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 <u>least</u> 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 <u>decrease</u> the available shutdown margin in a reactor? (Assume <u>no</u> operator actions.)

A. Depletion of fuel during reactor operation.

B. Depletion of burnable poisons during reactor operation.

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

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

ANSWER: B.

TOPIC: 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 increase the available shutdown margin? (Assume that no unspecified operator actions occur and the reactor does not 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 no 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 not 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.