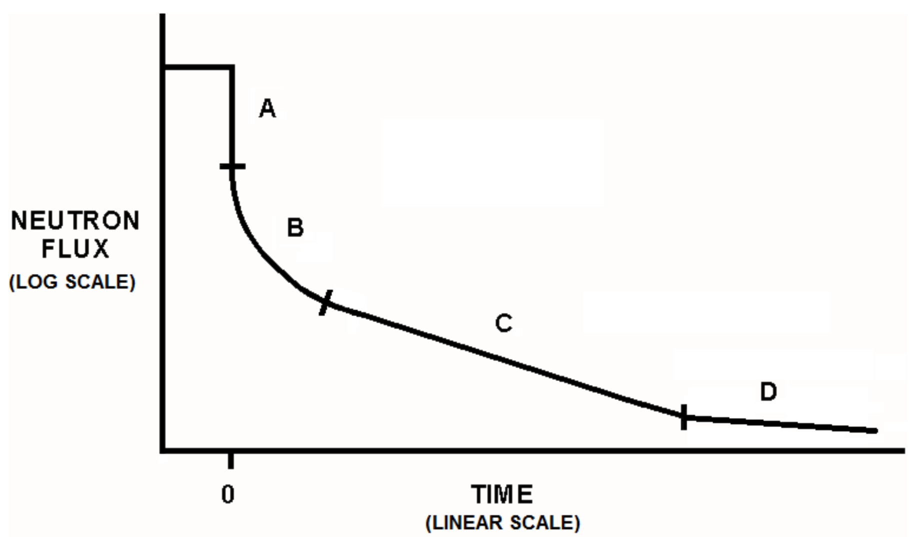
A. B only

B. B and C

C. C only

D. C and D

ANSWER: B.



TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7658 (P7658)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor trip from extended full power operation at time = 0 seconds.

In which section of the curve does the production rate of source neutrons primarily determine the slope of the curve?

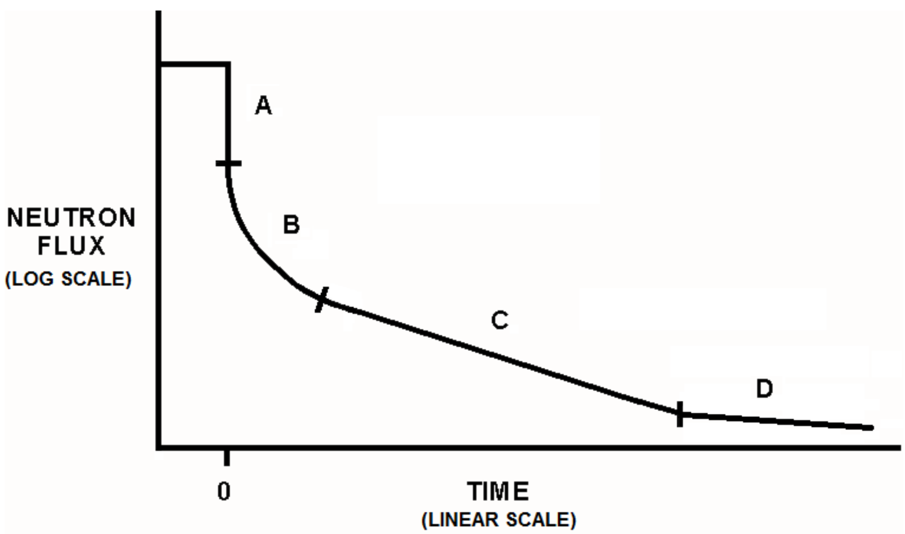
A. A

B. B

C. C

D. D

ANSWER: D.



TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7708 (P7708)

A reactor was operating for several months at 100 percent power when a reactor scram occurred. Which one of the following is primarily responsible for the reactor period value 2 minutes after the scram?

A. The K_{eff} in the core.

B. The rate of source neutron production in the core.

C. The effective delayed neutron fraction in the core.

D. The decay rates of the delayed neutron precursors in the core.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7738 (P7738)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor scram from steady-state 100 percent power at time = 0 seconds.

The shape of section A on the graph is primarily determined by a rapid decrease in the production rate of…

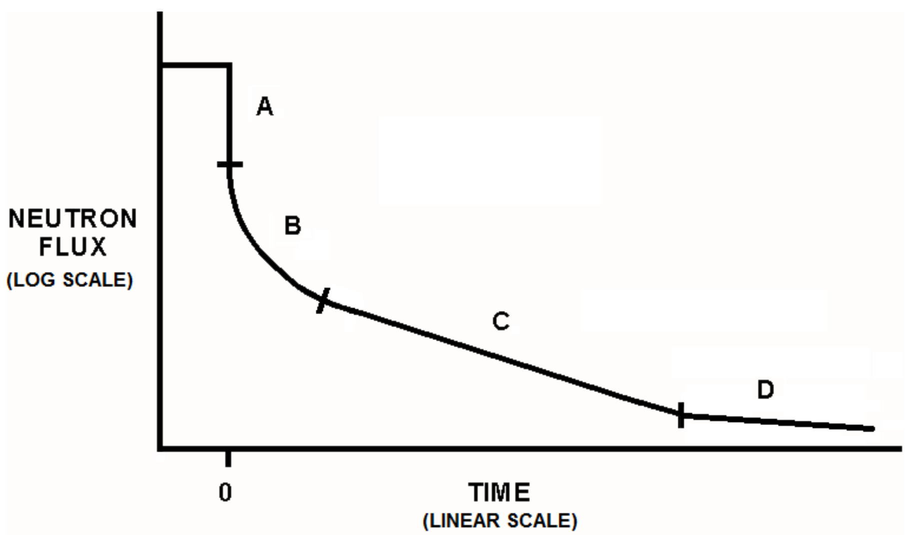
A. intrinsic source neutrons.

B. prompt fission neutrons.

C. delayed fission neutrons.

D. delayed fission neutron precursors.

ANSWER: B.



TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7758 (P7758)

A reactor was operating for several months at steady-state 100 percent power when a reactor scram occurred. Which one of the following lists the two factors most responsible for the value of the core neutron flux level 1 hour after the scram?

A. K_{eff} and the rate of source neutron production.

B. K_{eff} and the effective delayed neutron fraction.

C. The decay rates of the delayed neutron precursors and the rate of source neutron production.

D. The decay rates of the delayed neutron precursors and the effective delayed neutron fraction.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B7828 (P7828)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor scram from steady-state 100 percent power at time = 0.

The shape of section B of the curve is determined primarily by the decreasing production rate of…

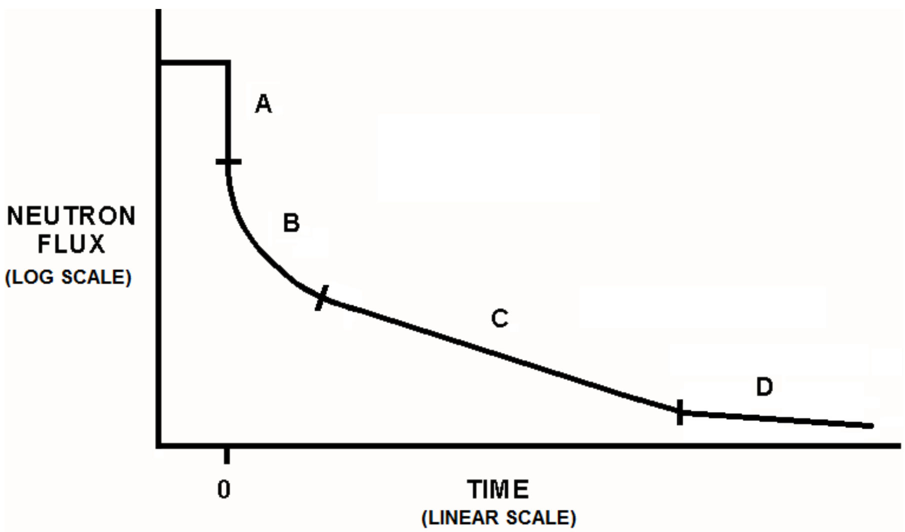
A. prompt fission neutrons.

B. delayed fission neutrons.

C. intrinsic source neutrons.

D. installed source neutrons.

ANSWER: B.



TOPIC: 292008
KNOWLEDGE: K1.26 [3.4/3.7]
QID: B471

A nuclear power plant is operating at steady-state 100 percent power. If a recirculation pump trips, which one of the following reactivity coefficients will cause the initial change in reactor power?

A. Void coefficient

B. Pressure coefficient

C. Moderator temperature coefficient

D. Fuel temperature (Doppler) coefficient

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.26 [3.4/3.7]
QID: B672

A nuclear power plant is operating at steady-state 70 percent of rated power when one recirculation pump trips. Reactor power will initially __________ because of the effects of the __________ coefficient.

A. decrease; void

B. increase; moderator temperature

C. decrease; moderator temperature

D. increase; void

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B126

Initially, a reactor is critical in the source range, when a fully-withdrawn control rod fully inserts into the core.

If no operator or automatic actions occur, the source range count rate will…

A. decrease to zero.

B. decrease to the count rate produced by the source neutron flux.

C. decrease to a count rate greater than that produced by the source neutron flux.

D. initially decrease, and then slowly increase and stabilize at the critical count rate.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B1472

Initially, a nuclear power plant is operating at steady-state 100 percent power when a control rod fully inserts into the core. Assume the reactor does not scram. With no operator action, reactor power will initially decrease and then...

A. return to 100 percent with the void boundary lower in the core.

B. stabilize at a lower power level with the void boundary lower in the core.

C. return to 100 percent with the void boundary higher in the core.

D. stabilize at a lower power level with the void boundary higher in the core.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B1969 (P672)

A reactor is critical below the point of adding heat when a fully withdrawn control rod fully inserts into the core. Assuming no operator or automatic actions, core neutron flux will slowly decrease to...

A. zero.

B. an equilibrium value less than the source neutron flux.

C. an equilibrium value greater than the source neutron flux.

D. a slightly lower value, then slowly return to the initial value.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B7336

Initially, a nuclear reactor has a K_{eff} of 0.999 and a stable source range count rate. Then, control rods are inserted until K_{eff} decreases to 0.998, resulting in a negative reactor period. After the control rod insertion stops, reactor period will...

A. gradually lengthen until the neutron population reaches equilibrium, then stabilize at infinity.

B. gradually lengthen until the neutron population reaches equilibrium, then stabilize at an unknown negative value.

C. quickly stabilize at approximately negative 80 seconds until the neutron population approaches equilibrium, then gradually lengthen and stabilize at infinity.

D. quickly stabilize at an unknown negative value until the neutron population approaches equilibrium, then gradually lengthen and stabilize at an unknown negative value.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B131 (P2672)

Which one of the following approximates the fission product decay heat produced in a reactor at one second and one hour following a reactor scram from long-term operation at 100 percent power?

	One Second	One Hour
A.	7 percent	1 percent
B.	7 percent	0.1 percent
C.	3 percent	1 percent
D.	3 percent	0.1 percent

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B372 (P370)

After one month of operation at 100 percent power, the fraction of rated thermal power being produced from the decay of fission products in a reactor is...

A. greater than 10 percent.

B. greater than 5 percent, but less than 10 percent.

C. greater than 1 percent, but less than 5 percent.

D. less than 1 percent.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2272 (P572)

A nuclear power plant has been operating at 100 percent power for several weeks when a reactor scram occurs. How much time will be required for core decay heat production to decrease to one percent power following the scram?

A. 1 to 8 seconds

B. 1 to 8 minutes

C. 1 to 8 hours

D. 1 to 8 days

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2872

A reactor has been shut down for one day when a loss of all AC power results in a loss of forced cooling water flow through the reactor vessel (RV). Only ambient losses are removing heat from the reactor vessel.

Given the following information:

Reactor rated thermal power	= 2,800 MW
Decay heat rate	= 0.2 percent rated thermal power
RV ambient heat loss rate	= 2.4 MW
RV water specific heat	= 1.1 Btu/lbm-°F
RV water inventory	= 325,000 lbm

What will the average reactor vessel water heatup rate be during the 5 minutes immediately after forced cooling water flow is lost?

A. Less than 25°F/hour

B. 26 to 50°F/hour

C. 51 to 75°F/hour

D. More than 76°F/hour

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2972 (P2972)

A nuclear power plant has been operating for one hour at 50 percent power following six months of operation at steady-state 100 percent power. What percentage of rated thermal power is currently being generated by fission product decay?

A. 1 percent to 2 percent

B. 3 percent to 5 percent

C. 6 percent to 8 percent

D. 9 percent to 11 percent

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B4336 (P4336)

A nuclear power plant had been operating at 100 percent power for six months when a reactor scram occurred. Which one of the following describes the source(s) of core heat generation 30 minutes after the reactor scram?

A. Fission product decay is the only significant source of core heat generation.

B. Delayed neutron-induced fission is the only significant source of core heat generation.

C. Fission product decay and delayed neutron-induced fission are both significant sources and produce approximately equal rates of core heat generation.

D. Fission product decay and delayed neutron-induced fission are both insignificant sources and generate core heat at rates that are less than the rate of ambient heat loss from the core.

ANSWER: A.