TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P545 (B1845)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P845 (B1945)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P1145 (B1545)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P1445 (B1345)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P1545

A neutron that is expelled 1.0×10^{-6} seconds after the associated fission event is a __________ neutron.

A. thermal

B. prompt

C. delayed

D. capture

ANSWER: C.

TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P1945 (B1146)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2045 (B2046)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2145 (B2145)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2345 (B2345)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2445 (B3345)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2545 (B2545)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2645 (B2645)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2845 (B3145)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2945 (B2945)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P3545 (B3545)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P4123 (B4123)

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

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P4923 (B4923)

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

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

A. 1.5×10^6

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^7

ANSWER: D.

TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P5023 (B2245)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P7123 (B7123)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P7523 (B7523)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P7677 (B7677)

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: 192001
KNOWLEDGE: K1.04 [2.4/2.4]
QID: P7767 (B7767)

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: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P7787

Delayed neutrons are fission neutrons that...

A. have an average lifetime of about 80 seconds.

B. have an average kinetic energy of about 2 MeV.

C. are responsible for less than one percent of all fissions.

D. are in thermal equilibrium with the surrounding medium.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.01 [1.4/1.4]
QID: P7737 (B7737)

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: 192002
KNOWLEDGE: K1.07 [3.1/3.1]
QID: P44 (B186)

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: 192002
KNOWLEDGE: K1.07 [3.1/3.1]
QID: P445 (B247)

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: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P45

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation is the...

A. effective multiplication factor.

B. fast fission factor.

C. nonleakage factor.

D. reproduction factor.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P1346 (B1447)

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: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P1846 (B847)

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: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P2647 (B2647)

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: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P3046 (B3147)

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: 192002
KNOWLEDGE: K1.08 [2.6/2.6]
QID: P6424 (B6424)

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: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P546

During reactor refueling, burnable poisons are often installed in the core to help control K_{excess}. Why are more burnable poisons installed for the first fuel cycle than for subsequent fuel cycles?

A. Control rod worth is lower at the beginning of subsequent fuel cycles.

B. More fuel reactivity is present at the beginning of subsequent fuel cycles.

C. More fission product poisons are present at the beginning of subsequent fuel cycles.

D. Reactor coolant boron concentration is higher at the beginning of subsequent fuel cycles.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P646 (B1848)

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: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P946

The following are combinations of critical conditions that exist for the same reactor operating at the point of adding heat at different times in core life. Which one of the following combinations indicates the most amount of excess reactivity present in the core?

	Control Rod Position	RCS Boron Concentration
A.	25% inserted	500 ppm
B.	50% inserted	500 ppm
C.	25% inserted	1,000 ppm
D.	50% inserted	1,000 ppm

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P1147

The following are combinations of critical conditions that exist for the same reactor operating at the point of adding heat at different times in core life. Which one of the following combinations indicates the least amount of excess reactivity present in the core?

	Control Rod Position	RCS Boron Concentration
A.	25% inserted	500 ppm
B.	25% inserted	1,000 ppm
C.	50% inserted	500 ppm
D.	50% inserted	1,000 ppm

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P1246 (B2048)

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: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P2847 (B2747)

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: 192002
KNOWLEDGE: K1.09 [2.5/2.7]
QID: P3547 (B3547)

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 trip.

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: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P127

Shutdown margin can be defined as the amount of reactivity...

A. inserted by burnable poisons at beginning of a fuel cycle.

B. added by boron in the reactor coolant system.

C. by which the reactor is subcritical.

D. that would be inserted by shutdown bank rods.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P245 (B248)

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: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P345

With a reactor initially operating at steady-state 85 percent power with manual rod control, the operator borates the reactor coolant system an additional 10 ppm. During the boration, the available shutdown margin will...

A. decrease and stabilize at a lower value.

B. initially decrease, then increase to the original value as coolant temperature changes.

C. increase and stabilize at a higher value.

D. initially increase, then decrease to the original value as coolant temperature changes.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P746

With a reactor initially operating at steady-state 75 percent power with manual rod control, the operator dilutes the reactor coolant system boron concentration by 5 ppm. During the dilution, the available shutdown margin will...

A. increase and stabilize at a higher value.

B. increase, then decrease to the original value as coolant temperature changes.

C. decrease and stabilize at a lower value.

D. decrease, then increase to the original value as coolant temperature changes.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P1747

A nuclear power plant is operating with the following initial conditions:

- Reactor power is 50 percent.
- Rod control is in manual.
- Reactor coolant system (RCS) boron concentration is 600 ppm.

Disregarding the effects of fission product poisons, which one of the following will result in a decrease in the available shutdown margin once the plant stabilizes?

A. Reactor power is reduced to 45 percent with final RCS boron concentration at 620 ppm.

B. Reactor power is increased to 55 percent with final RCS boron concentration at 580 ppm.

C. Control rods are withdrawn 3 inches with no change in steady-state reactor power or RCS boron concentration.

D. Control rods are inserted 3 inches with no change in steady-state reactor power or RCS boron concentration.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P2347 (B2348)

Which one of the following changes will decrease the available shutdown margin in a reactor? (Assume no 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: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P2546

A reactor is operating at steady-state 100 percent power with manual rod control about three months from the end of a fuel cycle. During the next two weeks of operation at 100 percent power, the available shutdown margin will... (Assume no operator actions are taken.)

A. continuously increase.

B. continuously decrease.

C. initially increase, and then decrease.

D. initially decrease, and then increase.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.11 [2.9/3.0]
QID: P46

Reactivity is defined as the fractional change in...

A. reactor power per second.

B. neutron population per second.

C. reactor period from criticality.

D. the effective multiplication factor from criticality.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.11 [2.9/3.0]
QID: P846

Which term is described by the following?

"The fractional change of the effective multiplication factor from criticality."

A. 1/M

B. K_{eff}

C. Reactor period

D. Reactivity

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P130

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

A. 1.48 %ΔK/K

B. 1.50 %ΔK/K

C. 1.52 %ΔK/K

D. 1.54 %ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P446 (B1548)

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: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P1946 (B648)

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 ΔK/K

B. 0.124 ΔK/K

C. 0.176 ΔK/K

D. 0.229 ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P2146 (B2848)

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: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P2447 (B1947)

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: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P3347 (B748)

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: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P7647 (B7647)

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: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P246

A reactor near the end of a fuel cycle has been shut down from 100 percent power and cooled down to 140°F over three days. During the cooldown, boron concentration was increased by 100 ppm. 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	=	( ) 6.918 %ΔK/K
Xenon	=	( ) 2.675 %ΔK/K
Power defect	=	( ) 1.575 %ΔK/K
Boron	=	( ) 1.040 %ΔK/K
Cooldown	=	( ) 0.500 %ΔK/K

A. -8.558 %ΔK/K

B. -6.358 %ΔK/K

C. -3.208 %ΔK/K

D. -1.128 %ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P346

A reactor was operating at steady-state 100 percent power with all control rods fully withdrawn and average reactor coolant temperature (T_{ave}) at 588°F when a reactor trip occurred.

After the trip, T_{ave} stabilized at the no-load temperature of 557°F and all control rods were verified to be fully inserted.

Given the following information, select the current value of core reactivity. (Assume no operator actions and disregard any reactivity effects of xenon.)

Power coefficient	=	-0.015 %ΔK/K/percent
Control rod worth	=	-6.918 %ΔK/K
Moderator temperature coefficient	=	-0.0012 %ΔK/K/°F

A. -5.381 %ΔK/K

B. -5.418 %ΔK/K

C. -8.383 %ΔK/K

D. -8.418 %ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P447

A reactor is operating at steady-state 90 percent power with all control rods fully withdrawn and average reactor coolant temperature (T_{ave}) at 580°F. A reactor trip occurs, after which T_{ave} stabilizes at the no-load temperature of 550°F and all control rods are verified to be fully inserted.

Given the following information, calculate the current value of core reactivity. (Assume no operator actions and disregard any reactivity effects of changes in xenon-135.)

Power coefficient	= -0.01 %ΔK/K/percent
Control rod worth	= -6.918 %ΔK/K
Moderator temperature coefficient	= -0.01 %ΔK/K/°F

A. -5.718 %ΔK/K

B. -6.018 %ΔK/K

C. -7.518 %ΔK/K

D. -7.818 %ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P647

A reactor was operating at steady-state 100 percent power near the end of a fuel cycle when a reactor trip occurred. Immediately after the trip, shutdown margin was determined to be -5.883 %ΔK/K. Over the next 72 hours, the reactor coolant system was cooled down and reactor coolant boron concentration was increased. The reactivities affected by the change in plant conditions are as follows:

Reactivity		Change (+) or (–)
Xenon	=	( ) 2.675 %ΔK/K
Moderator temperature	=	( ) 0.5 %ΔK/K
Boron	=	( ) 1.04 %ΔK/K

What is the value of core reactivity 72 hours after the trip?

A. -1.668 %ΔK/K

B. -3.748 %ΔK/K

C. -7.018 %ΔK/K

D. -9.098 %ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P747

A reactor near the end of a fuel cycle has been shut down from 100 percent power and cooled down to 140°F over three days. During the cooldown, reactor coolant boron concentration was increased by 100 ppm.

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.

Xenon	=	( ) 2.5 %ΔK/K
Moderator temperature	=	( ) 0.5 %ΔK/K
Power defect	=	( ) 1.5 %ΔK/K
Control rods	=	( ) 7.0 %ΔK/K
Boron	=	( ) 1.0 %ΔK/K

A. -8.5 %ΔK/K

B. -6.5 %ΔK/K

C. -3.5 %ΔK/K

D. -1.5 %ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P1047

A reactor near the end of a fuel cycle has been shut down from 100 percent power and cooled down to 140°F over three days. During the cooldown, reactor coolant boron concentration was increased by 100 ppm.

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.

Moderator temperature	=	( ) 0.50 %ΔK/K
Control rods	=	( ) 6.50 %ΔK/K
Boron	=	( ) 1.50 %ΔK/K
Power defect	=	( ) 1.75 %ΔK/K
Xenon	=	( ) 2.75 %ΔK/K

A. -0.0 %ΔK/K

B. -3.0 %ΔK/K

C. -3.5 %ΔK/K

D. -8.5 %ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P1446

A reactor near the middle of a fuel cycle has been shut down from 100 percent power and cooled down to 340°F over three days. During the cooldown, reactor coolant boron concentration was increased by 200 ppm.

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.

Xenon	=	( ) 3.0 %ΔK/K
Boron	=	( ) 3.5 %ΔK/K
Power defect	=	( ) 4.0 %ΔK/K
Control rods	=	( ) 7.0 %ΔK/K
Moderator temperature	=	( ) 2.0 %ΔK/K

A. -1.5 %ΔK/K

B. -2.5 %ΔK/K

C. -7.5 %ΔK/K

D. -9.5 %ΔK/K

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P1647

A reactor near the middle of a fuel cycle was operating at 100 percent power for two months when a reactor trip occurred. During the 14 hours since the trip, the reactor has been cooled to 340°F and reactor coolant boron concentration has been increased by 200 ppm.

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.

Xenon	= ( ) 2.0 %ΔK/K
Boron	= ( ) 2.5 %ΔK/K
Power defect	= ( ) 4.0 %ΔK/K
Control rods	= ( ) 7.0 %ΔK/K
Moderator temperature	= ( ) 2.0 %ΔK/K

A. -1.5 %ΔK/K

B. -3.5 %ΔK/K

C. -5.5 %ΔK/K

D. -7.5 %ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.13 [3.5/3.7]
QID: P5224

A reactor near the middle of a fuel cycle was initially operating at steady-state 100 percent power when it was shut down and cooled down to 200°F over a three-day period. During the cooldown, reactor coolant boron concentration was increased by 80 ppm.

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	= ( ) 6.75 %ΔK/K
Xenon	= ( ) 2.50 %ΔK/K
Power defect	= ( ) 2.00 %ΔK/K
Boron	= ( ) 1.25 %ΔK/K
Moderator temperature	= ( ) 0.50 %ΔK/K

A. -0.5 %ΔK/K

B. -3.0 %ΔK/K

C. -7.0 %ΔK/K

D. -8.0 %ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P124

Which one of the following plant parameter changes will increase the shutdown margin for a shutdown reactor near the end of a fuel cycle?

A. Reactor coolant boron concentration is decreased by 100 ppm.

B. One control rod is fully withdrawn for a test.

C. Xenon-135 has decayed for 72 hours following shutdown.

D. The reactor coolant system is allowed to heat up 30°F.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P547

A nuclear power plant is operating at steady-state 70 percent power with manual rod control. Which one of the following events will <u>increase</u> the available shutdown margin? (Assume that <u>no</u> unspecified operator actions occur and the reactor does <u>not</u> trip.)

A. Reactor coolant boron concentration is decreased by 10 ppm.

B. A control rod in a shutdown bank (safety group) drops.

C. Power is decreased to 50 percent using boration.

D. The plant experiences a 3 percent load rejection.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2046

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 100°F with a boron concentration of 2,000 ppm.

Which one of the following will increase core K_{eff}?

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

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

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

D. Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2247

A reactor is operating at steady-state 80 percent power when the operator adds 10 gallons of concentrated boric acid to the reactor coolant system (RCS). Over the next several minutes, the operator adjusts control rod position as necessary to maintain a constant RCS average temperature.

When the plant stabilizes, the available shutdown margin will be __________; and axial power distribution will have shifted toward the __________ of the core.

A. the same; top

B. the same; bottom

C. greater; top

D. greater; bottom

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2547

A nuclear power plant malfunction requires a rapid reactor power decrease from 100 percent to 90 percent. The crew performs the downpower transient using control rod insertion when necessary. Reactor coolant boron concentration is <u>not</u> changed.

If the available shutdown margin at 100 percent power was 3.5 %ΔK/K, which one of the following describes the available shutdown margin at the lower power level? (Ignore any changes in core fission product reactivity.)

A. Less than 3.5 %ΔK/K due only to the change in power defect.

B. Greater than 3.5 %ΔK/K due only to the insertion of control rods.

C. Less than 3.5 %ΔK/K due to the combined effects of control rod insertion and power defect.

D. Equal to 3.5 %ΔK/K regardless of the reactivity effects of control rod insertion and power defect.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2746

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 105°F with a boron concentration of 2,200 ppm.

Which one of the following will increase core K_{eff}?

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

B. Refueling water temperature is decreased to 100°F.

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

D. Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2747

Reactors A and B are identical except that reactor A is operating at steady-state 80 percent power, while reactor B is operating at steady-state 100 percent power. Initial control rod positions are the same for both reactors.

How will the shutdown margins (SDM) compare for the two reactors following a reactor trip? (Assume <u>no</u> post-trip operator actions are taken that would affect SDM.)

A. Immediately after the reactor trip, reactor A will have the greater SDM.

B. Immediately after the reactor trip, reactor B will have the greater SDM.

C. When sufficient time has passed to allow both cores to become xenon-free, the SDMs will be equal.

D. Within a few minutes after the reactors have tripped, when all parameters have returned to normal post-trip conditions, the SDMs will be equal.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P2947

Initially, a reactor is operating at steady-state 50 percent power. A plant test requires a 4°F decrease in reactor coolant system (RCS) average temperature (T-avg). The operator accomplishes this temperature decrease by adjusting RCS boron concentration. No other operator actions are taken.

If the initial available shutdown margin was 3.0 %ΔK/K, which one of the following describes the available shutdown margin at the lower RCS T-avg with the reactor still at steady-state 50 percent power?

A. Less than 3.0 %ΔK/K, because RCS T-avg is lower.

B. More than 3.0 %ΔK/K, because RCS boron concentration is higher.

C. Equal to 3.0 %ΔK/K, because the reactivity change caused by the change in RCS T-avg offsets the reactivity change caused by the change in RCS boron concentration.

D. Equal to 3.0 %ΔK/K because the available shutdown margin in an operating reactor will <u>not</u> change unless control rod position changes.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P3647 (B3648)

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 available shutdown margin (SDM), the current available 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: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P3747 (B3748)

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: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P4224

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 100°F with a boron concentration of 2,000 ppm.

Which one of the following will decrease core K_{eff}?

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

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

C. A depleted neutron source is removed from the core.

D. Refueling water boron concentration is decreased by 5 ppm.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P4924

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 with all control rods fully withdrawn.

If the total reactivity worth of the control rods is the same for both reactors, which reactor will have the smaller K_{eff} five minutes after a reactor trip, and why?

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

B. Reactor A, because the concentration of U-235 in the fuel rods is higher near the BOC.

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

D. Reactor B, because the concentration of U-235 in the fuel rods is lower near the EOC.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P5324

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 105°F with a boron concentration of 2,000 ppm.

Which one of the following will decrease K_{eff}?

A. Refueling water temperature decreases by 5°F.

B. A depleted neutron source is removed from the core.

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

D. Refueling water boron concentration decreases by 5 ppm.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P6224

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 with all control rods fully withdrawn.

If the total reactivity worth of the control rods is the same for both reactors, which reactor will have the greater K_{eff} five minutes after a reactor trip, and why?

A. Reactor A, because the pre-trip reactor coolant boron concentration is lower near the BOC.

B. Reactor A, because the power coefficient adds less positive reactivity after a trip near the BOC.

C. Reactor B, because the pre-trip reactor coolant boron concentration is higher near the EOC.

D. Reactor B, because the power coefficient adds more positive reactivity after a trip near the EOC.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P6624

Initially, a nuclear power plant was operating at steady-state 70 percent power near the middle of a fuel cycle when a control rod of moderate reactivity worth dropped into the core. The reactor did not trip. Consider the following two possible operator responses:

Response 1: An operator adjusts the reactor coolant system (RCS) boron concentration to restore the initial RCS temperatures.

Response 2: An operator partially withdraws some of the remaining control rods to restore the initial RCS temperatures.

In a comparison between the two responses, which response, if any, will result in the greater available shutdown margin (SDM) when the plant is stabilized at 70 percent power, and why?

A. Response 1, because a smaller (than response 2) amount of positive reactivity will be added by the RCS cooldown that occurs immediately after a reactor trip.

B. Response 2, because a greater (than response 1) amount of negative reactivity will be added by the control rods upon a reactor trip.

C. The available SDM is the same for both responses because the plant is stabilized at the same initial steady-state power level.

D. The available SDM is the same for both responses because the same amount of positive reactivity is added in both responses.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7124

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 120°F with a boron concentration of 2,000 ppm. Source range instrumentation indicates 100 cps.

How will source range indication be affected if refueling water temperature decreases to 100°F?

A. Indication will increase because the effect of increased K_{eff} more than offsets the effect of decreased neutron leakage from the core.

B. Indication will increase because of the cooperative effects of increased neutron leakage from the core and increased K_{eff}.

C. Indication will decrease because the effect of decreased neutron leakage from the core more than offsets the effect of increased K_{eff}.

D. Indication will decrease because of the cooperative effects of decreased K_{eff} and decreased neutron leakage from the core.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7224

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 conditions just prior to the refueling?

A. The reactor's available shutdown margin is greater.

B. The reactor coolant boron concentration is smaller.

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

D. The difference between the reactor coolant hot leg and cold leg temperatures is greater.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7757

A nuclear reactor is shut down with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 100°F with a boron concentration of 2,000 ppm. Source range count rate indicates 100 cps.

How will the source range count rate be affected if refueling water temperature increases to 120°F?

A. The count rate will increase, because the positive effect of increased core neutron leakage more than offsets the negative effect of a smaller K_{eff}.

B. The count rate will increase, because the positive effect of increased core neutron leakage adds to the positive effect of a greater K_{eff}.

C. The count rate will decrease, because the negative effect of decreased core neutron leakage more than offsets the positive effect of a greater K_{eff}.

D. The count rate will decrease, because the negative effect of decreased core neutron leakage adds to the negative effect of a smaller K_{eff}.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7777

Initially, a nuclear power plant is operating at steady-state 70 percent power near the middle of a fuel cycle when a control rod drops into the core. The reactor does not trip. Consider the following two possible operator responses:

Response 1: An operator adjusts the reactor coolant system (RCS) boron concentration to restore the initial RCS temperatures.

Response 2: An operator partially withdraws some of the remaining control rods to restore the initial RCS temperatures.

In a comparison between the two responses, which response, if any, will result in the smaller available shutdown margin (SDM) when the plant is stabilized at 70 percent power, and why?

A. Response 1, because a smaller (than response 2) amount of negative reactivity will be added by the control rods upon a reactor trip.

B. Response 2, because a greater (than response 1) amount of positive reactivity will be added by the RCS cooldown that occurs immediately after a reactor trip.

C. Both responses will produce the same available SDM, because both responses will stabilize the plant at the same initial steady-state power level and RCS temperatures.

D. Both responses will produce the same available SDM, because both responses will add the same amount of positive reactivity to compensate for the dropped control rod.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7788

A reactor is currently operating at steady-state 100 percent power near the beginning of a fuel cycle (BOC). When the same 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? Assume the control rods are fully withdrawn, and the total reactivity worths of the control rods are the same at BOC and EOC.

A. The EOC shutdown margin will be more negative because the power defect will add less positive reactivity immediately after a reactor trip near the EOC.

B. The EOC shutdown margin will be less negative because the power defect will add more positive reactivity immediately after a reactor trip near the EOC.

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

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

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P7817

Reactors A and B are identical except that reactor A is operating near the end of a fuel cycle (EOC), while reactor B is operating near the beginning of a fuel cycle (BOC). Currently, both reactors are operating at steady-state 100 percent power with all control rods fully withdrawn. 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 trip, and why?

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

B. Reactor A, because the power coefficient adds more positive reactivity after a trip near the EOC.

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

D. Reactor B, because the power coefficient adds more positive reactivity after a trip near the BOC.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P347 (B350)

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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P1848 (B1170)

A nuclear power plant has been operating at 100 percent power for 2 months when a reactor trip occurs. Two months after the reactor trip, 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P7687 (B7687)

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: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P548

Reactor power was increased from 1.0 x 10^{-9} percent to 1.0 x 10^{-6} percent in 6 minutes. The average startup rate was __________ decades per minute.

A. 0.5

B. 1.3

C. 2.0

D. 5.2

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P648

Reactor power increases from 1.0 x 10^{-8} percent to 5.0 x 10^{-7} percent in two minutes. What was the average startup rate during the power increase?

A. 0.95 DPM

B. 0.90 DPM

C. 0.85 DPM

D. 0.82 DPM

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P2349

During a reactor startup, reactor power increases from 1.0 x 10^{-8} percent to 2.0 x 10^{-8} percent in two 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: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P2648

During a reactor startup, reactor power increases from 3.0 x 10^{-6} percent to 5.0 x 10^{-6} percent in two 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: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P47 (B451)

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: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P126

A nuclear power plant is operating at steady-state 50 percent power in the middle of a fuel cycle. Which one of the following will initially produce a positive startup rate?

A. Main turbine runback.

B. Unintentional boration.

C. Increase in main turbine load.

D. Closure of a letdown isolation valve.

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P248

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical reactor is dependent on the __________ and __________.

A. prompt neutron lifetime; axial neutron flux distribution

B. prompt neutron lifetime; effective delayed neutron fraction

C. effective delayed neutron precursor decay constant; effective delayed neutron fraction

D. effective delayed neutron precursor decay constant; axial neutron flux distribution

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P2748 (B2751)

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 startup rate of 1.0 DPM?

A. 0.2 %ΔK/K

B. 0.5 %ΔK/K

C. 1.0 %ΔK/K

D. 2.0 %ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P3148 (B3151)

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 <u>no</u> 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: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P3548 (B3551)

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 startup rates (SUR) compare? (Consider only the reactor response while power is below the point of adding heat.)

A. Reactor A stable SUR will be greater.

B. Reactor B stable SUR will be smaller.

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

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

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P6825 (B6825)

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: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P7225

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

A. 0.24 DPM

B. 0.33 DPM

C. 0.52 DPM

D. 1.30 DPM

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P7607

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 no other reactivity changes occur, what will the approximate stable startup rate be for this reactor until the point of adding heat is reached?

A. 1.0 DPM

B. 0.6 DPM

C. 0.5 DPM

D. 0.3 DPM

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P48 (B1950)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P129

Following a reactor trip, when does the startup rate initially stabilize at –1/3 DPM?

A. When decay gamma heating starts adding negative reactivity.

B. When the long-lived delayed neutron precursors have decayed away.

C. When the installed neutron source contribution to the total neutron flux becomes significant.

D. When the short-lived delayed neutron precursors have decayed away.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P249

Delayed neutrons contribute more to reactor stability than prompt neutrons because they __________ the average neutron generation time and are born at a __________ kinetic energy.

A. increase; lower

B. increase; higher

C. decrease; lower

D. decrease; higher

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P348 (B2450)

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 higher startup rate (SUR) than at BOC.

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

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P1149 (B2651)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P1248 (B1349)

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 trip occurs at the same time on each reactor.

If <u>no</u> operator action is taken and the reactor systems for both reactors respond identically to the trip, 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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P1548 (B1250)

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 x 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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P1649 (B1649)

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 trip occurs at the same time on each reactor. The trips insert equal amounts of negative reactivity, and no operator actions are taken.

For the conditions above, a power level of 1.0 x 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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P1749 (B1751)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2249 (B2250)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2348 (B2349)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2849 (B2850)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2948 (B2950)

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 highest startup rate? (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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3248 (B3249)

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 trip occurs at the same time on each reactor. No operator action is taken and the reactor systems for both reactors respond identically to the trip.

Ten minutes after the trip, 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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3648 (B3650)

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 trip occurs at the same time on each reactor. No operator action is taken and the reactor systems for both reactors respond identically to the trip.

Ten minutes after the trip, 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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3748 (B3749)

A step positive reactivity addition of 0.001 ΔK/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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3849

A reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The effective delayed neutron fraction is 0.0062. The operator adds positive reactivity to establish a stable 0.5 DPM startup rate.

If the reactor had been near the end of a fuel cycle with an effective delayed neutron fraction of 0.005, what would the approximate stable startup rate be after the addition of the same amount of positive reactivity?

A. 0.55 DPM

B. 0.65 DPM

C. 0.75 DPM

D. 0.85 DPM

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P4425 (B4425)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P5425 (B5425)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P5525 (B5525)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P5725 (B5725)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P5825 (B5825)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P5925 (B5925)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P6225 (B6225)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P6325 (B6325)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P6525 (B6525)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7025 (B7025)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7325 (B7325)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7617 (B7617)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7697 (B7697)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7707 (B7707)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7747 (B7747)

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: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P7797 (B7797)

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

Case 1: A step addition of positive 0.001 ΔK/K.
Case 2: A step addition of negative 0.001 ΔK/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: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P549 (B3351)

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: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P748

A critical reactor will become prompt critical when the reactivity is equal to the...

A. shutdown margin.

B. effective delayed neutron fraction.

C. effective decay constant.

D. worth of the most reactive rod.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P949

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

Power defect	=	-0.0157 Δ/K/K
Shutdown margin	=	0.0241 Δ/K/K
Effective delayed neutron fraction	=	0.0058
Effective prompt neutron fraction	=	0.9942

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

A. 0.0157 ΔK/K

B. 0.0241 ΔK/K

C. 0.0058 ΔK/K

D. 0.9942 ΔK/K

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P1449

A reactor with a xenon-free core is critical several decades below the point of adding heat (POAH). The operator continuously withdraws control rods until a positive 0.5 DPM startup rate (SUR) is reached and then stops control rod motion.

When rod motion is stopped, the SUR will immediately... (Ignore any reactivity effects from fission product poisons.)

A. stabilize at 0.5 DPM until power reaches the POAH.

B. decrease, and then stabilize at a value less than 0.5 DPM until power reaches the POAH.

C. stabilize at 0.5 DPM, and then slowly and continuously decrease until power reaches the POAH.

D. decrease, and then continue to slowly decrease until power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P1948 (B1150)

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

A. 1.0001

B. 1.001

C. 1.01

D. 1.1

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P2049

A reactor initially has a stable positive 1.0 DPM startup rate with no control rod motion several decades below the point of adding heat (POAH). Control rods are inserted until a positive 0.5 DPM startup rate is attained and then stopped.

When rod insertion is stopped, startup rate will immediately...

A. stabilize at 0.5 DPM until power reaches the POAH.

B. increase, and then stabilize at a value greater than 0.5 DPM until power reaches the POAH.

C. continuously decrease until startup rate becomes zero when power reaches the POAH.

D. increase, and then slowly and continuously decrease until startup rate becomes zero when power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P2549 (B2550)

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 Aprompt 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: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P2949 (B2951)

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 <u>prompt</u> critical?

A. 0.0061 ΔK/K

B. 0.0185 ΔK/K

C. 0.0227 ΔK/K

D. 0.9939 ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3249 (B3250)

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 __________.

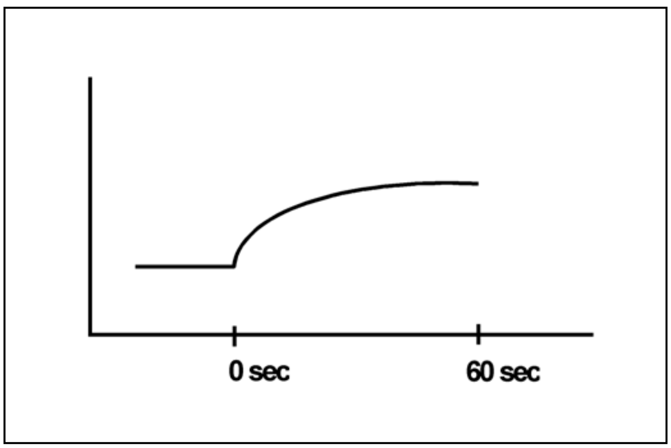
A. startup rate; subcritical

B. startup rate; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.



TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3449 (B3450)

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 startup rate 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; smaller

B. smaller; larger

C. larger; smaller

D. larger; larger

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3649 (B3651)

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) __________.

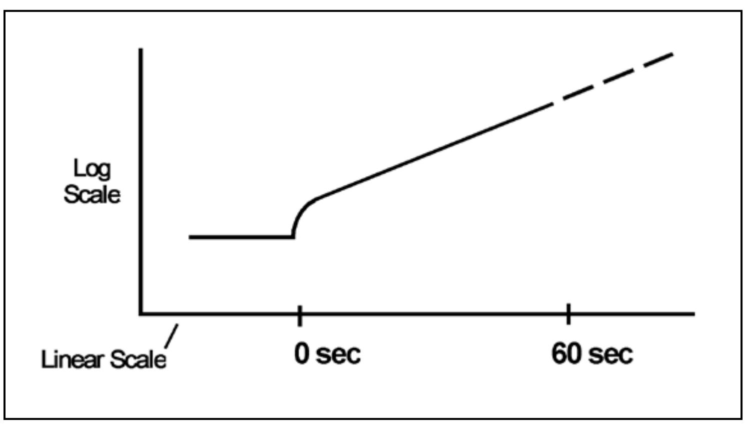
A. startup rate; exactly critical

B. startup rate; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.



TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3749 (B3750)

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 prompt critical?

A. 0.0067 ΔK/K

B. 0.0176 ΔK/K

C. 0.0234 ΔK/K

D. 0.9933 ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P7827 (B7827)

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: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P49

Which one of the following is a characteristic of a neutron source installed in a reactor?

A. Maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B. Provides a means to allow reactivity changes to occur in a subcritical reactor.

C. Generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D. Provides a neutron level that is detectable on the source range nuclear instrumentation.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P349

Neutron sources are installed in a reactor for which one of the following reasons?

A. To decrease the amount of fuel load required for criticality.

B. To compensate for neutrons being absorbed by burnable poisons.

C. To augment the shutdown neutron flux to allow detection on nuclear instrumentation.

D. To provide sufficient neutron flux to achieve criticality during a reactor startup following a long-term shutdown.

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P1249

Which one of the following neutron reactions yields the highest neutron production rate immediately following a reactor trip from extended power operations during the tenth fuel cycle? (Ignore any contribution from an installed neutron source.)

A. Alpha-neutron reactions

B. Beta-neutron reactions

C. Photo-neutron reactions

D. Spontaneous fission

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P1549 (B1549)

Which one of the following neutron sources undergoes the most significant source strength reduction during the hour immediately following a reactor trip 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: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P2149 (B2150)

Which one of the following is the neutron source that produces the greatest neutron flux for the first few days following a reactor trip 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: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P3149 (B967)

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

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

A. fuel temperature.

B. fuel cladding temperature.

C. reactor vessel temperature.

D. reactor coolant temperature.

ANSWER: D.

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

Which one of the following isotopes is the <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: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P1950 (B753)

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

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

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

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

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

ANSWER: D.

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

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

A. U-235

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

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

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

A. Uranium-235

B. Uranium-238

C. Samarium-149

D. Xenon-135

ANSWER: B.

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

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

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

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

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

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

ANSWER: C.

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

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

A. more negative, due to control rod withdrawal.

B. less negative, due to control rod insertion.

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

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

ANSWER: C.

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

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

A. U-238 and Pu-239

B. U-238 and Pu-240

C. Pu-239 and U-235

D. Pu-239 and Pu-240

ANSWER: B.

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

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

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

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

C. Reactor coolant boron concentration increases by 20 ppm.

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

ANSWER: A.

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

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

A. U-235 and Pu-239

B. U-235 and U-238

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

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

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

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

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

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

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

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

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

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

ANSWER: B.

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

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

A. fast fission factor.

B. thermal utilization factor.

C. total nonleakage probability.

D. resonance escape probability.

ANSWER: B.

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

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

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

B. BOC, low reactor coolant temperature

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

D. EOC, low reactor coolant temperature

ANSWER: C.

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

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

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

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

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

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

ANSWER: C.

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

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

A. high; high

B. high; low

C. low; high

D. low; low

ANSWER: C.

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

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

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

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

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

ANSWER: B.

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

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

A. a decreasing thermal utilization factor.

B. an increasing thermal utilization factor.

C. a decreasing resonance escape probability.

D. an increasing resonance escape probability.

ANSWER: D.

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

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

A. fission product poison buildup in the fuel.

B. decreasing fuel centerline temperature.

C. decreasing control rod worth.

D. decreasing reactor coolant boron concentration.

ANSWER: D.

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

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

A. low; low

B. high; low

C. low; high

D. high; high

ANSWER: B.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: D.

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

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

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

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

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

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

ANSWER: C.

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

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

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: D.

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

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

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: B.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: A.

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

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

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: C.

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

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

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

During the heatup, K_{eff} will…

A. increase continuously.

B. decrease continuously.

C. initially increase, and then decrease.

D. initially decrease, and then increase.

ANSWER: B.

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

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

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

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

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

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

ANSWER: D.

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

Which one of the following will cause the Doppler power coefficient to become <u>more</u> negative?

A. Increased clad creep

B. Increased pellet swell

C. Lower power level

D. Higher reactor coolant boron concentration

ANSWER: C.

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

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

A. more; decreases

B. more; increases

C. less; decreases

D. less; increases

ANSWER: A.

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

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

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

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

A nuclear power plant is operating at steady-state 70 percent power. Which one of the following will result in a less negative fuel temperature coefficient? (Consider only the <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 coolant voids.

ANSWER: C.

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

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

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

B. more; buildup of fission product poisons

C. less; higher fuel temperature

D. more; increased neutron flux

ANSWER: C.

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

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

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

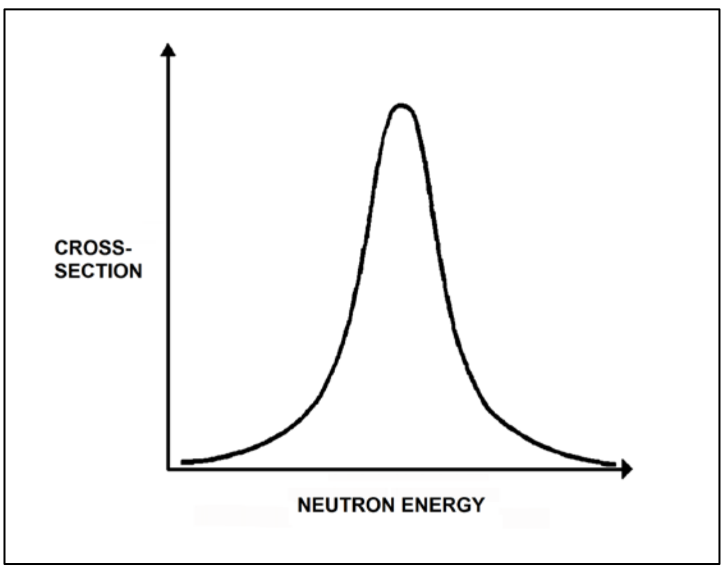
A. increase; neutrons of a wider range of energies will be absorbed by U-238

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

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

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

ANSWER: C.



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

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

A. It remains essentially constant over core life.

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

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

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

ANSWER: B.

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

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

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

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

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

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

ANSWER: A.

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

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

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

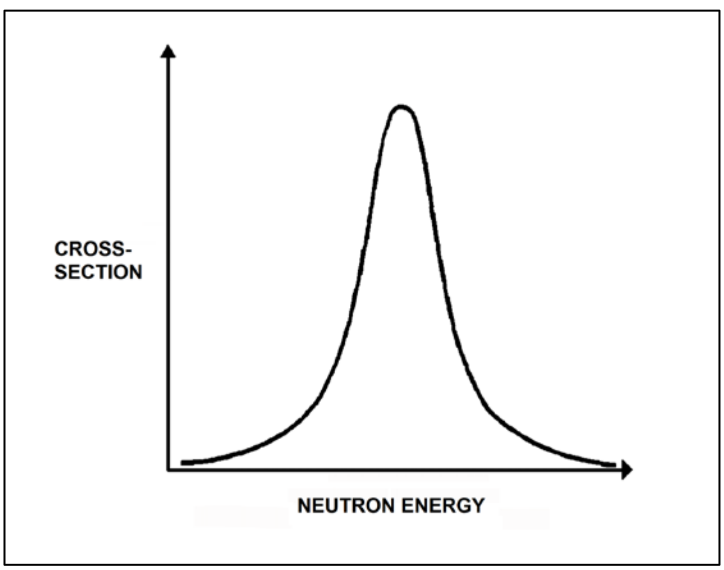
A. decrease; fewer neutrons will be absorbed by U-238 overall

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

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

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

ANSWER: C.



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

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

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

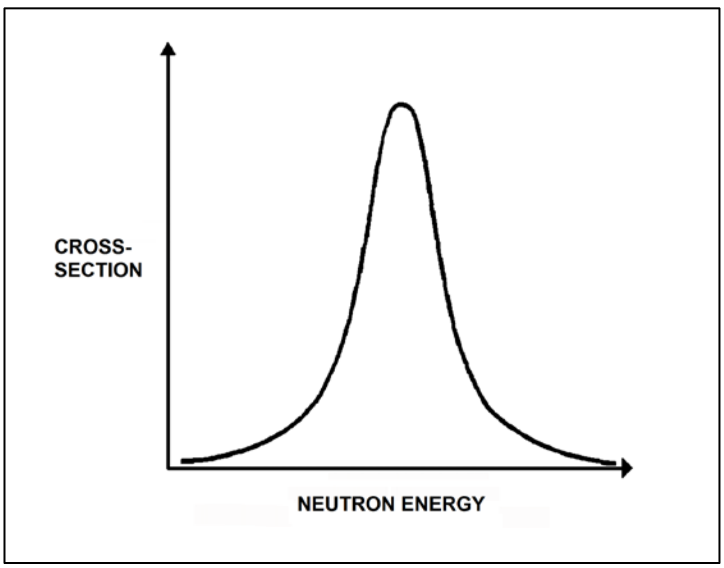
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: D.



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

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

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

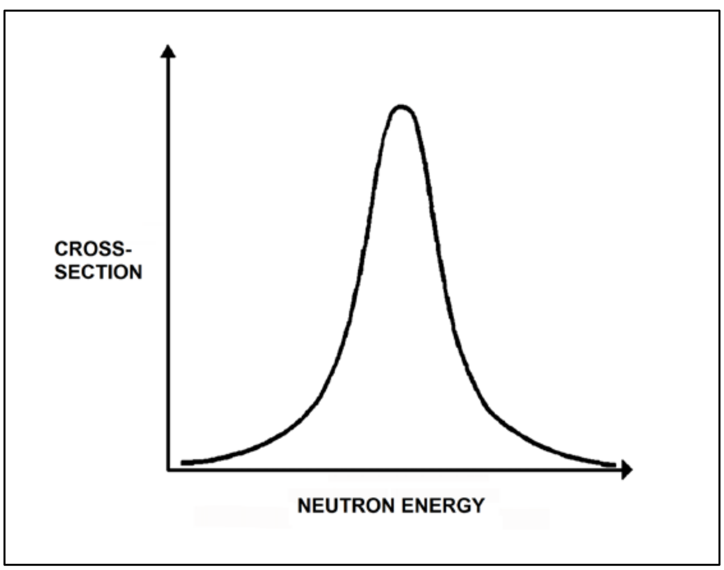
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: D.



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

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

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

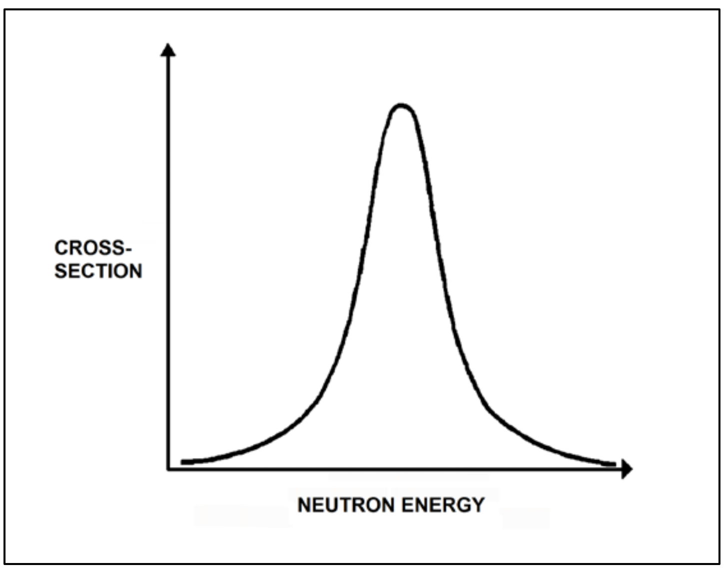
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.



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

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

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: B.

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

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

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: C.

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

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

A. 30 percent to 40 percent

B. 30 percent to 20 percent

C. 80 percent to 90 percent

D. 80 percent to 70 percent

ANSWER: A.

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

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

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

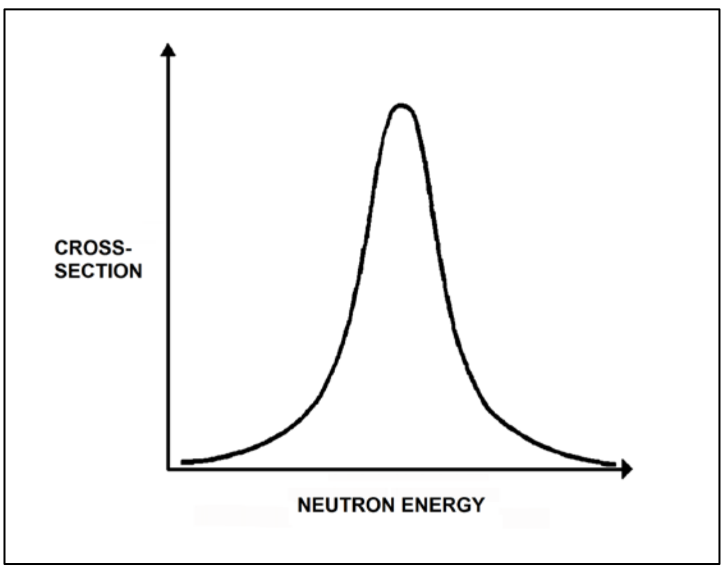
A. shorter and broader; increase

B. shorter and broader; decrease

C. taller and more narrow; increase

D. taller and more narrow; decrease

ANSWER: A.



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

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

A. less; greater

B. less; smaller

C. more; greater

D. more; smaller

ANSWER: B.

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

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

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

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

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

D. Moderator void fraction, fuel temperature, moderator temperature

ANSWER: D.

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

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

A. The change in Xe-135 concentration.

B. The change in control rod position.

C. The change in fuel temperature.

D. The change in moderator temperature.

ANSWER: C.

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

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

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

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

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

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

ANSWER: B.

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

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

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

A. buildup of core xenon-135.

B. increased fuel temperature.

C. burnout of burnable poisons.

D. increased reactor coolant temperature.

ANSWER: B.

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

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

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

A. increased reactor coolant temperature.

B. buildup of core xenon-135.

C. burnout of burnable poisons.

D. increased fuel temperature.

ANSWER: D.

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

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

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

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

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

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

ANSWER: D.

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

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

A. higher; smaller

B. higher; greater

C. lower; smaller

D. lower; greater

ANSWER: A.

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

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

A. more; fewer

B. more; more

C. less; fewer

D. less; more

ANSWER: C.

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

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

A. burnable poisons deplete.

B. boron concentration increases.

C. moderator temperature increases.

D. fission product poison concentration increases.

ANSWER: A.

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

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

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

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

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

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

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

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

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

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

ANSWER: D.

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

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

A. the same

B. four times as large

C. eight times as large

D. twelve times as large

ANSWER: A.

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

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

A. one-tenth

B. the same as

C. 10 times

D. 100 times

ANSWER: C.

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

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

A. integrated; total

B. integrated; differential

C. unit; total

D. unit; differential

ANSWER: C.

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

Given the following initial parameters:

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

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

A. 606 ppm

B. 603 ppm

C. 597 ppm

D. 594 ppm

ANSWER: A.

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

Given the following initial parameters:

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

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

A. 491 ppm

B. 496 ppm

C. 504 ppm

D. 509 ppm

ANSWER: A.

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

Given the following initial parameters:

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

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

A. 390 ppm

B. 420 ppm

C. 450 ppm

D. 470 ppm

ANSWER: C.

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

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

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

A. 509 ppm

B. 504 ppm

C. 496 ppm

D. 491 ppm

ANSWER: A.

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

Given the following initial parameters:

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

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

A. 425 ppm

B. 450 ppm

C. 550 ppm

D. 575 ppm

ANSWER: A.

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

Given the following initial parameters:

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

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

A. 425 ppm

B. 475 ppm

C. 525 ppm

D. 575 ppm

ANSWER: D.

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

Given the following initial parameters:

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

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

A. 420 ppm

B. 580 ppm

C. 620 ppm

D. 780 ppm

ANSWER: C.

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

Given the following initial parameters:

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

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

A. 410 ppm

B. 425 ppm

C. 575 ppm

D. 590 ppm

ANSWER: D.

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

Given the following initial parameters:

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

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

A. 520 ppm

B. 560 ppm

C. 640 ppm

D. 680 ppm

ANSWER: B.

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

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

A. 3 percent to 5 percent

B. 5 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 60 percent

ANSWER: D.

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

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

A. 2 percent to 5 percent

B. 5 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 50 percent

ANSWER: A.

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

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

A. 3 percent to 10 percent

B. 10 percent to 25 percent

C. 25 percent to 60 percent

D. 60 percent to 100 percent

ANSWER: D.

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

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

A. 3 percent to 10 percent

B. 10 percent to 25 percent

C. 25 percent to 65 percent

D. 65 percent to 100 percent

ANSWER: C.

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

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

A. 3 percent to 10 percent

B. 10 percent to 15 percent

C. 15 percent to 30 percent

D. 30 percent to 40 percent

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P254

A reactor is initially critical well below the point of adding heat (POAH) during a reactor startup. Control rods are withdrawn for 20 seconds to establish a 0.5 DPM startup rate.

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

A. continue increasing until the control rods are reinserted.

B. stabilize at a value slightly below the POAH.

C. stabilize at the POAH.

D. stabilize at a value slightly above the POAH.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P354

A reactor is initially critical below the point of adding heat during a reactor startup. If control rods are manually inserted for 5 seconds, reactor power will decrease...

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

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

C. temporarily, then return to the original power level due to a decrease in moderator temperature.

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

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P754 (B755)

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: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1054

A reactor is operating at steady-state 50 percent power near the end of a fuel cycle when the operator withdraws a group of control rods for 5 seconds. (Assume main turbine load remains constant and the reactor does <u>not</u> trip.)

In response to the control rod withdrawal, actual reactor power will stabilize __________ the initial power level and reactor coolant temperature will stabilize __________ the initial temperature.

A. at; at

B. at; above

C. above; at

D. above; above

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1254

Initially, a reactor is operating at steady-state 50 percent power, when control rods are inserted a short distance. Assume that main turbine-generator load remains constant and the reactor does not trip.

In response to the control rod insertion, reactor power will initially decrease, and then…

A. stabilize in the source range.

B. stabilize at a lower value in the power range.

C. increase and stabilize above the original value.

D. increase and stabilize at the original value.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1654

A reactor is operating at steady-state 50 percent power near the end of a fuel cycle when the operator inserts a group of control rods for 5 seconds. Assume that turbine load remains constant and the reactor does not trip.

In response to the control rod insertion, reactor power will stabilize __________ the initial power level and reactor coolant temperature will stabilize __________ the initial temperature.

A. at; at

B. at; below

C. below; at

D. below; below

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1854 (B2155)

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: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1955 (B954)

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: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P3854

Criticality has been achieved during a xenon-free reactor startup. The core neutron flux level is low in the intermediate range with a stable 0.5 DPM startup rate (SUR). 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 when the SUR indicates exactly 0.0 DPM.

Immediately after the operator stops inserting the control rods, the SUR 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: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P555 (B856)

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: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P654

Integral control rod worth can be described as the change in __________ for a __________ change in rod position.

A. reactor power; total

B. reactivity; unit

C. reactor power; unit

D. reactivity; total

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P755 (B756)

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: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P1354

Integral rod worth is the...

A. change in reactivity per unit change in control 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 one position to another position.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P1471

Reactor power was ramped from 80 percent power to 100 percent power over 4 hours. The 80 percent conditions were as follows:

Reactor coolant system (RCS) boron concentration	=	600 ppm
Control rod position	=	110 inches
RCS average temperature	=	575°F

The 100 percent conditions are as follows:

RCS boron concentration	=	580 ppm
Control rod position	=	130 inches
RCS average temperature	=	580°F

Given the following reactivity coefficient/worth values, and ignoring fission product poison reactivity changes, what was the average differential control rod worth during the power change?

Power coefficient	=	-0.03 %ΔK/K/percent
Moderator temperature coefficient	=	-0.02 %ΔK/K/°F
Differential boron worth	=	-0.01 %ΔK/K/ppm

A. -0.02 %ΔK/K/inch

B. -0.025 %ΔK/K/inch

C. -0.04 %ΔK/K/inch

D. -0.05 %ΔK/K/inch

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P1554 (B1057)

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: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P1755 (B1855)

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: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P2255

A reactor is initially operating at steady state 70 percent power with the following conditions:

Reactor coolant system (RCS) boron concentration	=	600 ppm
Control rod position	=	110 inches
RCS average temperature	=	575°F

Reactor power is increased to 100 percent. The 100 percent reactor power conditions are as follows:

RCS boron concentration	=	590 ppm
Control rod position	=	130 inches
RCS average temperature	=	580°F

Given the following reactivity coefficient/worth values, and ignoring fission product poison reactivity changes, what was the average differential control rod worth during the power change?

Power coefficient	=	-0.03 %ΔK/K/percent
Moderator temperature coefficient	=	-0.02 %ΔK/K/°F
Differential boron worth	=	-0.01 %ΔK/K/ppm

A. -0.02 %ΔK/K/inch

B. -0.025 %ΔK/K/inch

C. -0.04 %ΔK/K/inch

D. -0.05 %ΔK/K/inch

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.05 [2.8/3.1]
QID: P2554 (B2655)

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: 192005
KNOWLEDGE: K1.06 [2.6/2.9]
QID: P134 (B1755)

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: 192005
KNOWLEDGE: K1.06 [2.6/2.9]
QID: P655 (B2255)

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: 192005
KNOWLEDGE: K1.06 [2.6/2.9]
QID: P856

During normal full power operation, the differential control rod worth is less negative at the top and bottom of the core compared to the center regions due to the effects of...

A. reactor coolant boron concentration.

B. neutron flux distribution.

C. xenon concentration.

D. fuel temperature distribution.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.06 [2.6/2.9]
QID: P1555 (B1657)

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: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P54

As moderator temperature increases, the differential rod worth becomes more negative because...

A. moderator density decreases, which causes more neutron leakage out of the core.

B. the moderator temperature coefficient decreases, which causes decreased competition for neutrons.

C. fuel temperature also increases, which decreases the rate of neutron absorption in the fuel.

D. moderator density decreases, which increases the neutron migration length.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P454

Differential rod worth will become most negative if reactor coolant temperature is __________ and reactor coolant boron concentration is __________.

A. increased; decreased

B. decreased; decreased

C. increased; increased

D. decreased; increased

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P955

A nuclear power plant is operating at 50 percent power with one group of control rods partially inserted into the core. If the moderator temperature decreases by 5°F, the group differential control rod worth will become...

A. more negative, due to better moderation of neutrons.

B. less negative, due to shorter neutron migration lengths.

C. more negative, due to increased moderator absorption of neutrons.

D. less negative, due to increased resonance absorption of neutrons.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P1556 (B2656)

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: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P2156

A reactor is operating at 60 percent power near the end of a fuel cycle with the controlling group of control rods inserted 5 percent into the core. Which one of the following will cause the group differential rod worth to become <u>less</u> negative? (Consider only the direct effect of the indicated change.)

A. Burnable poison rods become increasingly depleted.

B. Core Xe-135 concentration decreases toward an equilibrium value.

C. Reactor coolant temperature is allowed to decrease from 575°F to 570°F.

D. The group of control rods is inserted an additional 0.5 percent.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P2356

A reactor startup is in progress from a cold shutdown condition. During the reactor coolant heatup phase of the startup, the differential control rod worth will become __________ negative; and during the complete withdrawal of the initial bank of control rods, the differential control rod worth will become __________.

A. more; more negative initially and then less negative

B. more; less negative initially and then more negative

C. less; more negative during the entire withdrawal

D. less; less negative during the entire withdrawal

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.07 [2.5/2.8]
QID: P2655

Which one of the following will cause the differential rod worth for a group of control rods to become less negative? (Consider only the direct effect of the initiated change.)

A. During long-term full power operation, fuel temperature decreases as the fuel pellets come into contact with the fuel clad.

B. The reactor coolant system is cooled from 170°F to 120°F in preparation for refueling.

C. Core xenon-135 builds up in the lower half of the core.

D. During the fuel cycle, the quantity of burnable poisons decreases.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.08 [2.7/2.9]
QID: P857 (B3356)

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: 192005
KNOWLEDGE: K1.08 [2.7/2.9]
QID: P2456 (B2457)

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 trip.

D. To increase differential control rod worth by peaking the thermal neutron flux at the top of the reactor core.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09 [2.8/3.0]
QID: P55

Which one of the following includes two reasons for control rod bank/group overlap?

A. Provides a more uniform differential rod worth, and minimizes axial neutron flux peaking.

B. Provides a more uniform differential rod worth, and allows dampening of xenon-induced neutron flux oscillations.

C. Ensures that all rods remain within the allowable tolerance between their individual position indicators and their group counters, and ensures rod insertion limits are not exceeded.

D. Ensures that all rods remain within their allowable tolerance between individual position indicators and their group counters, and provides a more uniform axial flux distribution.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09 [2.8/3.0]
QID: P656

Which one of the following includes two reasons for control rod bank/group overlap?

A. Provide a more uniform axial power distribution and provide a more uniform differential rod worth.

B. Provide a more uniform differential rod worth and provide a more uniform radial power distribution.

C. Provide a more uniform radial power distribution and maintain individual and group rod position indicators within allowable tolerances.

D. Maintain individual and group rod position indicators within allowable tolerances and provide a more uniform axial power distribution.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09 [2.8/3.0]
QID: P1156

One purpose of using control rod bank/group overlap is to...

A. ensure adequate shutdown margin.

B. provide a more uniform differential rod worth.

C. allow dampening of xenon-induced neutron flux oscillations.

D. ensure control rod insertion limits are <u>not</u> exceeded.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.10 [3.0/3.3]
QID: P455

A reactor has been operating at 100 percent power for several weeks near the middle of a fuel cycle with all control rods fully withdrawn. Which one of the following describes why most of the power is being produced in the lower half of the reactor core?

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

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

C. The fuel loading in the lower half of the core contains a higher uranium-235 enrichment.

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

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.10 [3.0/3.3]
QID: P1357

A reactor is operating at steady-state 75 percent power in the middle of a fuel cycle. Which one of the following actions will cause the greatest shift in reactor power distribution toward the top of the core? (Assume control rods remain fully withdrawn.)

A. Decrease reactor power by 25 percent.

B. Decrease reactor coolant boron concentration by 10 ppm.

C. Decrease average reactor coolant temperature by 5°F.

D. Decrease reactor coolant system operating pressure by 15 psia.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.10 [3.0/3.3]
QID: P2656

A reactor has been operating at 100 percent power for three weeks shortly after a refueling outage. All control rods are fully withdrawn. Which one of the following describes why most of the power is being produced in the lower half of the core?

A. The fuel loading in the lower half of the core contains a higher U-235 enrichment.

B. Reactor coolant boron is adding more negative reactivity in the upper half of the core.

C. There is a greater concentration of Xe-135 in the upper half of the core.

D. The moderator temperature coefficient of reactivity is adding more negative reactivity in the upper half of the core.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.11 [2.8/3.2]
QID: P1157

If core quadrant power distribution (sometimes called quadrant power tilt or azimuthal tilt) is maintained within design limits, which one of the following conditions is most likely?

A. Axial power distribution is within design limits.

B. Radial power distribution is within design limits.

C. Nuclear instrumentation is indicating within design accuracy.

D. Departure from nucleate boiling ratio is within design limits.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.12 [2.9/3.1]
QID: P256

A reactor was restarted following a refueling outage and is currently at the point of adding heat. Which one of the following describes the change in axial power distribution as reactor power is increased to 5 percent by control rod withdrawal?

A. Shifts toward the bottom of the core.

B. Shifts toward the top of the core.

C. Shifts from the center of the core toward the top and bottom of the core.

D. Shifts from the top and bottom of the core toward the center of the core.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.12 [2.9/3.1]
QID: P355

By maintaining the radial and axial core power distributions within their prescribed limits, the operator is assured that ___________ will remain within acceptable limits.

A. power density (kW/foot) and departure from nucleate boiling ratio (DNBR)

B. DNBR and shutdown margin

C. core delta-T and power density (kW/foot)

D. shutdown margin and core delta-T

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.13 [2.8/3.2]
QID: P3156

Consider a reactor core with four quadrants: A, B, C, and D. The reactor is operating at steady-state 90 percent power when a fully withdrawn control rod in quadrant C drops to the bottom of the core. Assume that no operator actions are taken and reactor power stabilizes at 88 percent.

How are the maximum upper and lower core power tilt values (sometimes called quadrant power tilt ratio or azimuthal power tilt) affected by the dropped rod?

A. Upper core value decreases while lower core value increases.

B. Upper core value increases while lower core value decreases.

C. Both upper and lower core values decrease.

D. Both upper and lower core values increase.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.14 [3.2/3.5]
QID: P356 (B358)

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: 192005
KNOWLEDGE: K1.14 [3.2/3.5]
QID: P956

After a control rod is fully inserted (from the fully withdrawn position), the effect on the axial flux shape is minimal. This is because...

A. the differential rod worth is constant along the length of the control rod.

B. the fully inserted control rod is an axially uniform poison.

C. a control rod only has reactivity worth if it is moving.

D. a variable poison distribution exists throughout the length of the control rod.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.15 [3.4/3.9]
QID: P57

The control rod insertion limits generally rise as reactor power increases because…

A. the power defect becomes more negative as power increases.

B. the control rod worth becomes more negative as power increases.

C. the fuel temperature coefficient becomes more negative as power increases.

D. the equilibrium xenon-135 reactivity becomes more negative as power increases.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.15 [3.4/3.9]
QID: P1055

Control rod insertion limits are established for power operation because excessive rod insertion will...

A. adversely affect core power distribution.

B. generate excessive liquid waste due to dilution.

C. cause reduced control rod lifetime.

D. cause unacceptable fast and thermal neutron leakage.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.15 [3.4/3.9]
QID: P1456

Control rod insertion limits ensure that control rods will be more withdrawn as reactor power __________ to compensate for the change in __________.

A. increases; xenon reactivity

B. decreases; xenon reactivity

C. increases; power defect

D. decreases; power defect

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.15 [3.4/3.9]
QID: P1757

Why are control rod insertion limits established for power operation?

A. To minimize the worth of a dropped control rod.

B. To maintain a negative moderator temperature coefficient.

C. To provide adequate shutdown margin after a reactor trip.

D. To ensure sufficient positive reactivity is available to compensate for the existing power defect.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P557

A reactor has been operating at 80 percent power for four weeks with the controlling rod bank/group inserted 10 percent from the fully withdrawn position.

Which one of the following will be <u>most</u> affected by inserting the controlling bank/group an additional 5 percent? (Assume steady-state reactor power does <u>not</u> change.)

A. Total xenon-135 reactivity

B. Radial power distribution

C. Quadrant (azimuthal) power distribution

D. Axial power distribution

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P1457

A reactor is operating at steady-state 75 percent power with all control rods fully withdrawn. Assuming the reactor does <u>not</u> trip, which one of the following compares the effects of dropping (full insertion) a center control rod to the effects of partially inserting (50 percent) the same control rod?

A. A dropped rod causes a greater change in shutdown margin.

B. A dropped rod causes a smaller change in shutdown margin.

C. A dropped rod causes a greater change in axial power distribution.

D. A dropped rod causes a greater change in radial power distribution.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P1657

A reactor is operating at steady-state 75 percent power with all control rods fully withdrawn. Assuming the reactor does not trip, which one of the following compares the effects of dropping (full insertion) a center control rod to the effects of partially inserting (50 percent) the same control rod?

A. A partially inserted rod causes a greater change in axial power distribution.

B. A partially inserted rod causes a greater change in radial power distribution.

C. A partially inserted rod causes a greater change in shutdown margin.

D. A partially inserted rod causes a smaller change in shutdown margin.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P2157

A reactor is operating at steady-state 75 percent power with all control rods fully withdrawn. Assuming the reactor power does not trip, which one of the following compares the effects of dropping (full insertion) a center control rod to the effects of partially inserting (50 percent) the same control rod?

A. A dropped rod causes a smaller change in axial power distribution.

B. A dropped rod causes a smaller change in radial power distribution.

C. A dropped rod causes a smaller change in shutdown margin.

D. A dropped rod causes a greater change in shutdown margin.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P2257

A reactor is operating at steady-state 85 percent power with all control rods fully withdrawn. Assuming the reactor does not trip, which one of the following compares the effects of partially inserting (50 percent) a center control rod to the effects of dropping (full insertion) the same control rod?

A. A partially inserted rod causes a smaller change in axial power distribution.

B. A partially inserted rod causes a smaller change in radial power distribution.

C. A partially inserted rod causes a greater change in shutdown margin.

D. A partially inserted rod causes a smaller change in shutdown margin.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P2457

A reactor is operating at steady-state 100 percent power at the beginning of a fuel cycle with all control rods fully withdrawn. Assuming the reactor does not trip, which one of the following compares the effects of dropping a control rod in the center of the core to dropping an identical control rod at the periphery of the core?

A. Dropping a center control rod causes a greater change in shutdown margin.

B. Dropping a center control rod causes a smaller change in shutdown margin.

C. Dropping a center control rod causes a greater change in axial power distribution.

D. Dropping a center control rod causes a greater change in radial power distribution.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P2556

A reactor has been operating at 80 percent power for four weeks with the controlling rod group inserted 15 percent from the fully withdrawn position.

Which one of the following will be significantly affected by withdrawing the controlling rod group an additional 5 percent? (Assume steady-state reactor power does <u>not</u> change.)

A. Total xenon-135 reactivity

B. Axial power distribution

C. Radial power distribution

D. Quadrant (azimuthal) power distribution

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.16 [2.8/3.1]
QID: P2857

A reactor is operating at steady-state 100 percent power with all control rods fully withdrawn when one control rod at the core periphery falls completely into the core. Assuming <u>no</u> reactor trip and <u>no</u> operator action, which one of the following will change significantly as a result of the dropped rod?

A. Axial power distribution only.

B. Axial power distribution and shutdown margin.

C. Radial power distribution only.

D. Radial power distribution and shutdown margin.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P58

Fission products that have large microscopic cross sections for capture of thermal neutrons are called...

A. breeder fuels.

B. burnable poisons.

C. fissionable fuels.

D. reactor poisons.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P858 (B1858)

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: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P2058 (B2061)

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: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P2158

A fission product poison can be differentiated from all other fission products in that a fission product poison...

A. will be radioactive for thousands of years.

B. is produced in a relatively large percentage of thermal fissions.

C. has a relatively high probability of absorbing a fission neutron.

D. is formed as a gas and is contained within the fuel pellets and fuel rods.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01 [2.5/2.6]
QID: P2858 (B1558)

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: 192006
KNOWLEDGE: K1.02 [3.0/1.1]
QID: P658

Xenon-135 is considered a major fission product poison because it has a large...

A. fission cross section.

B. absorption cross section.

C. elastic scatter cross section.

D. inelastic scatter cross section.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.02 [3.0/1.1]
QID: P1858 (B1058)

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: 192006
KNOWLEDGE: K1.02 [3.0/1.1]
QID: P2458 (B1658)

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: 192006
KNOWLEDGE: K1.02 [3.0/1.1]
QID: P2658 (B256)

Compared to other reactor poisons, the two characteristics that make xenon-135 a major 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: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P59

Immediately after a reactor trip from sustained high power operation, xenon-135 concentration in the reactor will...

A. increase, due to the decay of iodine-135.

B. decrease, because xenon-135 production from fission has stopped.

C. remain the same, because the decay of iodine-135 and xenon-135 balance each other out.

D. decrease initially, and then slowly increase due to the differences in the half-lives of iodine-135 and xenon-135.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P358 (B362)

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: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P1359 (B458)

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: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P1559 (B859)

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: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P1859 (B257)

What is the major contributor to the production of xenon-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: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P7818 (B7818)

One minute after a reactor trip from steady-state 100 percent reactor power, the greatest xenon-135 production rate will be from __________; and the greatest xenon-135 removal rate 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: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P60

One hour after a reactor trip from sustained 100 percent power operation, the xenon-135 removal process consists primarily of...

A. beta decay.

B. gamma decay.

C. neutron capture.

D. gamma capture.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P460 (B462)

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 directly 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: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P859

In a shutdown reactor, which decay chain describes the primary means of removing xenon-135?

A. $^{135}Xe \xrightarrow{\beta^-} {}^{135}Cs$

B. $^{135}Xe \xrightarrow{n} {}^{134}Xe$

C. $^{135}Xe \xrightarrow{\alpha} {}^{131}Te$

D. $^{135}Xe \xrightarrow{\beta^+} {}^{131}I$

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P1059 (B359)

Xenon-135 undergoes radioactive decay to...

A. iodine-135.

B. cesium-135.

C. tellurium-135.

D. lanthanum-135.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P2659 (B3358)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P61 (B58)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P660 (B658)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P1158 (B1160)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P1459 (B259)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P2159 (B2659)

Which one of the following indicates that core xenon-135 concentration is in equilibrium?

A. Xenon-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. Xenon-135 is being produced equally by fission and I-135 decay.

D. A reactor is currently operating at 100 percent power.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05 [2.8/2.8]
QID: P2558 (B2558)

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: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P2859 (B2760)

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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P259

A reactor has been operating at 50 percent power for one week when power is ramped to 100 percent over a four-hour period. How will the xenon-135 concentration respond after power reaches 100 percent?

A. Decrease initially, and then build to a new equilibrium concentration in 8 to 10 hours.

B. Decrease initially, and then build to a new equilibrium concentration in 40 to 50 hours.

C. Increase steadily to a new equilibrium concentration in 20 to 30 hours.

D. Increase steadily to a new equilibrium concentration in 70 to 80 hours.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P659

A reactor has been operating at a 50 percent power for 15 hours following a one-hour power reduction from 100 percent. Which one of the following describes the current xenon-135 concentration?

A. Increasing

B. Decreasing

C. At equilibrium

D. Oscillating

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P959

A reactor was operating for 42 weeks at a steady-state power level below 100 percent when a reactor trip occurred. The reactor was returned to critical after 12 hours and then ramped to 60 percent power in 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. Unable to determine without knowledge of previous power history

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P1258

A reactor has been operating at 100 percent power for one week when power is ramped in 4 hours to 25 percent power. The new equilibrium xenon-135 concentration will be __________ the initial 100 percent equilibrium concentration.

A. the same as

B. about 80 percent of

C. about 50 percent of

D. less than 25 percent of

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: 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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P1659

A reactor was operating for 24 weeks at a steady-state power level below 100 percent when a reactor trip occurred. The reactor was returned to critical after 12 hours, and then ramped to 80 percent power in 6 hours.

Approximately how much time at steady-state 80 percent power will be required to reach an equilibrium xenon-135 concentration?

A. 10 to 20 hours

B. 40 to 50 hours

C. 70 to 80 hours

D. Cannot determine without knowledge of previous power history

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P1960 (B1262)

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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2060

Initially, a reactor is operating at 50 percent power with equilibrium xenon-135. Then power is increased to 100 percent over a one-hour period and average reactor coolant temperature is adjusted to 588°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 8 hours after the power change is completed?

A. Greater than 588°F and decreasing slowly

B. Greater than 588°F and increasing slowly

C. Less than 588°F and decreasing slowly

D. Less than 588°F and increasing slowly

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2061 (B2158)

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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2160

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. 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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2359 (B2660)

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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2360 (B2361)

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: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2559

A reactor is initially operating at 100 percent power with equilibrium xenon-135. Power is decreased to 50 percent over a one-hour period and average reactor coolant temperature is adjusted to 572°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 10 hours after the power change is completed?

A. Less than 572°F and increasing slowly.

B. Less than 572°F and decreasing slowly.

C. Greater than 572°F and increasing slowly.

D. Greater than 572°F and decreasing slowly.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2760

Initially, a reactor is operating at 80 percent power with equilibrium xenon-135. Then power is increased to 100 percent over a 2-hour period. At the end of the power increase, the average reactor coolant temperature is 585°F. Rod control is in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 24 hours after reactor power reaches 100 percent?

A. Less than 585°F, and decreasing slowly.

B. Less than 585°F, and increasing slowly.

C. Greater than 585°F, and decreasing slowly.

D. Greater than 585°F, and increasing slowly.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P3460

Initially, a reactor is operating at 100 percent power with equilibrium xenon-135. Then power is decreased to 40 percent over a 2-hour period. At the end of the power decrease, the average reactor coolant temperature is 562°F. Rod control is in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of xenon-135 changes, which one of the following describes the average reactor coolant temperature 2 hours after reactor power reaches 40 percent?

A. Greater than 562°F, and decreasing slowly.

B. Greater than 562°F, and increasing slowly.

C. Less than 562°F, and decreasing slowly.

D. Less than 562°F, and increasing slowly.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P260 (B459)

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 trip at the same time, 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: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1159 (B1761)

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 trip 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: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1358 (B1361)

A reactor has been operating at 75 percent power for two months. A manual reactor trip is required for a test. The trip will be followed immediately by a reactor startup with criticality scheduled to occur 12 hours after the trip.

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 trip; and if criticality is rescheduled for __________ hours after the trip.

A. 100 percent; 8

B. 100 percent; 16

C. 50 percent; 8

D. 50 percent; 16

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1561

The amount of negative reactivity associated with peak xenon-135 is smallest after a reactor trip 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: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1660

The amount of negative reactivity associated with peak xenon-135 is greatest after a reactor trip 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: D.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P3860 (B3861)

A reactor has been operating at 80 percent power for two months. A manual reactor trip is required for a test. The trip will be followed by a reactor startup with criticality scheduled to occur 24 hours after the trip.

The greatest 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 trip; and if criticality is rescheduled for __________ hours after the trip.

A. 60 percent; 18

B. 60 percent; 30

C. 100 percent; 18

D. 100 percent; 30

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P6031

A reactor trip occurred <u>one</u> hour ago following several months of operation at 100 percent power. Reactor coolant temperature is being maintained at 550°F and the source range count rate is currently 400 cps. If <u>no</u> additional 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 initially decrease and then increase.

D. The count rate will initially increase and then decrease.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P7807 (B7807)

A reactor trip occurred 16 hours ago following several months of operation at 100 percent power. Reactor coolant temperature is being maintained at 557°F. The source range count rate is 400 cps, and the source neutron production rate is constant. Assume that <u>no</u> 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: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P62

Slow changes in axial power distribution in a reactor that has operated at a steady-state power level for a long time can be caused by xenon-135...

A. peaking.

B. override.

C. burnup.

D. oscillations.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P261

Xenon-135 oscillations that tend to <u>dampen</u> themselves over time are __________ oscillations.

A. converging

B. diverging

C. diffusing

D. equalizing

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P372

Which one of the following occurrences can cause reactor power production to fluctuate between the top and bottom of the core when steam demand is constant?

A. Steam generator level transients

B. Iodine-135 spiking

C. Xenon-135 oscillations

D. Inadvertent boron dilution

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P463

A reactor has been operating at 100 percent power for several weeks with a symmetrical axial power distribution peaked at the core midplane. Reactor power is reduced to 50 percent using boration to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power reduction, the axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. peak at the top and the bottom of the core.

D. remain symmetrical and peaked at the core midplane.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P563

A reactor was initially operating at 100 percent power at the beginning of core life with equilibrium xenon-135. Then, reactor power was reduced to 50 percent over a two-hour period.

The following information is given:

	Prior to Power Change	After Power Change
Reactor power:	100 percent	50 percent
Reactor coolant boron concentration:	740 ppm	820 ppm
Control rod position:	Fully withdrawn	Fully withdrawn

What is the effect on power distribution in the core during the first 4 hours following the power reduction?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P761

When a reactor experiences xenon-135 oscillations, the most significant shifts in power generation occur between the ___________ of the core.

A. top and bottom

B. adjacent quadrants

C. center and periphery

D. opposite quadrants

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P763

A reactor has been operating at 80 percent power for several weeks with power production equally distributed axially above and below the core midplane. Reactor power is increased to 100 percent using boron dilution to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power increase, axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. remain evenly distributed above and below the core midplane.

D. peak at the top and the bottom of the core.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P961

Which one of the following will cause reactor power production to fluctuate slowly between the top and bottom of the core with steady-state steam demand?

A. Feedwater variations

B. Dropped center control rod

C. Xenon-135 oscillations

D. Samarium-149 oscillations

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P1160

Xenon-135 oscillations take about __________ hours to get from maximum xenon-135 negative reactivity to minimum xenon-135 negative reactivity.

A. 40 to 50

B. 24 to 28

C. 12 to 14

D. 6 to 7

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P2764

A reactor was initially operating at 80 percent power near the beginning of a fuel cycle with equilibrium xenon-135. Then, reactor power was increased to 100 percent over a 2 hour period.

The following information is provided:

	Prior to Power Change	After Power Change
Reactor power:	80 percent	100 percent
Reactor coolant boron concentration:	780 ppm	760 ppm
Control rod position:	Fully Withdrawn	Fully Withdrawn

What is the effect on power distribution in the core during the first 4 hours following the power increase?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P3060 (B3061)

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 trip occurs. The reactor is restarted, with criticality occurring 6 hours after the trip. 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: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P353 (B355)

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: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P1263

A reactor has been shut down for 7 days to perform maintenance. A reactor startup is performed, and power level is increased to 50 percent over a 5 hour period.

When power reaches 50 percent, the magnitude of xenon-135 negative reactivity will be...

A. increasing toward a peak value.

B. increasing toward an equilibrium value.

C. decreasing toward an equilibrium value.

D. decreasing toward an upturn.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P1661

A reactor has been shut down for 5 days to perform maintenance. A reactor startup is performed, and power is ramped to 75 percent over a 16-hour period.

When power reaches 75 percent, the concentration of xenon-135 will be...

A. decreasing toward an upturn.

B. increasing toward a peak value.

C. decreasing toward an equilibrium value.

D. increasing toward an equilibrium value.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P5631 (B5631)

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: 192006
KNOWLEDGE: K1.10 [3.1/3.2]
QID: P128

A reactor startup is being performed 5 hours after a reactor trip from 100 percent power with equilibrium xenon-135. The reactor is currently at 10 percent power, and is being returned to 100 percent power at 2.0 percent per minute instead of the normal rate of 0.5 percent per minute.

At the faster rate of power increase, the <u>minimum</u> amount of xenon-135 will occur ___________ than normal; and the amount of equilibrium xenon-135 at 100 percent power will be ___________.

A. sooner; the same

B. sooner; smaller

C. later; the same

D. later; smaller

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.10 [3.1/3.2]
QID: P1062

A reactor was operating at 100 percent power for 8 weeks when a reactor trip occurred. The reactor was critical 6 hours later and power was increased to 100 percent over the next 6 hours.

What was the status of xenon-135 concentration when power reached 100 percent?

A. Increasing toward an equilibrium value.

B. Burning out faster than it is being produced.

C. Increasing toward a peak value.

D. At equilibrium.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.10 [3.1/3.2]
QID: P1262

Xenon-135 poisoning in a reactor is most likely to prevent a reactor startup following a reactor shutdown from ___________ power at the ___________ of core life.

A. high; beginning

B. low; beginning

C. high; end

D. low; end

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.10 [3.1/3.2]
QID: P4631

A reactor startup is in progress 5 hours after a reactor trip from 100 percent power with equilibrium xenon-135. The reactor is currently at 10 percent power, and is being returned to 100 percent power at 0.25 percent per minute instead of the normal rate of 0.5 percent per minute.

At the slower rate of power increase, the <u>maximum</u> amount of xenon-135 will occur ___________ than normal; and the amount of equilibrium xenon-135 at 100 percent power will be ___________.

A. sooner; the same

B. sooner; smaller

C. later; the same

D. later; smaller

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.10 [3.1/3.2]
QID: P6931

A nuclear power plant was operating at 100 percent power for 3 months near the beginning of a fuel cycle when a reactor trip occurred. Eighteen hours after the reactor trip, the reactor was critical at the point of adding heat. Then, reactor power was increased to 100 percent over a three-hour period.

During the three-hour reactor power increase to 100 percent, most of the positive reactivity added by the operator was 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: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P63

A reactor was operating at 100 percent power for two weeks when power was quickly reduced to 50 percent. Core xenon-135 will reach a new equilibrium concentration in __________ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P263

A reactor that has been operating at 100 percent power for two weeks is reduced in power to 50 percent. What happens to the xenon-135 concentration in the core?

A. There will be <u>no</u> change, because iodine-135 concentration is constant.

B. Xenon-135 concentration will initially build up, and then decrease to a new equilibrium value.

C. Xenon-135 concentration will initially decrease, and then build up to a new equilibrium value.

D. Xenon-135 concentration will steadily decrease to a new equilibrium value.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P1860 (B2259)

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: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P2261 (B2761)

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: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P2762 (B2763)

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: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P2961 (B2960)

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: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P3261

A nuclear power plant is initially operating at steady-state 100 percent power in the middle of a fuel cycle. The operators decrease main generator load while adding boric acid to the reactor coolant system over a period of 30 minutes. At the end of this time period, reactor power is 70 percent and average reactor coolant temperature is 575°F. All control rods remain fully withdrawn and in manual control.

Considering <u>only</u> the reactivity effects of xenon-135 changes, which one of the following describes the status of the average reactor coolant temperature 60 minutes after the power change is completed?

A. 575°F and stable.

B. Less than 575°F and increasing.

C. Less than 575°F and decreasing.

D. Less than 575°F and stable.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P3362 (B2559)

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: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P360

A reactor had operated at 100 percent power for several days when a reactor trip occurred. If the reactor had operated at 50 percent power prior to the trip, the xenon-135 concentration would peak __________; and the peak xenon-135 concentration would be __________.

A. earlier; the same

B. at the same time; the same

C. earlier; less negative

D. at the same time; less negative

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P663

Following a reactor trip, negative reactivity from xenon-135 initially increases due to...

A. xenon-135 production from the decay of iodine-135.

B. xenon-135 production from the spontaneous fission of uranium-235.

C. the reduction of xenon-135 removal by decay.

D. the reduction of xenon-135 removal by recombination.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P863 (B2262)

Twenty-four hours after a reactor trip 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 trip and decreasing.

B. the same as the concentration at the time of the trip and increasing.

C. 50 percent lower than the concentration at the time of the trip and decreasing.

D. 50 percent higher than the concentration at the time of the trip and increasing.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
KNOWLEDGE: K1.13 [2.9/3.0]
QID: P963

A reactor had been operating at 100 percent power for several days when it was shut down over a two-hour period for maintenance. How will the xenon-135 concentration change after the shutdown?

A. Peak in 2 to 4 hours and then decay to near zero in about 1 day.

B. Peak in 2 to 4 hours and then decay to near zero in 3 to 4 days.

C. Peak in 6 to 10 hours and then decay to near zero in about 1 day.

D. Peak in 6 to 10 hours and then decay to near zero in 3 to 4 days.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P1063 (B2159)

A reactor had operated at 100 percent power for three weeks when a reactor trip occurred. Which one of the following describes the concentration of xenon-135 in the core 24 hours after the trip?

A. At least twice the concentration at the time of the trip and decreasing.

B. Less than one-half the concentration at the time of the trip and decreasing.

C. At or approaching a peak concentration.

D. Approximately the same as the concentration at the time of the trip.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2262 (B2461)

Fourteen hours after a reactor trip 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 trip.

A. less; positive

B. less; negative

C. greater; positive

D. greater; negative

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2363

How does the amount of xenon-135 change immediately following a reactor trip from 100 percent power with equilibrium xenon-135?

A. Decreases, due to xenon-135 removal by decay.

B. Decreases, due to the reduction in xenon-135 production directly from fission.

C. Increases, due to xenon-135 production from the decay of iodine-135.

D. Increases, due to xenon-135 production from the spontaneous fission of uranium.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2662

Given:

- A reactor was operating at 100 percent power for six weeks when a reactor trip occurred.
- A reactor startup was performed, and criticality was reached 16 hours after the trip.
- Two hours later, the reactor is currently at 30 percent power with control rods in Manual.

If no operator actions are taken over the next hour, average reactor coolant temperature will __________ because xenon-135 concentration is __________.

A. increase; decreasing

B. increase; increasing

C. decrease; decreasing

D. decrease; increasing

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2862

A reactor was operating at 100 percent power for 2 months when a reactor trip occurred. Four hours later, the reactor is critical and stable at 10 percent power.

Which one of the following operator actions is required to maintain reactor coolant temperature stable over the next 18 hours?

A. Add positive reactivity during the entire period.

B. Add negative reactivity during the entire period.

C. Add positive reactivity at first, and then negative reactivity.

D. Add negative reactivity at first, and then positive reactivity.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P7717

Nuclear reactors A and B are identical and are operating near the middle of a fuel cycle. Reactor A is operating at steady-state 100 percent power, while reactor B is operating at steady-state 50 percent power. The integral control rod worth is the same for both reactors.

Which one of the following describes which reactor will have the greater K_{eff} at three minutes and at three days following a reactor trip? (Assume that all control rods fully insert and that no subsequent operator actions affecting reactivity are taken.)

	Three Minutes	Three Days
A.	Reactor A	Reactor A
B.	Reactor A	Reactor B
C.	Reactor B	Reactor A
D.	Reactor B	Reactor B

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.13 [2.9/3.0]
QID: P562

After a reactor shutdown from equilibrium xenon-135 conditions, the peak xenon-135 negative reactivity is __________ the pre-shutdown power level.

A. independent of

B. directly proportional to

C. inversely proportional to

D. dependent on, but not directly proportional to

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.13 [2.9/3.0]
QID: P1760

A reactor was shut down following three months of operation at full power. The shutdown occurred over a three-hour period with a constant rate of power decrease.

Which one of the following describes the reactivity added by xenon-135 during the shutdown?

A. Xenon-135 buildup added negative reactivity.

B. Xenon-135 buildup added positive reactivity.

C. Xenon-135 burnout added negative reactivity.

D. Xenon-135 burnout added positive reactivity.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P262

Four hours after a reactor trip from 100 percent power operation with equilibrium xenon-135, a reactor is taken critical and power is immediately stabilized for critical data. To maintain a constant reactor power, the operator must add __________ reactivity because xenon-135 concentration is __________.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P361 (B1862)

A nuclear power plant has been operating at 100 percent power for two months when a reactor trip occurs. Shortly after the reactor trip, a reactor startup is commenced. Four hours after the trip, 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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P561 (B562)

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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P1462

A reactor has been operating at 100 percent power for two weeks. Power is then decreased over a one hour period to 10 percent.

Assuming manual rod control, which one of the following operator actions is required to maintain a constant reactor coolant temperature at 10 percent power during the next 24 hours?

A. Add negative reactivity during the entire period.

B. Add positive reactivity during the entire period.

C. Add positive reactivity at first, and then negative reactivity

D. Add negative reactivity at first, and then positive reactivity

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P1762 (B1763)

A reactor had been operating for two months at 100 percent power when a trip 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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2260 (B2861)

Initially, a reactor is 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 level and reactor coolant temperature be maintained constant 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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2561

Initially, a reactor is shut down with no xenon-135 in the core. Over the next 4 hours, the reactor is made critical and power level is increased to 25 percent. The shift supervisor has directed that power level and reactor coolant temperature be maintained constant for 12 hours.

To accomplish this objective, control rods will have to be...

A. withdrawn periodically for the duration of the 12 hours.

B. inserted periodically for the duration of the 12 hours.

C. withdrawn periodically for 4 to 6 hours, and then inserted periodically.

D. inserted periodically for 4 to 6 hours, and then withdrawn periodically.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2863

Initially, a reactor was operating at steady-state 70 percent power. Then, reactor power was increased to 100 percent over a 1 hour period. To keep reactor coolant system temperature stable during the next 2 hours, the operator must gradually __________ the control rods or __________ the reactor coolant boron concentration.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2963

A reactor is operating at 60 percent power immediately after a one-hour power increase from steady-state 40 percent power. To keep reactor coolant temperature stable over the next two hours, the operator must __________ control rods or __________ reactor coolant boron concentration.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P3063

Initially, a nuclear power plant was operating at 100 percent power with equilibrium xenon-135. Then, power was decreased to 75 percent over a one-hour period. The operator is currently adjusting control rod position as necessary to maintain average reactor coolant temperature constant.

What will the control rod position and directional trend be 30 hours after power reached 75 percent?

A. Above the initial 75 percent power position and inserting slowly.

B. Above the initial 75 percent power position and withdrawing slowly.

C. Below the initial 75 percent power position and inserting slowly.

D. Below the initial 75 percent power position and withdrawing slowly.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P3563 (B3563)

A nuclear power plant had been operating at 100 percent power for two months when a reactor trip occurred. Soon afterward, a reactor startup was performed. Twelve hours after the trip, the startup has been paused with reactor power at 5 percent.

To maintain reactor power and reactor coolant temperatures stable 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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P3863

Initially, a nuclear power plant is operating at steady-state 100 percent reactor power in the middle of a fuel cycle. Then, the operators decrease main generator load to 90 percent over a one-hour period while adding boric acid to the reactor coolant system. After the required amount of boric acid is added, reactor power is 90 percent and average reactor coolant temperature is 582°F. All control rods remain fully withdrawn and in manual control.

If no other operator actions are taken, which one of the following describes the average reactor coolant temperature after an additional hour?

A. Higher than 582°F and increasing slowly.

B. Higher than 582°F and decreasing slowly.

C. Lower than 582°F and increasing slowly.

D. Lower than 582°F and decreasing slowly.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P6831 (B6831)

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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P7431 (B7431)

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 not change.

Compared to the equilibrium xenon-135 concentration at 100 percent power just prior to the refueling, the current 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: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P7657 (B7657)

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: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P362 (B364)

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: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P671

A major reason for installing burnable poisons in a reactor is to…

A. decrease the amount of fuel required to produce a given amount of heat.

B. decrease the amount of fuel required to produce a given duration of plant operation.

C. allow more fuel to be loaded to prolong a fuel cycle.

D. absorb neutrons that would otherwise be lost from the core.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P864

Instead of using only a higher reactor coolant boron concentration to offset the enrichment of new fuel assemblies, burnable poisons are installed in a new reactor core to...

A. prevent boron precipitation during normal operation.

B. establish a more negative moderator temperature coefficient.

C. allow control rods to be farther withdrawn upon initial criticality.

D. maintain reactor coolant pH above a minimum acceptable value.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P1664

Why are burnable poisons installed in a new reactor core instead of using a higher reactor coolant boron concentration for reactivity control?

A. To prevent boron precipitation during normal operation.

B. To establish a more negative moderator temperature coefficient.

C. To minimize the distortion of the neutron flux distribution caused by soluble boron.

D. To allow the loading of excessive reactivity in the form of higher fuel enrichment.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P64

A reactor is operating near the end of its fuel cycle. Reactor power and reactor coolant system (RCS) temperature are being allowed to "coast down."

Why is RCS boron dilution <u>no</u> <u>longer</u> used for reactivity control for this reactor?

A. The magnitude of the differential boron worth (ΔK/K/ppm) has increased so much that reactivity changes from RCS boron dilution cannot be safely controlled by the operator.

B. The magnitude of the differential boron worth (ΔK/K/ppm) has decreased so much that a very large amount of water must be added to the RCS to make a small positive reactivity addition to the core.

C. The RCS boron concentration has become so high that a very large amount of boron must be added to produce a small increase in boron concentration.

D. The RCS boron concentration has become so low that a very large amount of water must be added to the RCS to produce a small decrease in boron concentration.

ANSWER: D.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P264

Just prior to a refueling outage, a nuclear power plant was operating at 100 percent power with a reactor coolant boron concentration of 50 ppm. After the refueling outage, the 100 percent power boron concentration is approximately 1,000 ppm.

Which one of the following is the primary reason for the large increase in 100 percent power reactor coolant boron concentration?

A. The negative reactivity from power defect after the outage is much greater than before the outage.

B. The magnitude of differential boron worth (ΔK/K/ppm) after the outage is much less than before the outage.

C. The excess reactivity in the core after the outage is much greater than before the outage.

D. The magnitude of integral control rod worth after the outage is much less than before the outage.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P464

During a 6-month period of continuous 100 percent power operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically 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: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P1264 (B1163)

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…

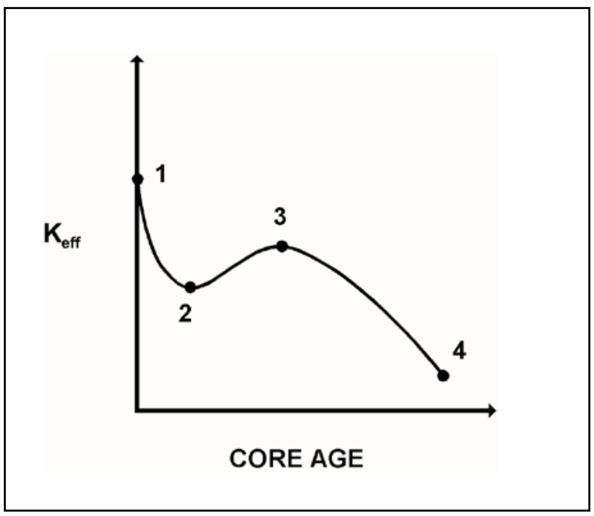
A. depletion of fuel.

B. burnout of burnable poisons.

C. initial heatup of the reactor.

D. buildup of fission product poisons.

ANSWER: D.



TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P1563

Refer to the graph of critical boron concentration versus core burnup for a reactor following a refueling outage (See figure below.).

Which one of the following is primarily responsible for the shape of the curve from the middle of core life to the end of core life?

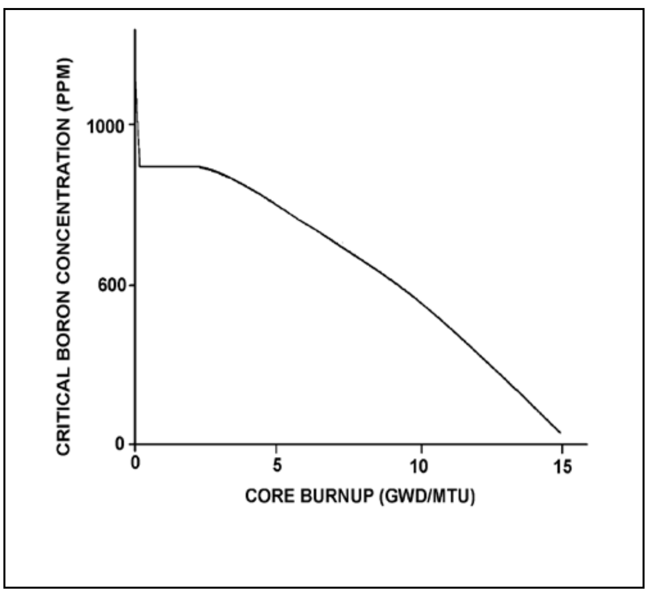
A. Fuel depletion

B. Fission product buildup

C. Burnable poison burnout

D. Conversion of U-238 to Pu-239

ANSWER: A.



TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P1864

Refer to the graph of critical boron concentration versus core burnup for a reactor during its first fuel cycle (see figure below).

Which one of the following explains why reactor coolant critical boron concentration becomes relatively constant for a period early in the fuel cycle?

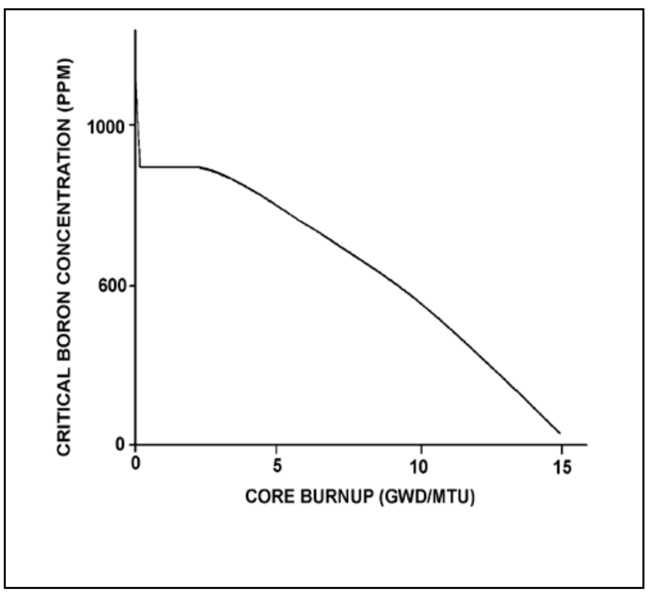
A. Fission product poison buildup is being offset by burnable poison burnout and fuel depletion.

B. Fission product poison buildup and fuel depletion are being offset by burnable poison burnout.

C. Fuel depletion is being offset by the buildup of fissionable plutonium and fission product poisons.

D. Fuel depletion and burnable poison burnout and are being offset by the buildup of fission product poisons.

ANSWER: B.



TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P2763

During continuous 100 percent power operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically to compensate for fuel depletion. What other core age-related factor requires a periodic decrease in reactor coolant boron concentration?

A. Decreasing control rod worth.

B. Buildup of fission product poisons.

C. Burnout of burnable poisons.

D. Decreasing fuel temperature.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P2964

A reactor has been operating at 100 percent power for 3 months following a refueling outage. If the reactor is operated at 100 percent power for another month without making RCS boron additions or dilutions, the RCS boron concentration will...

A. decrease, because boron atoms decompose at normal RCS operating temperatures.

B. decrease, because irradiated boron-10 atoms undergo a neutron-alpha reaction.

C. remain constant, because irradiated boron-10 atoms become stable boron-11 atoms.

D. remain constant, because irradiated boron-10 atoms still have large absorption cross sections for thermal neutrons.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P4832

Just prior to a refueling outage, the reactor coolant boron concentration at 100 percent power was 50 ppm. Burnable poisons were installed during the outage. Immediately following the outage, the boron concentration at 100 percent power was 1,000 ppm.

Which one of the following contributes to the need for a much higher 100 percent power reactor coolant boron concentration after the outage?

A. The negative reactivity from burnable poisons after the outage is greater than before the outage.

B. The negative reactivity from fission product poisons after the outage is smaller than before the outage.

C. The positive reactivity from the fuel in the core after the outage is smaller than before the outage.

D. The positive reactivity from a unit withdrawal of a typical control rod after the outage is greater than before the outage.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04 [3.1/3.4]
QID: P7532

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 reducing the reactor coolant boron concentration 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: 192007
KNOWLEDGE: K1.05 [3.0/3.2]
QID: P1964

Which one of the following describes whether reactor power can be increased from 50 percent to 100 percent in a controlled manner faster near the beginning of core life (BOL) or near the end of core life (EOL)? (Assume all control rods are fully withdrawn just prior to beginning the power increase.)

A. Faster near EOL, because faster changes in boron concentration are possible.

B. Faster near EOL, because integral control rod worth is greater.

C. Faster near BOL, because faster changes in boron concentration are possible.

D. Faster near BOL, because integral control rod worth is greater.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE: K1.05 [3.0/3.2]
QID: P2053

Which one of the following correctly compares the rates at which reactor power can be safely increased from 80 percent to 100 percent at the beginning of a fuel cycle (BOC) versus at the end of a fuel cycle (EOC)?

A. Slower at EOC, due to a lower maximum rate of reactor coolant boron dilution.

B. Slower at EOC, due to a less negative differential control rod worth.

C. Slower at BOC, due to a lower maximum rate of reactor coolant boron dilution.

D. Slower at BOC, due to a less negative differential control rod worth.

ANSWER: A.

TOPIC: 192007
KNOWLEDGE: K1.05 [3.0/3.2]
QID: P3364

Compared to adding boric acid to the reactor coolant system (RCS) during forced circulation, adding boric acid during natural circulation requires __________ time to achieve complete mixing in the RCS; and after complete mixing occurs, a 1 ppm increase in RCS boron concentration during natural circulation will cause a/an __________ change in reactivity for a given reactor coolant temperature.

A. more; smaller

B. more; equal

C. less; smaller

D. less; equal

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.01 [3.4/3.5]
QID: P565

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 160 cps.

Which one of the following statements accurately compares the two reactivity additions?

A. The first reactivity addition was larger.

B. The second reactivity addition was larger.

C. The first and second reactivity additions were equal.

D. There is not enough information given to compare the reactivity values.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.01 [3.4/3.5]
QID: P1665

During a reactor startup, the first positive reactivity addition caused the stable source range count rate to increase from 20 cps to 30 cps. The second positive reactivity addition caused the stable count rate to increase from 30 cps to 60 cps. K_{eff} was 0.97 prior to the first reactivity addition.

Which one of the following statements accurately compares the reactivity additions?

A. The first and second reactivity additions were approximately equal.

B. The first reactivity addition was approximately twice as large as the second.

C. The second reactivity addition was approximately twice as large as the first.

D. There is not enough information given to compare the reactivity values.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.02 [2.8/3.1]
QID: P3366

A nuclear power plant was operating at steady-state 100 percent power near the end of a fuel cycle when a reactor trip occurred. Four hours after the trip, with reactor coolant temperature at normal no-load temperature, which one of the following will cause the fission rate in the reactor core to increase?

A. The operator fully withdraws one bank/group of control rods.

B. Reactor coolant temperature increases by 3°F.

C. Reactor coolant boron concentration increases by 10 ppm.

D. An additional two hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.02 [2.8/3.1]
QID: P3464

A nuclear power plant was operating at steady-state 100 percent power near the end of a fuel cycle when a reactor trip occurred. Four hours after the trip, reactor coolant temperature is currently being maintained at normal no-load temperature in anticipation of commencing a reactor startup.

At this time, which one of the following will cause the fission rate in the reactor core to decrease?

A. The operator fully withdraws one bank/group of control rods.

B. Reactor coolant temperature decreases by 3°F.

C. Reactor coolant boron concentration decreases by 10 ppm.

D. An additional 2 hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P65 (B266)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P265

A reactor startup is in progress. The reactor is subcritical in the source range with a 0 DPM startup rate indication. Assuming the reactor remains subcritical, a short control rod <u>withdrawal</u> will cause the reactor startup rate indication to become positive, and then...

A. decrease, and stabilize at a negative 1/3 DPM.

B. decrease, and stabilize at 0 DPM.

C. stabilize until the point of adding heat (POAH) is reached; then decrease to 0 DPM.

D. increase continuously until the POAH is reached; then decrease to 0 DPM.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P448 (B1949)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P848 (B2149)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1065 (B1565)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1166

Which one of the following describes the prompt jump and the change in stable source range count rate resulting from a short control rod withdrawal with K_{eff} at 0.95 as compared to an identical control rod withdrawal with K_{eff} at 0.99? (Assume the reactivity additions are equal, and the reactor remains subcritical.)

A. The prompt jump in count rate will be the same, and the increase in stable count rate will be the same.

B. The prompt jump in count rate will be greater with K_{eff} at 0.99, but the increase in stable count rate will be the same.

C. The prompt jump in count rate will be the same, but the increase in stable count rate will be greater with K_{eff} at 0.99.

D. The prompt jump in count rate will be greater with K_{eff} at 0.99, and the increase in stable count rate will be greater with K_{eff} at 0.99.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1348 (B1449)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1448 (B1849)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1748

A subcritical reactor has a stable source range count rate of 60 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. 0.4 %ΔK/K

B. 0.6 %ΔK/K

C. 1.4 %ΔK/K

D. 1.6 %ΔK/K

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1766 (B2165)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P2466 (B2465)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P2448 (B2649)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995. 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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P2467

A reactor startup is in progress. The reactor is slightly subcritical with a constant startup rate of 0.0 DPM. If control rods are inserted for a few seconds, the startup rate will become negative initially, and then...

A. gradually become less negative and return to 0.0 DPM.

B. gradually become more negative until source neutrons become the only significant contributor to the neutron population, and then return to 0.0 DPM.

C. stabilize until source neutrons become the only significant contributor to the neutron population, and then return to 0.0 DPM.

D. stabilize at -1/3 DPM until fission neutrons are no longer a significant contributor to the neutron population, and then return to 0.0 DPM.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P3048 (B3049)

A reactor startup is being commenced with the initial source range count rate stable at 20 cps. After a period of control rod withdrawal, count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal is 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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P3348

A xenon-free shutdown nuclear power plant is slowly cooling down due to an unisolable steam leak. The leak began when reactor coolant temperature was 400°F and the readings on all source range channels were 80 cps. Currently, reactor coolant temperature is 350°F and all source range channels indicate 160 cps.

Assume the moderator temperature coefficient remains constant throughout the cooldown, and <u>no</u> operator action is taken. What will the status of the reactor be when reactor coolant temperature reaches 290°F?

A. Subcritical, with source range count rate less than 320 cps.

B. Subcritical, with source range count rate greater than 320 cps.

C. Supercritical, with source range count rate less than 320 cps.

D. Supercritical, with source range count rate greater than 320 cps.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P3925 (B3925)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P4225 (B4225)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P4525 (B4525)

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 coolant 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 coolant 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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P4534

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 0.5 DPM startup rate.

If the core effective delayed neutron fraction had been 0.005, what would be the approximate stable startup rate after the addition of the same amount of positive reactivity?

A. 0.6 DPM

B. 0.66 DPM

C. 0.7 DPM

D. 0.76 DPM

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P5025 (B7433)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P5225 (B5225)

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P5625

A PWR nuclear power plant has been shut down for two weeks and currently has the following stable conditions:

Reactor coolant temperature	=	550°F
Reactor coolant boron concentration	=	800 ppm
Source range count rate	=	32 cps

A reactor coolant boron dilution is commenced. After two hours, with reactor coolant boron concentration stable at 775 ppm, the source range count rate is stable at 48 cps.

Assume the differential boron worth ($\Delta K/K/ppm$) remains constant throughout the dilution. Also assume that reactor coolant temperature remains constant, control rod position does not change, and no reactor protection actuations occur.

If the reactor coolant boron concentration is further reduced to750 ppm, 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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P7627 (B7627)

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?

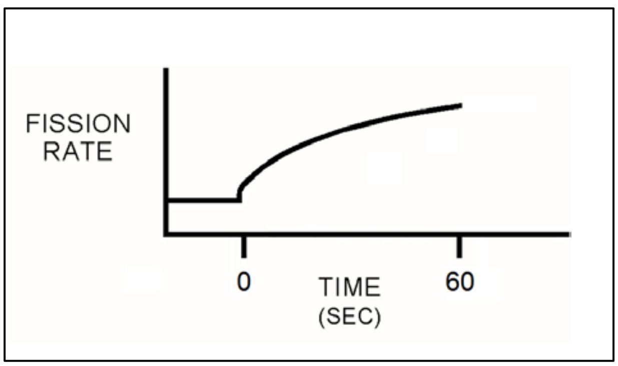
A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range, and remains subcritical for the duration of the 60-second interval shown.

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: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P7668 (B7668)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P266 (B1566)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P566

Initially, a reactor is subcritical with a K_{eff} of 0.97 and a stable source range count rate of 500 cps.

Which one of the following will be the approximate final steady-state count rate following a rod withdrawal that adds 1.05 %ΔK/K?

A. 750 cps

B. 1,000 cps

C. 2,000 cps

D. 2,250 cps

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P666

During a reactor startup, control rods are withdrawn such that K_{eff} increases from 0.98 to 0.99. If the stable source range count rate before the rod withdrawal was 500 cps, which one of the following will be the final stable count rate?

A. 707 cps

B. 1,000 cps

C. 1,500 cps

D. 2,000 cps

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P1866 (B2266)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P1867 (B2167)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P1972 (B1067)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P2248 (B2249)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P2265 (B366)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P2366 (B2365)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P2468 (B1766)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P2766 (B2765)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P3848 (B3849)

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 <u>other</u> than neutron-induced fission?

A. 10 percent

B. 20 percent

C. 80 percent

D. 100 percent

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P4734 (B7638)

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 <u>not</u> enough information given to determine the relationship between the reactivity additions.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P6133 (B6134)

A subcritical reactor has a stable source range count rate of 2.0 x 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 x 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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P7628 (B7628)

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: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P7698 (B7698)

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 <u>other</u> than neutron-induced fission?

A. 4 percent

B. 50 percent

C. 96 percent

D. 100 percent

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P7718 (B7718)

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 <u>not</u> enough information given to compare the positive reactivity additions.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P267 (B1365)

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: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P365 (B365)

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: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P1265 (B1967)

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: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P1770 (B1665)

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.

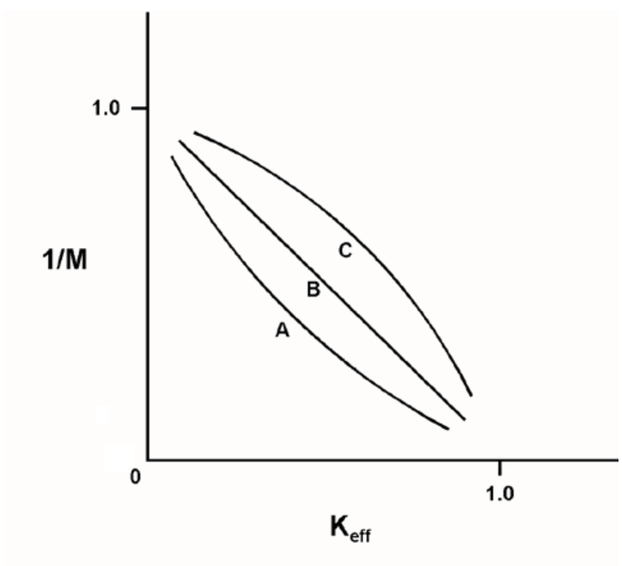
A. A; shorter

B. A; longer

C. C; shorter

D. C; longer

ANSWER: C.



TOPIC: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P3567

A reactor startup is in progress for a reactor that is in the middle of a fuel cycle. The reactor coolant system 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 startup rate (SUR) is stable at zero when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser. The operator immediately ensures <u>no</u> control rod motion is occurring and takes <u>no</u> further action. Assume the steam generator water levels remain stable, and <u>no</u> automatic reactor protective actions occur.

As a result of the valve failure, SUR will initially become __________; and reactor power will stabilize __________ the point of adding heat.

A. positive; at

B. positive; above

C. negative; at

D. negative; above

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P3665 (B3665)

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 __________.

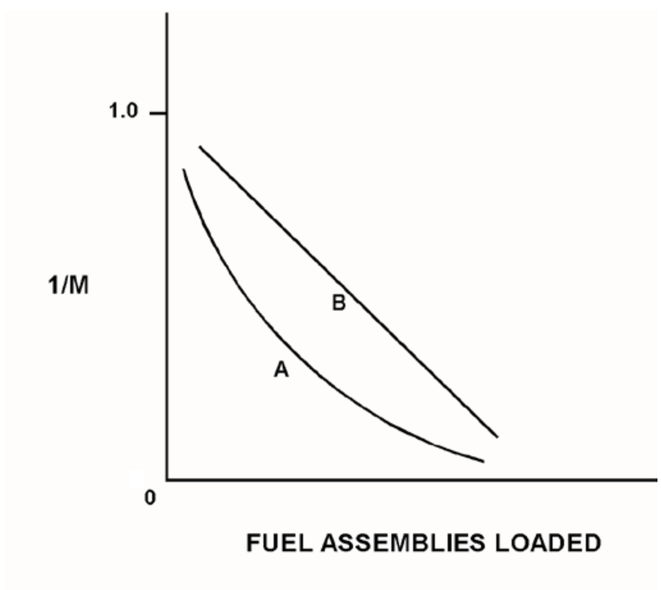
A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: D.



TOPIC: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P5733 (B5733)

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: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P6034 (B6033)

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 __________.

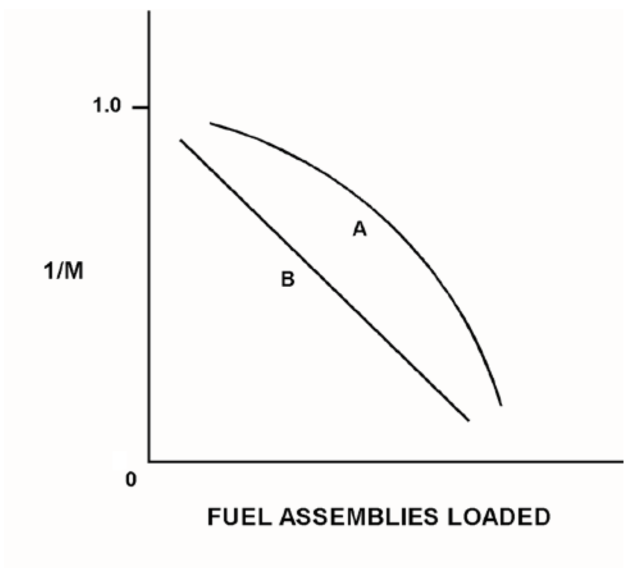
A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: B.



TOPIC: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P466

During a reactor startup, as K_{eff} increases toward 1.0 the value of 1/M...

A. decreases toward zero.

B. decreases toward 1.0.

C. increases toward infinity.

D. increases toward 1.0.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P969

The following data was obtained under stable conditions during a reactor startup:

Control Rod Position (units withdrawn)	Source Range Count Rate (cps)
0	20
10	25
15	28
20	33
25	40
30	50

Assuming uniform differential rod worth, at what approximate control rod position will criticality occur?

A. 66 to 75 units withdrawn

B. 56 to 65 units withdrawn

C. 46 to 55 units withdrawn

D. 35 to 45 units withdrawn

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P1167 (B2767)

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: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P1667 (B1567)

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: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P1966 (B1767)

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: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P67

An estimated critical rod position has been calculated for criticality to occur 4 hours after a reactor trip from steady-state 100 percent power. The actual critical rod position will be lower than the estimated critical rod position if...

A. the startup is delayed until 8 hours after the trip.

B. the steam dump pressure setpoint is lowered by 100 psi prior to reactor startup.

C. actual boron concentration is 10 ppm higher than the assumed boron concentration.

D. one control rod remains fully inserted during the approach to criticality.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P367

Which one of the following is not required to determine the estimated critical boron concentration for a reactor startup to be performed 48 hours following an inadvertent reactor trip?

A. Reactor power level just prior to the trip.

B. Steam generator levels just prior to the trip.

C. Xenon-135 reactivity in the core just prior to the trip.

D. Samarium-149 reactivity in the core just prior to the trip.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P467

An estimated critical rod position (ECP) has been calculated for criticality to occur 6 hours after a reactor trip from 60 days of operation at 100 percent power. Which one of the following events or conditions will result in the actual critical rod position being lower than the ECP?

A. The startup is delayed for approximately 2 hours.

B. Steam generator feedwater addition rate is reduced by 5 percent just prior to criticality.

C. Steam generator pressures are decreased by 100 psi just prior to criticality.

D. A new boron sample shows a current boron concentration 20 ppm higher than that used in the ECP calculation.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P765

Which one of the following conditions will result in criticality occurring at a rod position that is lower than the estimated control rod position?

A. Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations.

B. A malfunction resulting in control rod speed being lower than normal speed.

C. Delaying the time of startup from 10 days to 14 days following a trip from 100 percent power equilibrium conditions.

D. Misadjusting the steam dump (turbine bypass) controller such that steam pressure is maintained 50 psig higher than the required no-load setting.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P970

An estimated critical rod position (ECP) has been calculated for criticality to occur 15 hours after a reactor trip from long-term 100 percent power operation. Which one of the following conditions would cause the actual critical rod position to be higher than the ECP?

A. A 90 percent value for reactor power was used for power defect determination in the ECP calculation.

B. Reactor criticality is achieved approximately 2 hours earlier than anticipated.

C. Steam generator pressures are decreased by 100 psi just prior to criticality.

D. Current boron concentration is 10 ppm lower than the value used in the ECP calculation.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P1266

A reactor is subcritical with a startup in progress. Which one of the following conditions will result in a critical rod position that is lower than the estimated critical rod position?

A. A malfunction resulting in control rod speed being faster than normal speed.

B. A malfunction resulting in control rod speed being slower than normal speed.

C. Delaying the time of startup from 3 hours to 5 hours following a trip from 100 percent power equilibrium conditions.

D. An inadvertent dilution of reactor coolant system boron concentration.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P1365

Control rods are being withdrawn during a reactor startup. Which one of the following will result in reactor criticality at a rod position that is higher than the estimated critical rod position?

A. Steam generator pressure increases by 50 psia.

B. Steam generator level increases by 10 percent.

C. Pressurizer pressure increases by 50 psia.

D. Pressurizer level increases by 10 percent.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P1565

A reactor startup is in progress following a reactor trip from steady-state 100 percent power. Which one of the following conditions will result in criticality occurring at a rod position that is higher than the estimated critical rod position?

A. Misadjusting the steam dump (turbine bypass) controller such that steam generator pressure is maintained 50 psig higher than the required no-load setting.

B. Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations.

C. A malfunction resulting in control rod speed being 10 percent slower than normal speed.

D. Delaying the time of startup from 10 days to 14 days following the trip.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P1666

An estimated critical rod position (ECP) has been calculated for criticality to occur 15 hours after a reactor trip that ended three months of operation at 100 percent power.

Which one of the following will result in criticality occurring at a rod position that is <u>lower</u> than the calculated ECP?

A. Adjusting reactor coolant system boron concentration to 50 ppm higher than assumed for startup calculations.

B. A malfunction resulting in control rod speed being slower than normal speed.

C. Moving the time of startup from 15 hours to 12 hours following the trip.

D. Using a pretrip reactor power of 90 percent to determine power defect.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P1765

A reactor trip has occurred from 100 percent reactor power and equilibrium xenon-135 conditions near the middle of a fuel cycle. An estimated critical rod position (ECP) has been calculated using the following assumptions:

- Criticality occurs 24 hours after the trip.
- Reactor coolant temperature is 550°F.
- Reactor coolant boron concentration is 400 ppm.

Which one of the following will result in criticality occurring at a rod position that is <u>higher</u> than the calculated ECP?

A. Decreasing reactor coolant system boron concentration to 350 ppm.

B. A malfunction resulting in control rod speed being 20 percent higher than normal speed.

C. Moving the time of criticality to 30 hours after the trip.

D. Misadjusting the steam dump (turbine bypass) controller such that reactor coolant temperature is being maintained at 553°F.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P7335

A reactor trip has occurred from 100 percent power and equilibrium xenon-135 conditions near the middle of a fuel cycle. An estimated critical rod position (ECP) has been calculated for the subsequent reactor startup using the following assumptions:

- Criticality occurs 24 hours after the trip.
- Reactor coolant temperature is 550°F.
- Reactor coolant boron concentration is 400 ppm.

Which one of the following will result in criticality occurring at a control rod position that is lower than the calculated ECP?

A. Moving the time of criticality to 18 hours after the trip.

B. Decreasing reactor coolant system boron concentration to 350 ppm.

C. A malfunction resulting in control rod speed being 20 percent lower than normal speed.

D. Misadjusting the steam dump (turbine bypass) controller such that reactor coolant temperature is being maintained at 553°F.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.09 [3.2/3.3]
QID: P68 (B123)

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: 192008
KNOWLEDGE: K1.09 [3.2/3.3]
QID: P469

A reactor is subcritical by 1.0 %ΔK/K when the operator dilutes the reactor coolant system boron concentration by 30 ppm. If differential boron worth is -0.025 %ΔK/K/ppm, the reactor is currently...

A. subcritical.

B. critical.

C. supercritical.

D. prompt critical.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.09 [3.2/3.3]
QID: P2267 (B867)

When a reactor is critical, reactivity is...

A. infinity.

B. undefined.

C. 0.0 ΔK/K.

D. 1.0 ΔK/K.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P69

During a reactor startup, if the startup rate is constant and positive without any further reactivity addition, then the reactor is...

A. critical.

B. supercritical.

C. subcritical.

D. prompt critical.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P125

Initially, a reactor is critical at 10,000 cps in the source range when a steam generator atmospheric relief valve fails open. Assume end of fuel cycle conditions, no reactor trip, and no operator actions are taken.

When the reactor stabilizes, the average reactor coolant temperature (T_{ave}) will be __________ than the initial T_{ave} and reactor power will be __________ the point of adding heat.

A. greater; at

B. greater; greater than

C. less; at

D. less; greater than

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P136

A reactor startup is being performed following a one-month shutdown period. If the reactor is taken critical and then stabilized at 10,000 cps in the source range, over the next 10 minutes the count rate will...

A. remain constant.

B. decrease linearly.

C. decrease geometrically.

D. decrease exponentially.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P1870

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a positive 0.5 DPM startup rate and stops control rod motion.

After an additional five minutes, reactor power will be __________ and startup rate 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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P2667

A reactor is critical at 1.0 x 10^{-6} percent power. Control rods are withdrawn for 5 seconds and then stopped, resulting in a stable startup rate (SUR) of positive 0.2 DPM.

If the control rods had been inserted for 5 seconds instead of withdrawn, the stable SUR would have been: (Assume equal absolute values of reactivity are added in both cases.)

A. more negative than -0.2 DPM because, compared to reactor power increases, reactor power decreases result in smaller delayed neutron fractions.

B. more negative than -0.2 DPM because, compared to reactor power increases, reactor power decreases are less limited by delayed neutrons.

C. less negative than -0.2 DPM because, compared to reactor power increases, reactor power decreases result in larger delayed neutron fractions.

D. less negative than -0.2 DPM because, compared to reactor power increases, reactor power decreases are more limited by delayed neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P3467 (B3451)

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 startup rate (SUR) is established.

With the stable positive SUR, 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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P5334 (B5334)

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 are initially operating at 1.0×10^{-8} percent power.

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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P5535 (B5534)

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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P6435 (B6434)

A reactor is critical near the end of a fuel cycle with power level stable at 1.0 x 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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P6734 (B6734)

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 x 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 higher startup rate.

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P7688 (B7688)

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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P7727

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 value for K_{eff}, which is slightly greater than 1.0.

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 greater startup rate.

B. Reactor B, because it has the greater startup rate.

C. Both reactors will reach the POAH at the same time, because they both have the same value for startup rate.

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: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P7778

A reactor and plant startup is in progress. Reactor power is currently 5.0 x 10^{-5} percent and increasing, with a constant startup rate of 0.2 DPM. 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: 192008
KNOWLEDGE: K1.11 [3.8/3.8]
QID: P868

Which one of the following indicates that a reactor has achieved criticality during a normal reactor startup?

A. Constant positive startup rate during rod withdrawal.

B. Increasing positive startup rate during rod withdrawal.

C. Constant positive startup rate with no rod motion.

D. Increasing positive startup rate with no rod motion.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.11 [3.8/3.8]
QID: P2968

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. Startup rate is stable at 0.0 DPM; source range count rate is stable.

B. Startup rate is stable at 0.2 DPM; source range count rate is stable.

C. Startup rate is stable at 0.0 DPM; source range count rate is slowly increasing.

D. Startup rate is stable at 0.2 DPM; source range count rate is slowly increasing.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.12 [3.5/3.6]
QID: P767

A reactor has just achieved criticality at 1.0 x 10^{-8} percent reactor power during a reactor startup from xenon-free conditions. The operator establishes a 0.5 DPM startup rate to increase power. Over a period of 10 minutes, startup rate decreases to zero and then becomes increasingly negative.

Which one of the following is a possible cause for these indications?

A. Fuel depletion.

B. Burnable poison burnout.

C. Reactor power reaching the point of adding heat.

D. Inadvertent boration of the reactor coolant system.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.12 [3.5/3.6]
QID: P1366

During a reactor startup from a xenon-free condition, and after recording critical data, the operator establishes a positive 0.4 DPM startup rate to increase power. Within 10 minutes, and prior to reaching the point of adding heat, reactor power stops increasing and begins to slowly decrease.

Which one of the following changes could have caused this behavior?

A. Inadvertent boration of the RCS.

B. Xenon buildup in the core.

C. Gradual cooling of the RCS.

D. Fission-induced heating of the fuel.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P670 (B670)

After taking critical data during a reactor startup, the operator establishes a positive 1.0 DPM startup rate 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: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P768

The point of adding heat can be defined as the power level at which the reactor is producing enough heat...

A. for the fuel temperature coefficient to produce a positive reactivity feedback.

B. for the void coefficient to produce a negative reactivity feedback.

C. to cause a measurable temperature increase in the fuel and coolant.

D. to support main turbine operations.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P2370 (B2369)

After taking critical data during a reactor startup, the operator establishes a positive 0.54 DPM startup rate 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: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P2470

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a stable positive 1.0 DPM startup rate and stops rod motion.

After an additional 30 seconds, reactor power will be __________ and startup rate will be __________. (Assume reactor power remains below the point of adding heat.)

A. increasing; increasing

B. increasing; constant

C. constant; increasing

D. constant; constant

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P2668

A reactor is critical during a xenon-free reactor startup. Reactor power is increasing in the intermediate range with a stable 0.5 DPM startup rate (SUR).

Assuming <u>no</u> operator action is taken that affects reactivity, SUR will remain constant until...

A. reactor coolant temperature begins to increase, then SUR will increase.

B. core xenon-135 production becomes significant, then SUR will increase.

C. delayed neutron production rate exceeds prompt neutron production rate, then SUR will decrease.

D. fuel temperature begins to increase, then SUR will decrease.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P3068 (B3068)

After taking critical data during a reactor startup, the operator establishes a positive 0.75 DPM startup rate 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: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P3935 (B3934)

After taking critical data during a reactor startup, the operator establishes a positive 0.52 DPM startup rate 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: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P568

During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required intermediate range (IR) power level. The critical data was taken again at the proper IR power level with the same reactor coolant temperature and boron concentration.

The critical rod position taken at the proper IR power level is __________ the critical rod position taken two decades below the proper IR power level.

A. unrelated to

B. greater than

C. the same as

D. less than

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P669

During a xenon-free reactor startup, critical data was inadvertently taken one decade above the required intermediate range (IR) power level. The critical data was taken again at the proper IR power level with the same reactor coolant temperature and boron concentration.

The critical rod position taken at the proper IR power level is __________ the critical rod position taken one decade above the proper IR power level.

A. less than

B. the same as

C. greater than

D. unrelated to

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P972

A reactor is critical several decades below the point of adding heat (POAH) when a small amount of positive reactivity is added to the core. If the exact same amount of negative reactivity is then added prior to reaching the POAH, reactor power will stabilize...

A. higher than the initial power level but below the POAH.

B. lower than the initial power level.

C. at the initial power level.

D. at the POAH.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P1267

A reactor has just achieved criticality during a xenon-free reactor startup and power is being increased to take critical data. Instead of stabilizing power at 1.0 x 10^{-5} percent per the startup procedure, the operator inadvertently stabilizes power at 1.0 x 10^{-4} percent.

Assuming reactor coolant system (RCS) temperature and RCS boron concentration do not change, the critical rod height at 1.0 x 10^{-4} percent power will be __________ the critical rod height at 1.0 x 10^{-5} percent power.

A. less than

B. equal to

C. greater than

D. independent of

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P1268

A reactor is exactly critical two decades below the point of adding heat when -0.01 %ΔK/K of reactivity is added. If +0.01 %ΔK/K is added 2 minutes later, reactor power will stabilize at...

A. the point of adding heat.

B. the initial power level.

C. somewhat lower than the initial power level.

D. an equilibrium subcritical power level.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P1669

Initially, a reactor is critical at 1.0×10^{-5} percent power near the middle of a fuel cycle with manual rod control when a steam generator relief valve fails open. Assume no operator actions are taken and the reactor does not trip.

When the reactor stabilizes, average reactor coolant temperature will be __________ the initial reactor coolant temperature; and reactor power will be __________ the point of adding heat.

A. equal to; greater than

B. equal to; equal to

C. less than; greater than

D. less than; equal to

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P2269

A reactor is critical at the point of adding heat (POAH) when a small amount of negative reactivity is added. If the same amount of positive reactivity is added approximately 5 minutes later, reactor power will...

A. increase and stabilize at the POAH.

B. quickly stabilize at a power level below the POAH.

C. continue to decrease with a -1/3 DPM startup rate until an equilibrium shutdown neutron level is reached.

D. continue to decrease with an unknown startup rate until an equilibrium shutdown neutron level is reached.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P2568 (B2568)

A reactor was operating at 1.0×10^{-3} percent power with a positive 0.6 DPM startup rate when an amount of negative reactivity was inserted that caused reactor power to decrease with a negative 0.4 DPM startup rate.

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 0.4 DPM startup rate until an equilibrium shutdown neutron level is reached.

D. continue to decrease with an unknown startup rate until an equilibrium shutdown neutron level is reached.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P3668

A reactor is slightly supercritical during a reactor startup. A short control rod withdrawal is performed to establish the desired positive startup rate. Assume that the reactor remains slightly supercritical after the control rod withdrawal, and that reactor power remains well below the point of adding heat.

Immediately after the control rod withdrawal is stopped, the startup rate will initially decrease and then...

A. stabilize at a positive value.

B. turn and slowly increase.

C. stabilize at zero.

D. continue to slowly decrease.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P4033

Refer to the figure below for the following question. The axes on each graph have linear scales.

Initially, a reactor is critical in the source range. At 0 seconds, a constant rate addition of positive reactivity commences. Assume that reactor power remains below the point of adding heat for the entire time interval shown.

The general response of startup rate to this event is shown on graph _____; and the general response of reactor power to this event is shown on graph _____. (Note: Either graph may be chosen once, twice, or not at all.)

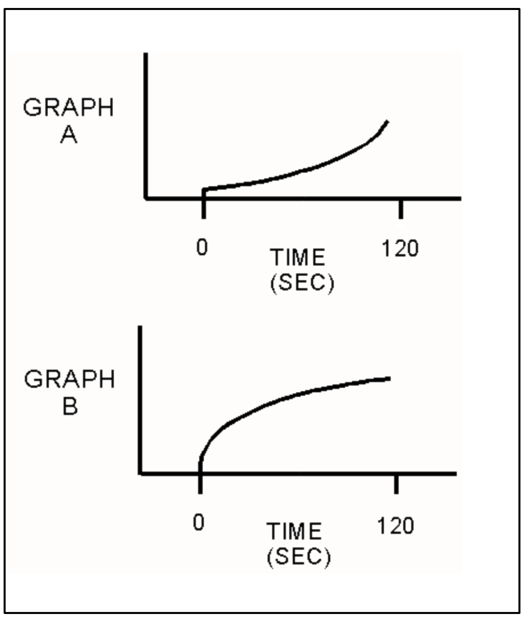
A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: A.



TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P4434

Refer to the drawing that shows a graph of startup 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?

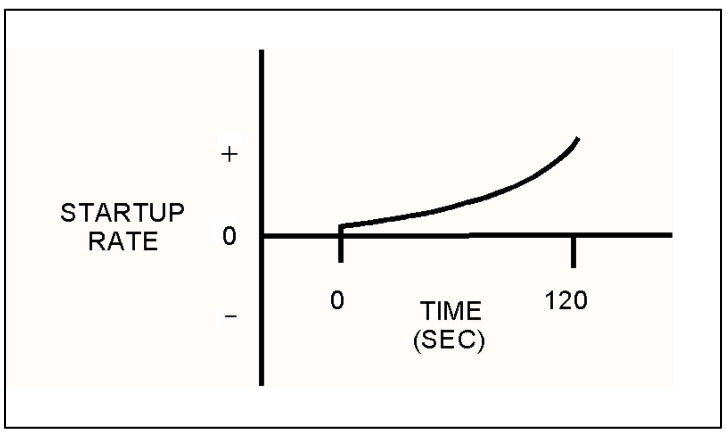
A. A step addition of positive reactivity to a reactor that is initially stable in the power range and remains in the power range for the duration of the 120-second interval shown.

B. A constant rate of positive reactivity addition to a reactor that is initially stable in the power range and remains in the power range 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 source range and remains below the point of adding heat 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 source range and remains below the point of adding heat for the duration of the 120-second interval shown.

ANSWER: D.



TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P4636

During a reactor startup, source range count rate is observed to double every 30 seconds. Which one of the following is the approximate startup rate?

A. 0.6 DPM

B. 0.9 DPM

C. 1.4 DPM

D. 2.0 DPM

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P5834 (B5833)

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?

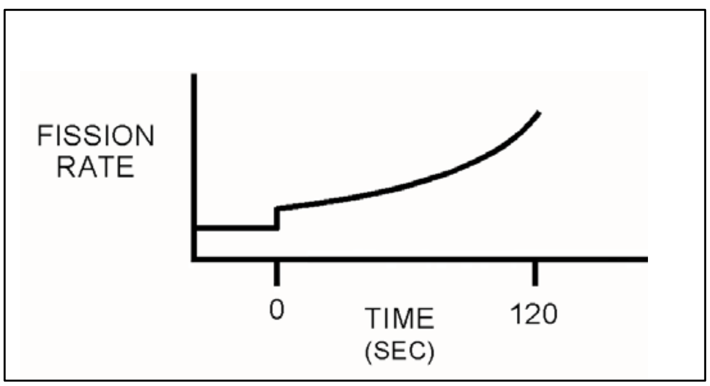
A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range and remains subcritical for the duration of the 120-second interval shown.

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: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P6335

Refer to the drawing that shows a graph of startup rate versus time (see figure below) for a reactor. Both axes have linear scales.

Which one of the following events, initiated at 0 seconds, would cause the startup rate response shown on the graph?

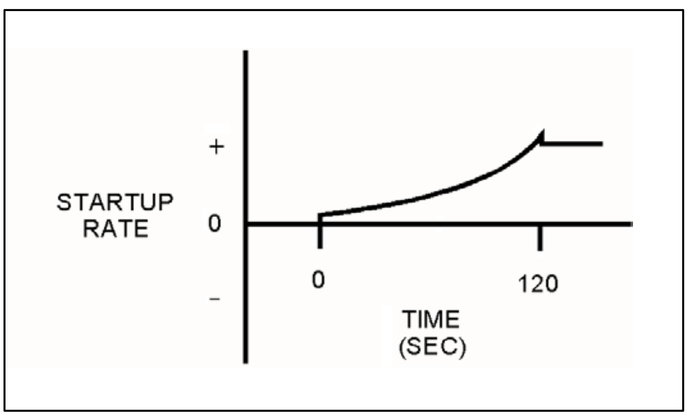
A. A step addition of positive reactivity to a reactor that is initially critical in the source range. Reactor power enters the power range at 120 seconds.

B. A step addition of positive reactivity to a reactor that is initially stable in the power range. A step addition of negative reactivity is inserted at 120 seconds.

C. A controlled constant rate of positive reactivity addition to a reactor that is initially critical in the source range and remains below the point of adding heat. The positive reactivity addition ends at 120 seconds.

D. A controlled constant rate of positive reactivity addition to a reactor that is initially stable in the power range and remains in the power range. The positive reactivity addition ends at 120 seconds.

ANSWER: C.



TOPIC: 192008
KNOWLEDGE: K1.15 [3.4/3.4]
QID: P569

A reactor is critical below the point of adding heat (POAH). The operator adds enough reactivity to attain a startup rate of 0.5 decades per minute. Which one of the following will decrease <u>first</u> when the reactor reaches the POAH?

A. Pressurizer level

B. Reactor coolant temperature

C. Reactor power

D. Startup rate

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P70

For a slightly supercritical reactor operating below the point of adding heat (POAH), what reactivity effects are associated with reaching the POAH?

A. There are no reactivity effects.

B. An increase in fuel temperature will begin to create a positive reactivity effect.

C. A decrease in fuel temperature will begin to create a negative reactivity effect.

D. An increase in fuel temperature will begin to create a negative reactivity effect.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P471

A reactor is operating at a stable power level just above the point of adding heat. To raise reactor power to a higher stable power level, the operator must increase...

A. steam demand.

B. steam generator water levels.

C. average reactor coolant temperature.

D. reactor coolant system boron concentration.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1070

A reactor is critical at a stable power level below the point of adding heat (POAH) when a small amount of positive reactivity is added. Which one of the following reactivity coefficient(s) will stabilize reactor power at the POAH?

A. Moderator temperature only

B. Fuel temperature only

C. Moderator temperature and fuel temperature

D. Fuel temperature and moderator voids

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1172

A reactor startup is in progress near the end of a fuel cycle. Reactor power is 5 x 10^{-2} percent and increasing slowly with a stable 0.3 DPM startup rate. Assuming no operator action, no reactor trip, and no steam release, what will reactor power be after 10 minutes?

A. 100 percent

B. 50 percent

C. 10 percent

D. 1 percent (point of adding heat)

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1367

A reactor startup is in progress near the end of a fuel cycle. Reactor power is 5 x 10^{-3} percent and increasing slowly with a stable 0.3 DPM startup rate. Assuming no operator action, no reactor trip, 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 50 percent.

D. Greater than 50 percent.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1465

Near the end of a fuel cycle, a reactor required three hours to increase power from 70 percent to 100 percent using only reactor coolant system (RCS) boron dilution at the maximum rate to control RCS temperature.

Following a refueling outage, the same reactor power change performed under the same conditions will require a __________ period of time because the rate at which RCS boron concentration can be decreased at the beginning of a fuel cycle is __________.

A. longer; slower

B. shorter; slower

C. longer; faster

D. shorter; faster

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1470 (B1371)

With a reactor on a constant startup rate, which one of the following power changes requires the longest 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: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1567 (B1570)

With a reactor on a constant startup rate, which one of the following power changes requires the least 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: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P2069 (B2072)

With a reactor on a constant startup rate, 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: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P2168

Initially, a reactor is stable at the point of adding heat (POAH) during a reactor startup with the average reactor coolant temperature at 550°F. Control rods are manually withdrawn a few inches to increase steam generator steaming rate.

When the reactor stabilizes, reactor power will be __________ the POAH, and average reactor coolant temperature will be __________ 550°F.

A. greater than; equal to

B. greater than; greater than

C. equal to; equal to

D. equal to; greater than

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P2770 (B2770)

With a reactor on a constant startup rate, which one of the following power changes requires the <u>least</u> 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: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P7808 (B7808)

Given the following:

- Initially, reactor power is 1.0×10^{-3} percent and increasing with a constant startup rate of 0.1 DPM.
- The steam dump system is maintaining steam generator pressures at 1,000 psia.
- The point of adding heat is 1.0 percent power.
- The power coefficient is -1.0×10^{-4} ΔK/K/percent power.
- The effective delayed neutron fraction is 0.006.
- <u>No</u> 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: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P869

A nuclear power plant is operating at 100 percent power near the end of a fuel cycle with all control systems in manual. The reactor operator inadvertently adds 100 gallons of boric acid (4 percent by weight) to the reactor coolant system (RCS).

Which one of the following will occur as a result of the boric acid addition? (Assume a constant main generator output.)

A. Pressurizer level will decrease and stabilize at a lower value.

B. RCS pressure will increase and stabilize at a higher value.

C. Reactor power will decrease and stabilize at a lower value.

D. Average RCS temperature will increase and stabilize at a higher value.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P1071

A nuclear power plant was operating with the following initial steady-state conditions:

Power level	=	100 percent
Reactor coolant boron concentration	=	620 ppm
Average reactor coolant temperature	=	587°F

After a load decrease, the current steady-state conditions are as follows:

Power level	=	80 percent
Reactor coolant boron concentration	=	650 ppm
Average reactor coolant temperature	=	577°F

Given the following information, how much reactivity was added by control rod movement during the load decrease? (Disregard any changes in fission product poison reactivity.)

Differential boron worth	=	-1.0×10^{-2} %ΔK/K/ppm
Total power coefficient	=	-1.5×10^{-2} %ΔK/K/%
Moderator temperature coefficient	=	-2.0×10^{-2} %ΔK/K/°F

A. 0.0 %ΔK/K

B. -0.2 %ΔK/K

C. -0.6 %ΔK/K

D. -0.8 %ΔK/K

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P1871

A nuclear power plant was operating with the following initial steady-state conditions:

Power level	=	100 percent
Reactor coolant boron concentration	=	630 ppm
Average reactor coolant temperature	=	582°F

After a load decrease, the current steady-state conditions are as follows:

Power level	=	80 percent
Reactor coolant boron concentration	=	640 ppm
Average reactor coolant temperature	=	577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

Total power coefficient	=	-1.5×10^{-2} %ΔK/K/%
Moderator temperature coefficient	=	-2.0×10^{-2} %ΔK/K/°F
Differential boron worth	=	-1.5×10^{-2} %ΔK/K/ppm

A. +0.15 %ΔK/K

B. +0.25 %ΔK/K

C. -0.15 %ΔK/K

D. -0.25 %ΔK/K

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P1968

A nuclear power plant was operating with the following initial steady-state conditions:

Power level = 80 percent
Reactor coolant boron concentration = 630 ppm
Average reactor coolant temperature = 582°F

After a normal load decrease, the current steady-state conditions are as follows:

Power level = 50 percent
Reactor coolant boron concentration = 650 ppm
Average reactor coolant temperature = 572°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

Total power coefficient = -1.5×10^{-2} %ΔK/K/%
Moderator temperature coefficient = -2.0×10^{-2} %ΔK/K/°F
Differential boron worth = -1.5×10^{-2} %ΔK/K/ppm

A. -0.5 %ΔK/K

B. -0.15 %ΔK/K

C. -0.25 %ΔK/K

D. -0.35 %ΔK/K

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P2070

A nuclear power plant was operating with the following initial steady-state conditions:

Power level	=	100 percent
Reactor coolant boron concentration	=	620 ppm
Average reactor coolant temperature	=	587°F

After a load decrease, the current steady-state conditions are as follows:

Power level	=	80 percent
Reactor coolant boron concentration	=	630 ppm
Average reactor coolant temperature	=	577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

Total power coefficient	=	-1.5×10^{-2} %ΔK/K/%
Moderator temperature coefficient	=	-2.0×10^{-2} %ΔK/K/°F
Differential boron worth	=	-1.0×10^{-2} %ΔK/K/ppm

A. -0.2 %ΔK/K

B. +0.2 %ΔK/K

C. -0.4 %ΔK/K

D. +0.4 %ΔK/K

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18 [3.6/3.5]
QID: P3269

One week after a refueling outage, a nuclear power plant is currently operating at 80 percent power with control rods fully withdrawn. During the outage, the entire core was replaced by new fuel assemblies, and new burnable poison assemblies were installed at various locations.

Assume reactor power and control rod position do <u>not</u> change during the next week. If <u>no</u> operator action is taken, how and why will average reactor coolant temperature change during the next week?

A. Decrease slowly, due to fuel burnup <u>only</u>.

B. Decrease slowly, due to fuel burnup <u>and</u> fission product poison buildup.

C. Increase slowly, due to burnable poison burnout <u>only</u>.

D. Increase slowly, due to burnable poison burnout <u>and</u> fission product poison decay.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.19 [3.5/3.6]
QID: P570

How do the following parameters change during a normal ramp of reactor power from 15 percent to 75 percent?

	Main Turbine First Stage Pressure	Reactor Coolant System Boron Concentration
A.	Increases	Decreases
B.	Decreases	Decreases
C.	Increases	Increases
D.	Decreases	Increases

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.19 [3.5/3.6]
QID: P1672 (B1671)

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: 192008
KNOWLEDGE: K1.19 [3.5/3.6]
QID: P2272

A nuclear power plant 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-235 and Pu-239.

C. U-238 and Pu-239.

D. U-238 and Pu-241.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.19 [3.5/3.6]
QID: P2868

A refueling outage has just been completed, during which the entire core was offloaded and replaced with new fuel. A reactor startup has been performed and 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: A.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P271

A reactor is critical at 2.0×10^{-8} percent power. The operator withdraws rods as necessary to immediately establish and maintain a positive 0.1 DPM startup rate. How long will it take the reactor to reach 7.0×10^{-8} percent power?

A. 2.4 minutes

B. 5.4 minutes

C. 7.4 minutes

D. 10.4 minutes

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P2869

A reactor is critical at 3.0×10^{-8} percent power. The operator withdraws rods as necessary to immediately establish and maintain a positive 0.1 DPM startup rate. How long will it take the reactor to reach 7.0×10^{-8} percent power?

A. 3.7 minutes

B. 5.4 minutes

C. 6.7 minutes

D. 8.4 minutes

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P2970

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws control rods for 20 seconds to establish a stable positive 0.5 DPM startup rate (SUR). One minute later (prior to reaching the point of adding heat), the operator inserts the same control rods for 25 seconds.

During the rod insertion, when will the SUR become negative?

A. Immediately when the control rod insertion is initiated.

B. After the control rods pass through the critical rod height.

C. Just as the control rods pass through the critical rod height.

D. Prior to the control rods passing through the critical rod height.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P3050 (B3051)

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: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P4327 (B4325)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power level 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: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P6727 (B6736)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power level 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: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P7728

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 control rod withdrawal that adds positive 0.32 %ΔK/K to the reactor.

Given:

- All control rod motion has stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.02 %ΔK/K/percent.
- The effective delayed neutron fraction equals 0.005.

What is the 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. 1.6 percent

B. 6.4 percent

C. 16 percent

D. 64 percent

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P7748

A reactor is operating at steady-state 80 percent power near the end of a fuel cycle with a symmetrical axial power distribution peaked at the core midplane. Control rods are in manual control.

If the reactor coolant system (RCS) boron concentration is increased by 10 ppm, the axial power distribution will shift toward the __________ of the core. Then, if the control rods are repositioned to return RCS temperatures to normal for 80 percent power, the axial power distribution will shift toward the __________ of the core.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P7798

A reactor is operating at steady-state 80 percent power near the end of a fuel cycle with a symmetrical axial power distribution peaked at the core midplane. Control rods are in manual control.

If the reactor coolant system (RCS) boron concentration is decreased by 10 ppm, the axial power distribution will shift toward the __________ of the core. Then, if the control rods are repositioned to return RCS temperatures to normal for 80 percent power, the axial power distribution will shift toward the __________ of the core.

A. top; top

B. top; bottom

C. bottom; top

D. bottom; bottom

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P272

A nuclear power plant has been operating at 75 percent power for several weeks when a partial main steam line break occurs that releases 3 percent of rated steam flow. Assuming <u>no</u> operator or automatic actions occur, reactor power will stabilize __________ 75 percent; and average reactor coolant temperature will stabilize at a __________ temperature.

A. greater than; higher

B. at; higher

C. greater than; lower

D. at; lower

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P368

A reactor is critical at a stable power level below the point of adding heat (POAH). An unisolable steam line break occurs and 3 percent of rated steam flow is escaping.

Assuming <u>no</u> reactor trip, which one of the following describes the response of the reactor?

A. Reactor coolant average temperature will decrease. The reactor will become subcritical.

B. Reactor coolant average temperature will remain the same. The reactor will stabilize at 3 percent power.

C. Reactor coolant average temperature will decrease. The reactor will stabilize at 3 percent power.

D. Reactor coolant average temperature will decrease. Reactor power will <u>not</u> change because the reactor was below the POAH.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P1370

A nuclear power plant has been operating at 80 percent power for several weeks when a partial steam line break occurs that releases 2 percent of rated steam flow. Main turbine load and control rod position remain the same.

Assuming no operator or protective actions occur, when the plant stabilizes reactor power will be __________; and average reactor coolant temperature will be __________.

A. higher; higher

B. unchanged; higher

C. higher; lower

D. unchanged; lower

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P1570

A nuclear power plant is operating at steady-state 85 percent power and 580°F average reactor coolant temperature (T_{ave}) near the end of a fuel cycle. A failure of the turbine control system opens the turbine control valves to admit 10 percent more steam flow to the main turbine. No operator actions occur and no protective system actuations occur. Rod control is in manual.

Following the transient, reactor power will stabilize __________ 85 percent; and T_{ave} will stabilize __________ 580°F.

A. above; above

B. above; below

C. below; above

D. below; below

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P2372

A nuclear power plant is operating at steady-state 90 percent power near the end of a fuel cycle with manual rod control when a turbine control system malfunction opens the main turbine steam inlet valves an additional 5 percent. Reactor power will initially...

A. increase, because the rate of neutron absorption in the moderator initially decreases.

B. increase, because the rate of neutron absorption at U-238 resonance energies initially decreases.

C. decrease, because the rate of neutron absorption in the moderator initially increases.

D. decrease, because the rate of neutron absorption at U-238 resonance energies initially increases.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P2671

A nuclear power plant is operating at 100 percent power near the end of a fuel cycle when the main turbine trips. If the reactor does not immediately trip, reactor power will initially…

A. increase, due to positive reactivity from the Doppler coefficient.

B. increase, due to positive reactivity from the moderator temperature coefficient.

C. decrease, due to negative reactivity from the Doppler coefficient.

D. decrease, due to negative reactivity from the moderator temperature coefficient.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P2771

A nuclear power plant is operating at steady-state 80 percent power and 580°F average reactor coolant temperature (T_{ave}) near the end of a fuel cycle with manual rod control. A turbine control system malfunction partially closes the turbine control valves resulting in 5 percent less steam flow to the main turbine. No operator actions occur and no protective system actuations occur.

Following the transient, reactor power will stabilize __________ 80 percent; and T_{ave} will stabilize __________ 580°F.

A. at; above

B. at; below

C. below; above

D. below; below

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P3171

A nuclear power plant is operating at steady-state 60 percent power in the middle of a fuel cycle with manual rod control, when a turbine control system malfunction closes the main turbine steam inlet valves an additional 5 percent. Which one of the following is most responsible for the initial reactor power decrease?

A. The rate of neutron absorption by core xenon-135 initially increases.

B. The rate of neutron absorption by the moderator initially increases.

C. The rate of neutron absorption by the fuel at resonance energies initially increases.

D. The rate of neutron absorption by the boron in the reactor coolant initially increases.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P3484

A multi-loop nuclear power plant is operating at steady-state 50 percent power with manual rod control when the main steam isolation valve (MSIV) for one steam generator inadvertently closes. Assume that no reactor trip or other protective action occurs, and no operator action is taken.

Immediately after the MSIV closure, the cold leg temperature (T_{cold}) in the reactor coolant loop with the closed MSIV will initially __________; and the T_{cold} in a loop with an open MSIV will initially __________.

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P4035

A nuclear power plant is operating at steady-state 60 percent power in the middle of a fuel cycle with manual rod control, when a turbine control system malfunction opens the main turbine steam inlet valves an additional 5 percent. Which one of the following is responsible for the initial reactor power increase?

A. The rate of neutron absorption by core Xe-135 initially decreases.

B. The rate of neutron absorption in the moderator initially decreases.

C. The rate of neutron absorption at U-238 resonance energies initially decreases.

D. The rate of neutron absorption by the boron in the reactor coolant initially decreases.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P4735

Initially, a nuclear power plant is operating at steady-state 100 percent reactor power with the main generator producing 1,100 MW. Then, a power grid disturbance occurs and appropriate operator actions are taken. The plant is stabilized with the following current conditions:

- Main generator output is 385 MW.
- Steam dump/bypass system is discharging 15 percent of rated steam flow to the main condenser.
- All reactor coolant system parameters are in their normal ranges.

What is the approximate current reactor power level?

A. 15 percent

B. 35 percent

C. 50 percent

D. 65 percent

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22 [2.6/3.8]
QID: P1072

A high boron concentration is necessary at the beginning of a fuel cycle to...

A. compensate for excess reactivity in the fuel.

B. produce a negative moderator temperature coefficient.

C. flatten the axial and radial neutron flux distributions.

D. maximize control rod worth until fission product poisons accumulate.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.22 [2.6/3.8]
QID: P2570

During a refueling outage, new fuel assemblies with higher enrichments of U-235 were loaded to prolong the fuel cycle from 12 months to 16 months. What is a possible consequence of offsetting all the excess positive reactivity of the new fuel assemblies with a higher concentration of boron in the reactor coolant system (RCS)?

A. Boron may precipitate out of the reactor coolant during a cooldown.

B. An RCS temperature decrease may result in a negative reactivity addition.

C. Power changes requiring dilution of RCS boron may take longer.

D. The differential boron worth (ΔK/K/ppm) may become positive.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P71 (B72)

Shortly after a reactor trip, reactor power indicates 5.0×10^{-2} percent when a stable negative startup rate 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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P572 (B2272)

A nuclear power plant has been operating at 100 percent power for several weeks when a reactor trip occurs. How much time will be required for core decay heat production to decrease to one percent power following the trip?

A. 1 to 8 seconds

B. 1 to 8 minutes

C. 1 to 8 hours

D. 1 to 8 days

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P770 (B771)

Which one of the following determines the value of the stable negative startup rate observed shortly after a reactor trip?

A. The shortest-lived delayed neutron precursors.

B. The longest-lived delayed neutron precursors.

C. The shutdown margin just prior to the trip.

D. The worth of the inserted control rods.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P1965 (B1369)

Shortly after a reactor trip, reactor power indicates 1.0 x 10^{-3} percent when a stable negative startup rate 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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P2171 (B1770)

Following a reactor trip, reactor power indicates 0.1 percent when the typical post-trip stable startup rate 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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P2672 (B131)

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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P2768 (B2769)

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor trip 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 smaller negative startup rate five minutes after the trip, 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 startup rate because both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same startup rate because only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P2969

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor trip occurs simultaneously on both reactors. All reactor A control rods fully insert, while one reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the smaller negative startup rate five minutes after the trip, and why?

A. Reactor A, because its delayed neutron fraction will be smaller.

B. Reactor B, because its delayed neutron fraction will be larger.

C. Both reactors will have the same startup rate because both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same startup rate because only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P3271 (B3271)

Reactors A and B are identical and have operated at 100 percent power for six months when a reactor trip 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 trip, when compared to reactor B the fission rate in reactor A will be __________; and the startup rate in reactor A will be __________.

A. the same; more negative

B. the same; the same

C. smaller; more negative

D. smaller; the same

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P3468

A reactor is critical just below the point of adding heat when an inadvertent reactor trip occurs. All control rods fully insert except for one rod, which remains fully withdrawn. Five minutes after the reactor trip, with reactor startup rate (SUR) stable at approximately -1/3 DPM, the remaining withdrawn control rod suddenly drops (fully inserts).

Which one of the following describes the reactor response to the drop of the last control rod?

A. SUR will remain stable at approximately -1/3 DPM.

B. SUR will immediately become more negative, and then return to and stabilize at approximately -1/3 DPM.

C. SUR will immediately become more negative, and then turn and stabilize at a value more negative than -1/3 DPM.

D. SUR will immediately become more negative, and then turn and stabilize at a value less negative than -1/3 DPM.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7035

A nuclear power plant is operating at steady-state 100 percent power when a reactor trip occurs. As a result of the trip, the core neutron flux will initially decrease at a startup rate that is much __________ negative than -1/3 DPM; the startup rate will become approximately -1/3 DPM about __________ minutes after the trip.

A. less; 3

B. less; 30

C. more; 3

D. more; 30

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7618 (B7618)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant reactor that experienced a reactor trip 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?

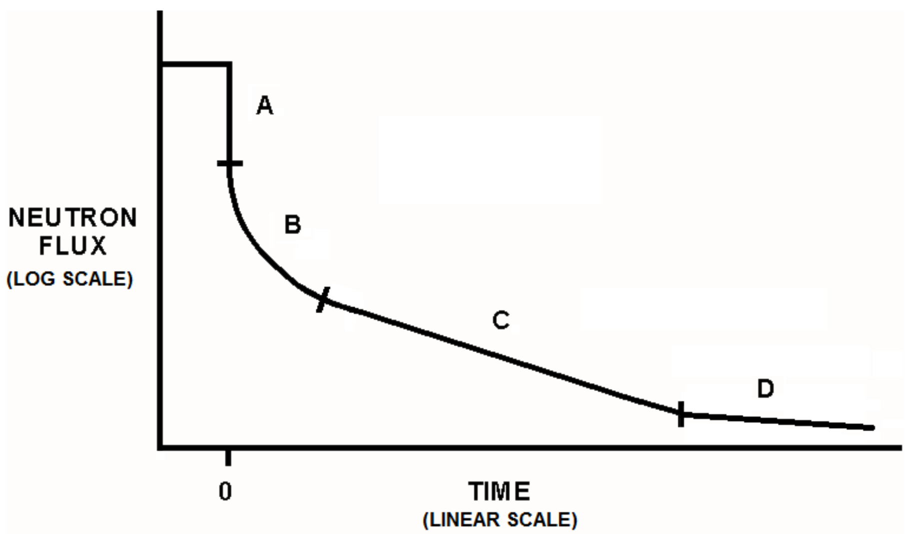
A. B only

B. B and C

C. C only

D. C and D

ANSWER: B.



TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7658 (B7658)

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?

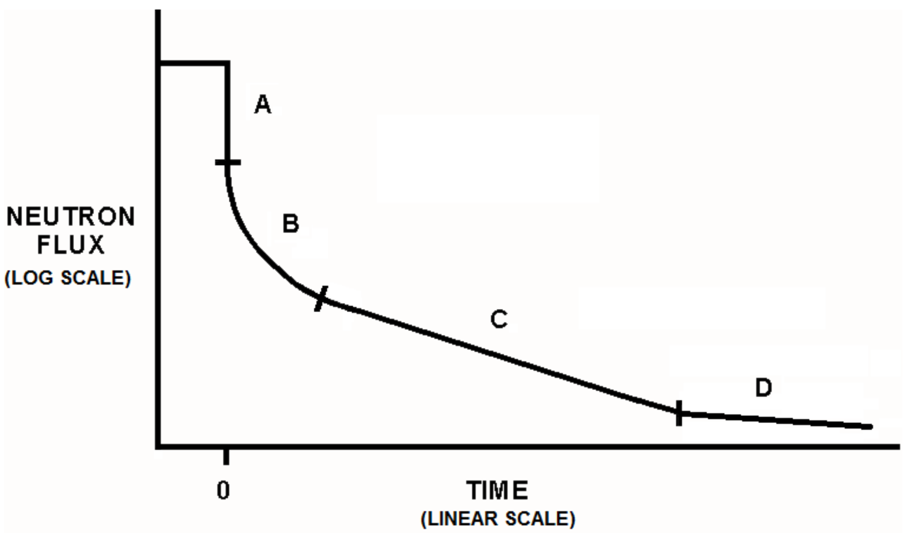
A. A

B. B

C. C

D. D

ANSWER: D.



TOPIC: 192008
KNOWLEDGE: K1.23 (2.9/3.1)
QID: P7708 (B7708)

A reactor was operating for several months at 100 percent power when a reactor trip occurred. Which one of the following is primarily responsible for the startup rate value 2 minutes after the trip?

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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7738 (B7738)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor trip 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…

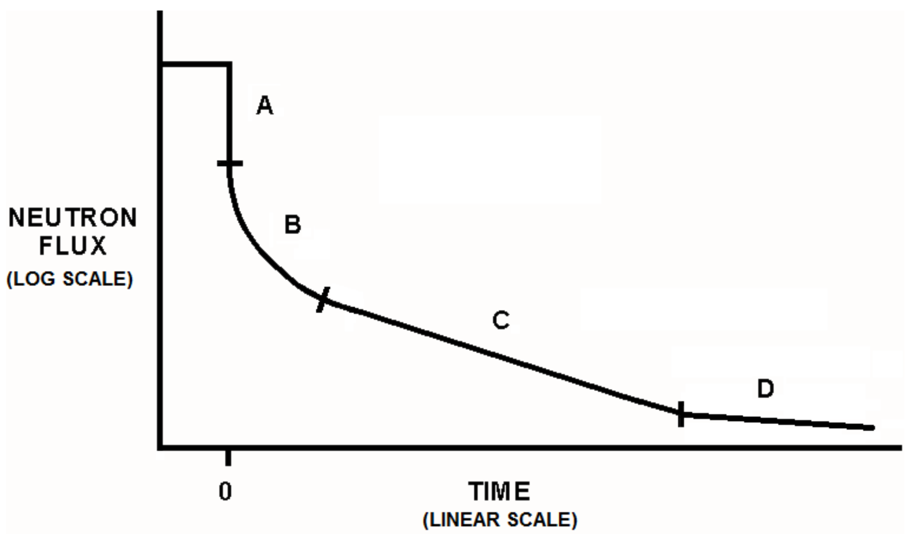
A. intrinsic source neutrons.

B. prompt fission neutrons.

C. delayed fission neutrons.

D. delayed fission neutron precursors.

ANSWER: B.



TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7758 (B7758)

A reactor was operating for several months at steady-state 100 percent power when a reactor trip 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 trip?

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: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P7828 (B7828)

Refer to the graph of neutron flux versus time (see figure below) for a nuclear power plant that experienced a reactor trip 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…

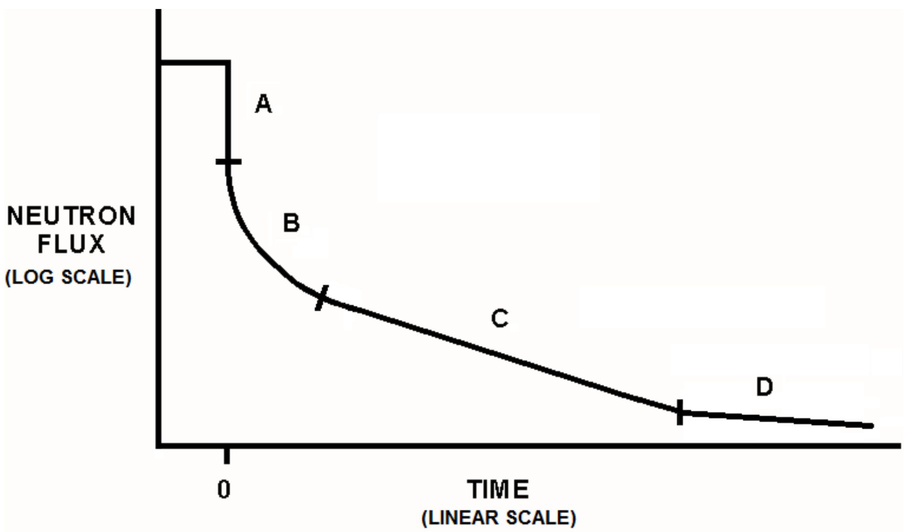
A. prompt fission neutrons.

B. delayed fission neutrons.

C. intrinsic source neutrons.

D. installed source neutrons.

ANSWER: B.



TOPIC: 192008
KNOWLEDGE: K1.24 [3.5/3.6]
QID: P672 (B1969)

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: 192008
KNOWLEDGE: K1.24 [3.5/3.6]
QID: P1472

A reactor is critical just below the point of adding heat when a single fully withdrawn control rod drops into the core. Assuming no operator or automatic actions occur, when the plant stabilizes reactor power will be __________; and average reactor coolant temperature will be __________.

A. the same; the same

B. the same; lower

C. lower; the same

D. lower; lower

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.24 [3.5/3.6]
QID: P5136

Initially, a reactor is critical in the source range during a reactor startup when the control rods are inserted a small amount. Reactor startup rate stabilizes at -0.15 DPM. Assuming startup rate remains constant, how long will it take for source range count rate to decrease by one-half?

A. 0.3 minutes

B. 2.0 minutes

C. 3.3 minutes

D. 5.0 minutes

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.24 [3.5/3.6]
QID: P7768 (B7768)

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 startup rate was observed to be stable at – 0.24 DPM. Was the reactivity event a reactor trip or a dropped fully-withdrawn control rod, and why?

A. Reactor trip, because a dropped fully-withdrawn control rod will <u>not</u> produce a stable negative startup rate 10 seconds after the completion of the negative reactivity insertion.

B. Reactor trip, because a dropped fully-withdrawn control rod will produce a <u>less</u> negative stable startup rate 10 seconds after the completion of the negative reactivity insertion.

C. A dropped fully-withdrawn control rod, because a reactor trip will <u>not</u> produce a stable negative startup rate 10 seconds after the completion of the negative reactivity insertion.

D. A dropped fully-withdrawn control rod, because a reactor trip will produce a <u>more</u> negative stable startup rate 10 seconds after the completion of the negative reactivity insertion.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.25 [2.9/3.1]
QID: P772

Which one of the following is the reason for inserting control rods in a predetermined sequence during a normal reactor shutdown?

A. To prevent uneven fuel burnup.

B. To prevent an excessive reactor coolant system cooldown rate.

C. To prevent abnormally high local power peaks.

D. To prevent divergent xenon-135 oscillations.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.25 [2.9/3.1]
QID: P2971

Which one of the following describes how control rods are inserted during a normal reactor shutdown, and why?

A. One bank at a time, to maintain acceptable power distribution.

B. One bank at a time, to maintain a rapid shutdown capability from the remainder of the control rods.

C. In a bank overlapping sequence, to maintain a relatively constant differential control rod worth.

D. In a bank overlapping sequence, to limit the amount of positive reactivity added during a rod ejection accident.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.26 [3.1/3.2]
QID: P370 (B372)

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: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P132

The magnitude of decay heat generation is determined primarily by...

A. core burnup.

B. power history.

C. final power at shutdown.

D. control rod worth at shutdown.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P1272 (B1372)

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: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P1372

A nuclear power plant had been operating at 100 percent power for six months when a steam line rupture occurred that resulted in a reactor trip and all steam generators (SGs) blowing down (emptying) after approximately 1 hour. The SG blowdown caused reactor coolant system (RCS) temperature to decrease to 400°F, at which time the SGs became empty and an RCS heatup began.

Given the following information:

Reactor rated thermal power	= 3,400 MW
Decay heat rate	= 1.0 percent rated thermal power
Reactor coolant pump heat input to the RCS	= 15 MW
RCS total heat loss rate	= Negligible
RCS specific heat	= 1.1 Btu/lbm-°F
RCS inventory (less pressurizer)	= 475,000 lbm

What will the average RCS heatup rate be during the 5 minutes immediately after all SGs became empty?

A. 8 to 15 °F/hr

B. 50 to 75 °F/hr

C. 100 to 150 °F/hr

D. 300 to 350 °F/hr

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P2572

A nuclear power plant had been operating at 100 percent power for six months when a steam line rupture occurred that resulted in a reactor trip and all steam generators (SGs) blowing down (emptying) after approximately 1 hour. The SG blowdown caused reactor coolant system (RCS) temperature to decrease to 400°F, at which time the SGs became empty and an RCS heatup began.

Given the following information:

Reactor rated thermal power	= 2,400 MW
Decay heat rate	= 1.0 percent rated thermal power
Reactor coolant pump heat input to the RCS	= 13 MW
RCS total heat loss rate	= 2.4 MW
RCS specific heat	= 1.1 Btu/lbm-°F
RCS inventory (less pressurizer)	= 325,000 lbm

What will the average RCS heatup rate be during the 5 minutes immediately after all SGs became empty?

A. 8 to 15 °F/hr

B. 25 to 50 °F/hr

C. 80 to 150 °F/hr

D. 300 to 400 °F/hr

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P2872

A reactor has been shut down for several weeks when a loss of all AC power results in a loss of forced coolant flow in the reactor coolant system (RCS).

Given the following information:

Reactor rated thermal power	=	2,800 MW
Decay heat rate	=	0.2 percent rated thermal power
RCS ambient heat loss rate	=	2.4 MW
RCS specific heat	=	1.1 Btu/lbm-°F
RCS inventory (less pressurizer)	=	325,000 lbm

What will the average reactor coolant heatup rate be during the 20 minutes immediately after forced coolant flow is lost? Assume the RCS remains in thermal equilibrium and that only ambient losses are removing heat from the RCS.

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: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P2972 (B2972)

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: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P4336 (B4336)

A nuclear power plant had been operating at 100 percent power for six months when a reactor trip occurred. Which one of the following describes the source(s) of core heat generation 30 minutes after the reactor trip?

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.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P7638

A nuclear power plant has been operating at 100 percent power for six months when a reactor trip occurs. Which one of the following describes the source(s) of core heat generation 1 minute after the reactor trip?

A. Fission product decay is the only heat source capable of increasing fuel temperature.

B. Delayed neutron-induced fission is the only heat source capable of increasing fuel temperature.

C. Both fission product decay and delayed neutron-induced fission are capable of increasing fuel temperature.

D. Neither fission product decay nor delayed neutron-induced fission are capable of increasing fuel temperature.

ANSWER: C.