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 the neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

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

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

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

ANSWER: C.

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 1.0×10^{-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 x 10^{-6} 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: 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...

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)

As compared to a prompt neutron, a delayed neutron, produced from the same fission event, requires _______ collisions in the moderator to become thermal and is _______ likely to cause fission of a U-238 nucleus. (Neglect the effects of neutron leakage.)

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. leak out of the core while slowing down.

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

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: 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 commercial nuclear reactor operating 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 nuclear 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 core until it interacts with a U-238 nucleus.)

A. Thermal neutron

B. Prompt fission neutron beginning to slow down

C. Delayed fission neutron beginning to slow down

D. 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 commercial nuclear reactor operating 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 commercial nuclear reactor operating at the beginning of a fuel cycle, 4.25×10^5 delayed neutrons were emitted.

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

A. 1.5×10^6

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

C. be absorbed in a B-10 nucleus.

D. leak out of the core.

ANSWER: C.

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

A nuclear reactor is initially 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 nuclear 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. neutron nonleakage factor.

D. neutron 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 produced from fission in the third generation by the number of neutrons produced from fission 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. end; previous

B. beginning; next

C. beginning; previous

D. end; next

ANSWER: A.

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 nuclear reactor core. Which one of the following describes the most likely interaction and the effect on core 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 equilibrium 80 percent power near the end of its fuel cycle. During the next 3 days of equilibrium power operation no operator action is taken.

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

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

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

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

D. Core 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 nuclear reactor core. Which one of the following describes the most likely interaction and the effect on core 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 core refueling, burnable poisons are often installed in the core to help control K_{excess}. Why are more burnable poison rods installed during fuel load 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)

Select the equation that defines K-excess (excess reactivity).

A. $K_{eff} + 1$

B. $K_{eff} - 1$

C. $K_{eff}(1\text{-SDM})$

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

ANSWER: B.

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

Which one of the following combinations of critical core conditions indicates the most excess reactivity exists 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 nuclear 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 core?

A. To compensate for the conversion of U-238 to Pu-239 over core life.

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

C. To ensure the fuel temperature coefficient remains negative throughout core life.

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 nuclear 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 nuclear reactor core?

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 is the actual amount of reactivity...

A. inserted by burnable poisons at beginning of life.

B. due to dissolved boron in the reactor coolant system.

C. by which the reactor is subcritical.

D. which would be inserted by shutdown bank rods.

ANSWER: C.

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

When determining the shutdown margin for an operating nuclear reactor, how many control rods are assumed to remain fully withdrawn?

A. A single control rod of the highest reactivity worth.

B. A symmetrical pair of control rods of the highest 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 nuclear power plant operating at 85 percent power and rod control in Manual, the operator borates the reactor coolant system an additional 10 ppm. Assuming reactor power does not change during the boration, shutdown margin will...

A. decrease and stabilize at a lower value.

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

C. increase and stabilize at a higher value.

D. 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 nuclear power plant operating at 75 percent power and rod control in Manual, the operator dilutes reactor coolant system (RCS) boron concentration by 5 ppm. Assuming that reactor power does not change, 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 core changes will decrease shutdown margin? Assume no operator actions.

A. Depletion of fuel during reactor operation

B. Depletion of burnable poisons during reactor operation

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

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

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P2546

A nuclear power plant is operating at 100 percent power with rod control in Manual. If no operator action is taken, then during the next two weeks of steady-state operation at 100 percent power, shutdown margin will...

A. continuously increase.

B. continuously decrease.

C. initially increase, then return to the same value.

D. initially decrease, then return to the same value.

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} = 0.985, how much reactivity must be added to make the nuclear reactor critical?

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 core K_{eff} equal to 0.987, how much reactivity must be added to make the nuclear reactor <u>exactly</u> critical? (Answer options are rounded 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} = 0.982, how much positive reactivity is required to make the nuclear reactor critical?

A. 1.720% ΔK/K

B. 1.767% ΔK/K

C. 1.800% ΔK/K

D. 1.833% ΔK/K

ANSWER: D.

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

With K_{eff} = 0.985, how much positive reactivity is required to make the nuclear reactor exactly critical?

A. 1.487% ΔK/K

B. 1.500% ΔK/K

C. 1.523% ΔK/K

D. 1.545% 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 exactly critical? (Round answer to 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: K1.13 [3.5/3.7]
QID: P246

A nuclear reactor at the end of core life 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 temperature	= ( ) 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 nuclear reactor was operating at steady-state 100 percent power with all control rods fully withdrawn and RCS 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/% power
Control rod worth	= -6.918% ΔK/K
Moderator temperature coefficient	= -0.0012% ΔK/K per °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 nuclear reactor is operating at steady-state 90 percent power with all control rods fully withdrawn and 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 xenon.

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

Immediately after a reactor trip from 100 percent power, shutdown margin was determined to be -5.883% ΔK/K. Over the next 72 hours the reactor coolant system was cooled down and 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? (Assume end of core life.)

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 nuclear reactor at end of life 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.

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 nuclear reactor at end of core life 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.

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 nuclear reactor at the beginning of core life has been shut down from 100 percent power and cooled down to 340 °F over three days. During the cooldown, 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 nuclear reactor 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 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 nuclear reactor 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 result in an <u>increase</u> in shutdown margin for a shutdown nuclear reactor at end of core life?

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

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

C. Xenon 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 70 percent power with manual rod control. Which one of the following conditions will <u>increase</u> 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 nuclear 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 nuclear reactor is operating at 80 percent power when the operator adds 10 gallons of 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 reactor coolant average temperature.

When the plant stabilizes, 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. larger; top

D. larger; 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 hurriedly performs the downpower transient using control rod insertion when necessary. Reactor coolant boron concentration is <u>not</u> changed.

If the initial shutdown margin was 3.5% ΔK/K, which one of the following describes the 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 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 nuclear 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

Nuclear 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 each reactor.

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. Reactor A will have the greater SDM.

B. 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 trips, 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

A nuclear 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 shutdown margin was 3.0% ΔK/K, which one of the following describes the 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 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 nuclear reactor is initially operating at steady-state 60 percent power near the end of core life when a fully withdrawn control rod suddenly inserts completely into the core. No operator action is taken and the plant control systems stabilize the reactor at a power level in the power range.

Compared to the initial shutdown margin (SDM), the new steady-state SDM is ___________; and compared to the initial 60 percent power core K_{eff}, the new steady-state 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. Reactor engineers have predicted a control rod configuration at which the reactor will become critical during the initial reactor startup following the refueling outage based on the expected core loading. 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 nuclear 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

Nuclear 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 nuclear 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 core 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

Nuclear 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 core 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

A nuclear power plant was initially operating at steady state 70 percent power near the middle of a fuel cycle when a control rod dropped into the core. Consider the following two possible operator responses:

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

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

In a comparison between the two responses, which response, if any, will result in the greater available shutdown margin 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 larger (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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P347 (B350)

Which one of the following statements 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 a 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: P448 (B1949)

A subcritical nuclear reactor has an initial source/startup 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P848 (B2149)

A subcritical nuclear 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 source range count rate stabilize?

A. 150 cps

B. 200 cps

C. 300 cps

D. 400 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P1348 (B1449)

A nuclear reactor is shutdown by 1.8 %ΔK/K. Positive reactivity is added which increases stable neutron count rate from 15 to 300 cps.

Assuming the reactor is still subcritical, what is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P1448 (B1849)

A subcritical nuclear reactor has an initial source/startup 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P1748

A subcritical nuclear reactor has an initial source/startup 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P1848 (B1170)

A nuclear power plant that has been operating at 100 percent power for two months experiences a reactor trip. 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/startup range nuclear instruments.

The majority of the source/startup range detector output 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: P2248 (B2249)

Two nuclear reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 200 neutrons per second. Control rods are stationary and K_{eff} is 0.98 in both reactors. Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

	Reactor A	Reactor B
A.	5,000	10,000
B.	10,000	20,000
C.	10,000	40,000
D.	20,000	40,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P2448 (B2649)

A nuclear reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995 and 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. 1,000 cps and constant.

B. Less than 1,000 cps and decreasing toward the prestartup count rate.

C. Less than 1,000 cps and stable above the prestartup count rate.

D. Greater than 1,000 cps and increasing toward criticality.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P3048 (B3049)

A nuclear reactor startup is being commenced with initial source (startup) 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
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 that the moderator temperature coefficient remains constant throughout the cooldown, and no operator action is taken. What will be the status of the reactor when reactor coolant temperature reaches 290°F?

A. Subcritical, with source range count rate below 320 cps.

B. Subcritical, with source range count rate above 320 cps.

C. Supercritical, with source range count rate below 320 cps.

D. Supercritical, with source range count rate above 320 cps.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P3848 (B3849)

A nuclear reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10 percent

B. 20 percent

C. 80 percent

D. 100 percent

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P3925 (B3925)

A nuclear reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P4225 (B4225)

A nuclear reactor is shutdown with a K_{eff} of 0.96 and a stable source range indication of 50 counts per second (cps) when a reactor startup is commenced. Which one of the following will be the stable source range indication when K_{eff} reaches 0.995?

A. 400 cps

B. 800 cps

C. 4,000 cps

D. 8,000 cps

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P4525 (B4525)

A nuclear power plant is being cooled down from 500°F to 190°F. Just prior to commencing the cooldown, the readings for all source range nuclear instruments were stable at 32 counts per second (cps). After two hours, with reactor coolant temperature at 350°F, the source range count rate is stable at 64 cps.

Assume that the moderator temperature coefficient remains constant throughout the cooldown, reactor power remains below the point of adding heat, and no reactor protection actions occur.

Without additional operator action, what will be the status of the reactor 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: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P5025

A nuclear power plant is initially shutdown with an effective multiplication factor (K_{eff}) of 0.92 and a stable source range count rate of 200 cps. Then, a reactor startup is initiated. All control rod motion is stopped when K_{eff} equals 0.995. The instant that rod motion stops, source range count rate is 600 cps.

When source range count rate stabilizes, count rate will be approximately...

A. 600 cps

B. 650 cps

C. 1,800 cps

D. 3,200 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P5225 (B5225)

A nuclear power plant was initially shutdown with a stable source range count rate of 30 cps. Using many small additions of positive reactivity, a total of 0.1 %ΔK/K was added to the core and stable source range count rate is currently 60 cps.

What was the stable source range count rate after 0.05 %ΔK/K was added to the core?

A. 40 cps

B. 45 cps

C. 50 cps

D. 55 cps

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P5625

A PWR nuclear power plant has been shut down for two weeks and has the following stable initial 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 boron differential reactivity worth 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 reduced further 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: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P548

Reactor power was increased from 10^{-9} percent to 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 1.0×10^{-8} percent to 5.0×10^{-7} percent in two minutes. What is the average startup rate?

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 nuclear reactor startup, reactor power increases from 1.0 x 10^{-8} percent to 2.0 x 10^{-8} percent in 2 minutes with no operator action. Which one of the following is 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 nuclear reactor startup, reactor power increases from $3x10^{-6}$ percent to $5x10^{-6}$ percent in 2 minutes with no operator action. Which one of the following 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 critical reactor in the source range. The amount of reactivity added is much less than the core effective delayed neutron fraction.

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

A. Moderator temperature coefficient

B. Fuel temperature coefficient

C. Prompt neutron lifetime

D. Effective decay constant

ANSWER: D.

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

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

A. Increase in turbine loading

B. Unintentional boration

C. Turbine runback

D. Closure of a letdown isolation valve

ANSWER: A.

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 nuclear reactor is dependent on the ________________ and ________________.

A. prompt neutron lifetime; axial flux distribution

B. prompt neutron lifetime; effective delayed neutron fraction

C. effective decay constant; effective delayed neutron fraction

D. effective decay constant; axial flux distribution

ANSWER: C.

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

A nuclear reactor is exactly critical at 1.0 x 10^{-8} percent power during a reactor startup. $\overline{\beta}_{eff}$ 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 initiate a reactor power increase toward the point of adding heat with 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 nuclear reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1 %ΔK/K into the reactor core. Assuming no other reactivity additions, what will be the approximate stable reactor period 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)

Nuclear reactors A and B are identical except that the reactor cores 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 reactor 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 higher because it will have the higher positive reactivity in the core.

B. Reactor B stable SUR will be higher because it has the smaller effective delayed neutron fraction.

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 nuclear reactor:

Power level: 1.0×10^{-8} percent
K_{eff} : 0.999
Core $\overline{\beta}_{eff}$: 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: K1.07 [3.0/3.0]
QID: P48 (B1950)

Over core life, plutonium isotopes are produced with delayed neutron fractions that are ______________ than uranium delayed neutron fractions, thereby causing reactor power transients to be ______________ near the end of core life.

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

When does the power decrease rate initially stabilize at negative one-third decade per minute following a reactor trip?

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 nuclear 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 core delayed neutron fraction from beginning of core life (BOL) to end of core life (EOL)?

A. A given set of plant parameters at EOL yields a greater shutdown margin (SDM) than at BOL.

B. A given set of plant parameters at EOL yields a smaller SDM than at BOL.

C. A given reactivity addition at EOL results in a higher startup rate (SUR) than it would at BOL.

D. A given reactivity addition at EOL results in a lower SUR than it would at BOL.

ANSWER: C.

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

Delayed neutrons are important for nuclear reactor control because...

A. they are produced with 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 neutron generation lifetime.

ANSWER: D.

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

Two nuclear 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 the reactor systems for each reactor respond identically to the trip and no operator action is taken, reactor A will attain a negative ________ second stable period and reactor B will attain a negative ________ second stable period. (Assume control rod worth equals -0.97 $\Delta K/K$ and λ_{eff} equals 0.0124 $seconds^{-1}$ for both reactors.)

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

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor ______ because it has a ___________ 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 nuclear reactors are identical in every way 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.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, a power level of 10^{-5} percent will be reached first by reactor _____ because it has a ____________ 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 in the core compared to prompt neutrons.

B. Delayed neutrons have a long mean lifetime 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 in a nuclear reactor will result in the largest reactor core 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 percentages of fission, by fuel, occurring in a nuclear reactor will result in the smallest reactor core 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 nuclear reactors are identical in every way 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 ___________ 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 typical PWR nuclear power plant is operating at equilibrium 50 percent power when a control rod is ejected from the core. Which one of the following combinations of fission percentages, by fuel, would result in the highest reactor startup rate? (Assume the reactivity worth of the ejected control rod is the same for each case.)

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

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3248 (B3249)

Two nuclear reactors are identical in every way 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 reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher fission rate will exist in reactor ______ because it has a ___________ 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 nuclear reactors are identical in every way 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. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher shutdown fission rate will exist in reactor ______ because it has a ___________ 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 nuclear reactor with a stable neutron population and an initial core K_{eff} of 0.99. Consider the following two cases:

Case 1: The reactor is near the beginning of core life.
Case 2: The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case. Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

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

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

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

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

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3849

A nuclear reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The core 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 core life with a core effective delayed neutron fraction of 0.005, what would be the approximate stable startup rate 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 nuclear reactor core:

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 approximate core 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 nuclear reactor core:

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 core 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 nuclear 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 nuclear reactor, the “effective” core delayed neutron fraction may differ from the core delayed neutron fraction because, compared to prompt neutrons, delayed neutrons...

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

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

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

D. spend less time in the resonance absorption energy region, and they 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 nuclear reactor:

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

The above data indicates that the reactor core 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 the core described above.

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)

A reactor is initially critical below the point of adding heat (POAH) and remains below the POAH. Consider the following two cases:

Case 1: An operator adds positive 1.0×10^{-4} $\Delta K/K$ reactivity to the reactor.
Case 2: An operator adds negative 1.0×10^{-4} $\Delta K/K$ reactivity to the reactor.

The time required for reactor power to change by a factor of 10 will be greater in 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 x 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 applies to a nuclear reactor core 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 core 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 nuclear reactor core:

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 core delayed neutron fraction for this reactor?

A. 0.0044

B. 0.0055

C. 0.0063

D. 0.0071

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 nuclear reactor is prompt critical?

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

B. The fission process is occurring so rapidly that the 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 nuclear reactor will become prompt critical when reactivity is added equal in magnitude 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 nuclear 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 take 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 nuclear reactor is exactly critical several decades below the point of adding heat (POAH) with a xenon-free core. The operator continuously withdraws control rods until a positive 0.5 decades per minute (dpm) startup rate (SUR) is reached and then stops control rod motion.

When rod motion is stopped, SUR will immediately... (Neglect any reactivity effects of fission products.)

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)

Positive reactivity is continuously added to a critical nuclear reactor. Which one of the following values of core K_{eff} will first 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 nuclear reactor has a stable positive 1.0 dpm startup rate with no control rod motion several decades below the point of adding heat (POAH). The operator then inserts control rods until a positive 0.5 dpm startup rate is attained and then stops control rod motion.

When rod insertion is stopped, reactor 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. stabilize, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

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

ANSWER: B.

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

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

A. The duration of control rod withdrawal.

B. The differential control rod worth.

C. The total control rod worth.

D. The magnitude of the fuel temperature coefficient.

ANSWER: B.

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

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

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

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

A. 0.0061 ΔK/K

B. 0.0185 ΔK/K

C. 0.0227 ΔK/K

D. 0.9939 ΔK/K

ANSWER: A.

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

Refer to the unlabeled nuclear 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 _________.

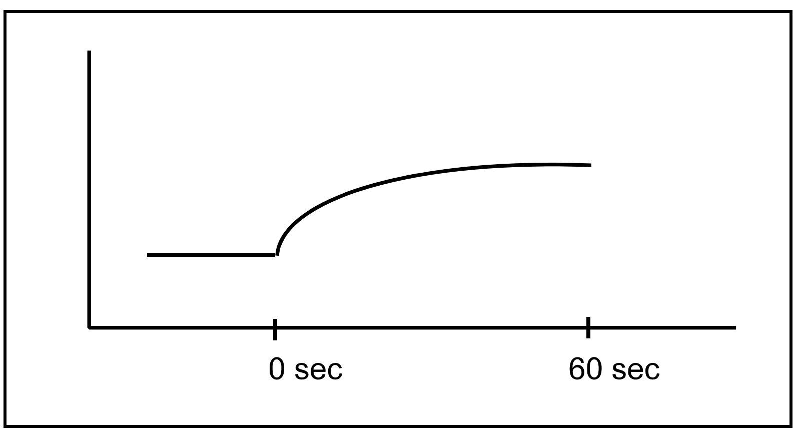
A. startup rate; subcritical

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 nuclear reactors, A and B, are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 ΔK/K) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be ___________ than reactor A (BOL); and the stable startup rate observed for reactor B (EOL) will be ___________ than reactor A (BOL).

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

ANSWER: A.

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

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

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

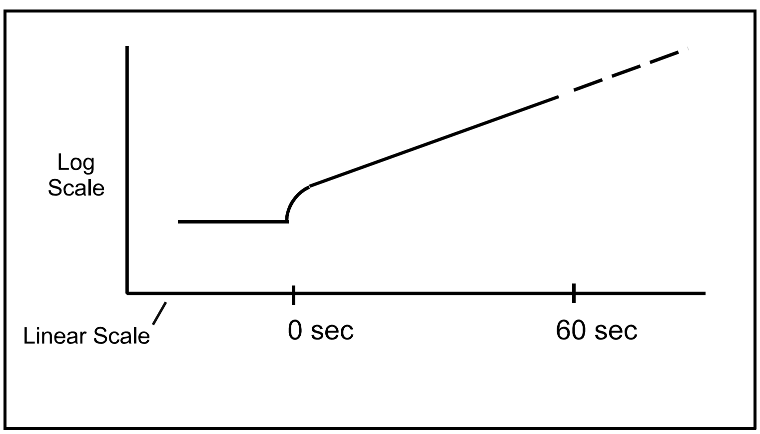
A. reactor period; exactly critical

B. reactor period; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.



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

A nuclear 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: K1.11 [2.7/2.8]
QID: P49

An installed neutron source...

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 the nuclear reactor core for which one of the following reasons?

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

B. To compensate for those neutrons absorbed in burnable poisons

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

D. To provide enough neutrons in a shutdown reactor to start a chain reaction for reactor startup

ANSWER: C.

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

Which one of the following neutron reactions produces the largest contribution to the intrinsic source neutron level immediately following a reactor trip from extended power operations during the tenth fuel cycle? (Neglect 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 intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period 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 intrinsic 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 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 nuclear 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/startup 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

Moderator temperature coefficient is defined as the change in core reactivity per degree change in...

A. fuel temperature.

B. fuel clad 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 resonance capture of fission neutrons in a nuclear reactor core at the beginning of a fuel cycle?

A. U-233

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

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

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

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

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

ANSWER: A.

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

Which one of the following isotopes is the most significant contributor to resonance capture of fission neutrons in a nuclear reactor core near 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 nuclear 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 the nuclear reactor most likely to have a <u>positive</u> 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 nuclear 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 decreased reactor coolant system (RCS) boron concentration.

D. less negative due to increased RCS boron concentration.

ANSWER: C.

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

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

A. Pu-239 and U-235

B. Pu-239 and Pu-240

C. U-238 and Pu-240

D. U-238 and Pu-239

ANSWER: C.

TOPIC: 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 nuclear reactor core at the beginning of the sixth fuel cycle? (Assume that each refueling replaces one-third of the fuel.)

A. U-235 and Pu-239

B. U-235 and U-238

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

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

Which one of the following contains two isotopes, both of which are responsible for the negative reactivity inserted when fuel temperature increases near the end of core life?

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 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 of the following conditions is the moderator temperature coefficient most negative?

A. Beginning of core life (BOL), high temperature

B. BOL, low temperature

C. End of core life (EOL), high temperature

D. EOL, low temperature

ANSWER: C.

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

During a nuclear power plant heat-up at end of core life, 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 least 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 nuclear reactor is operating at full power following a refueling outage. In comparison to the current moderator temperature coefficient (MTC), the MTC just prior to the refueling was...

A. 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 decrease in the thermal utilization factor.

B. an increase in the thermal utilization factor.

C. a decrease in the resonance escape probability.

D. an increase in the resonance escape probability.

ANSWER: D.

TOPIC: 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 system boron concentration.

ANSWER: D.

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

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

A. low; low

B. high; low

C. low; high

D. high; high

ANSWER: B.

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

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

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 core life (EOL) compared to the beginning of core life (BOL)?

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

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

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

D. Decreased coolant boron concentration near the EOL 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 net reactivity effect of a moderator temperature decrease in an overmoderated reactor core?

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

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

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

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

ANSWER: C.

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

A nuclear reactor is operating at full 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 net reactivity effect of a moderator temperature increase in an overmoderated nuclear reactor core?

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: 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 in an undermoderated nuclear reactor core?

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: B.

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

As compared to the moderator temperature coefficient (MTC) of reactivity near the beginning of core life, the MTC near the end of core life 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 overall core reactivity effect of a moderator temperature increase in an undermoderated nuclear reactor core?

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

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

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

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

ANSWER: A.

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

Why does the fuel temperature (Doppler) coefficient becomes less negative at higher fuel temperatures?

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

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

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

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

ANSWER: D.

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

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

A. Increased clad creep

B. Increased pellet swell

C. Lower power level

D. Higher reactor coolant boron concentration

ANSWER: C.

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

As core age increases, for the same power level the fuel temperature coefficient of reactivity becomes ______________ negative because 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 isotopes is responsible for the negative reactivity associated with a fuel temperature increase near the end of core life?

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P1951 (B1553)

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

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

B. Increase in moderator temperature.

C. Increase in fuel temperature.

D. Increase in void fraction.

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

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

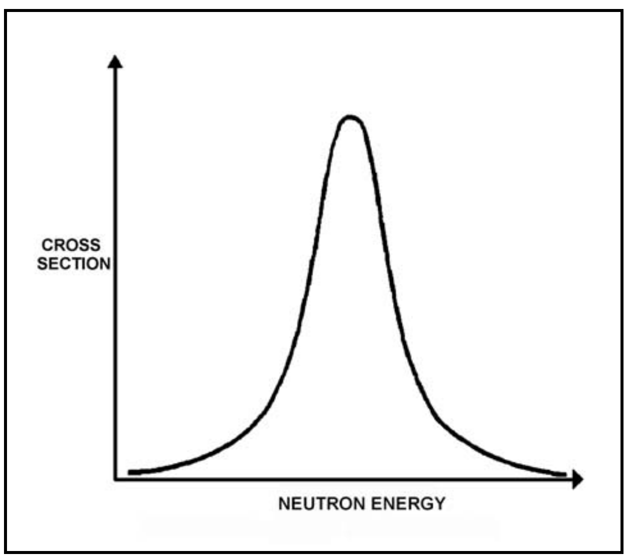
A. increase; neutrons of a wider range of energies will be absorbed by U-238

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

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

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

ANSWER: C.



TOPIC: 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 over core life?

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)

The fuel temperature (Doppler) coefficient of reactivity is more negative at the ____________ of a fuel cycle because ________________. (Assume the same initial fuel temperature throughout the fuel cycle.)

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

B. end; more fission products are in the core

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

D. beginning; less fission products are in the core

ANSWER: A.

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

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

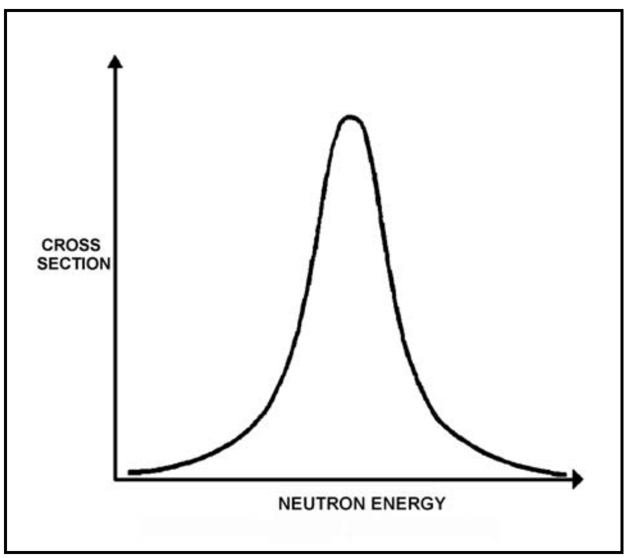
A. decrease; fewer neutrons will be absorbed by U-238 overall

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 drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a nuclear 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 _________.

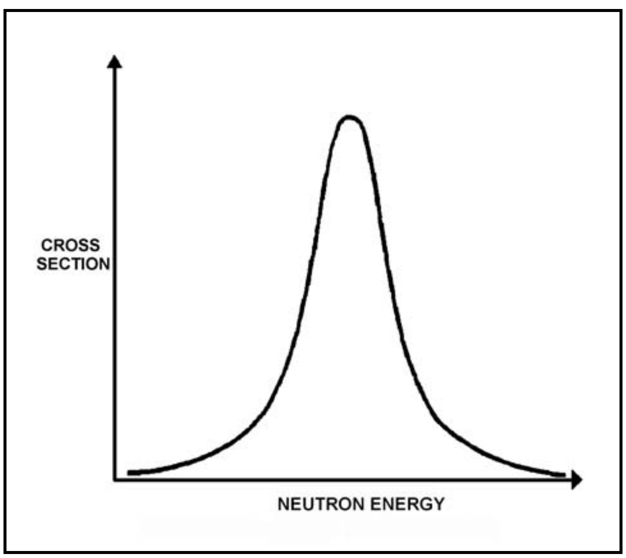
A. increase; increase

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 nuclear 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 ________.

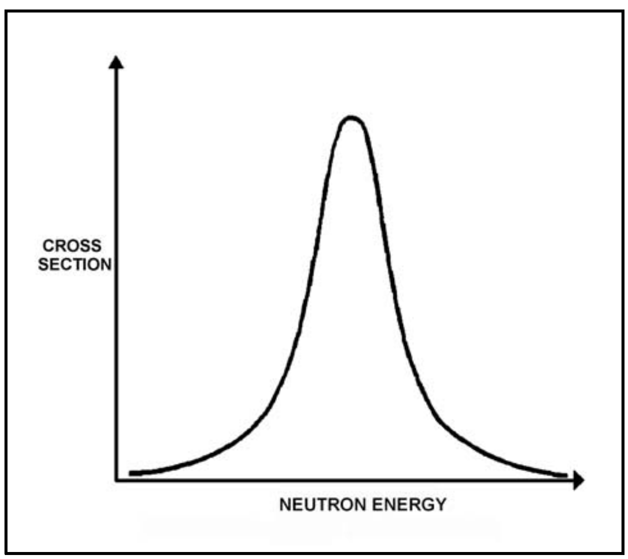
A. taller and more narrow; decrease

B. taller and more narrow; increase

C. shorter and broader; decrease

D. shorter and broader; increase

ANSWER: A.



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

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a nuclear reactor operating at 80 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 _________.

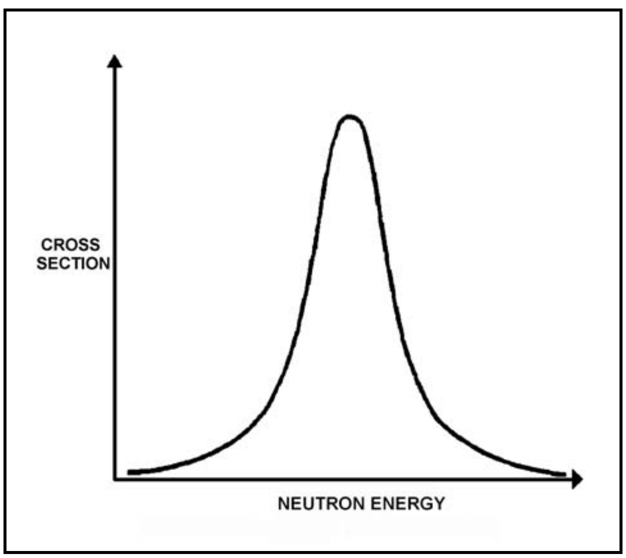
A. increase; increase

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 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: K1.08 [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 voids

B. Moderator temperature, RCS pressure, Xenon level

C. Fuel temperature, xenon level, control rod position

D. Moderator voids, fuel temperature, moderator temperature

ANSWER: D.

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

Which one of the following adds the most positive reactivity following a reactor trip/scram from full power near the beginning of core life? (Assume reactor coolant system parameters stabilize at their normal post-trip values.)

A. Void coefficient

B. Pressure coefficient

C. Fuel temperature coefficient

D. Moderator temperature coefficient

ANSWER: C.

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

A nuclear power plant is initially operating at 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 voids

B. Moderator voids, fuel temperature, and moderator temperature

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

D. Moderator temperature, reactor coolant pressure, and xenon concentration

ANSWER: B.

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

A nuclear reactor is exactly critical at the point of adding heat during a xenon-free reactor startup near the beginning of core life. Reactor power is ramped to 50 percent over the next 4 hours.

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 Xe-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 reactor has been operating at steady state 50 percent power for one month following a refueling outage. Reactor power is ramped to 100 percent over the next 2 hours.

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 Xe-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 is reduced, the differential boron reactivity worth (ΔK/K per ppm) becomes...

A. less negative due to the increased number of water molecules in the core.

B. less negative due to the decreased number of boron molecules in the core.

C. more negative due to the increased number of water molecules in the core.

D. more negative due to the decreased 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; lower

B. higher; higher

C. lower; lower

D. lower; higher

ANSWER: A.

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

Differential boron reactivity worth will become _______ negative as moderator temperature increases because, at higher moderator temperatures, a 1 ppm increase in reactor coolant system 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 ($\Delta K/K/ppm$) 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.

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

Reactor power is 80 percent.
Average reactor coolant temperature is 582°F.

Assume that the initial and current reactor coolant boron concentrations are the same. Which one of the following describes the current differential boron worth (DBW) in comparison to the initial DBW?

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

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

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

D. The current DBW is 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 near the beginning of core life (1,200 ppm) is approximately ____________ as the amount of boric acid required to increase boron concentration by 50 ppm near the end of core life (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 near the end of core life (100 ppm) is approximately ______________ the amount of pure water required to decrease reactor coolant boron concentration by 20 ppm near the beginning of core life (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 due to a change in the measured parameter.

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:

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

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

A. 606 ppm

B. 603 ppm

C. 597 ppm

D. 594 ppm

ANSWER: A.

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

Given the following initial parameters:

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

Which one of the following is the final reactor coolant boron concentration required to <u>increase</u> 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:

Total power coefficient	= -0.016 %ΔK/K/%
Boron worth	= -0.010 %ΔK/K/ppm
Control rod worth	= -0.030 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30 percent to 80 percent by boration/dilution with 10 inches of outward control rod motion. (Assume no change in fission product poison reactivity.)

A. 390 ppm

B. 420 ppm

C. 450 ppm

D. 470 ppm

ANSWER: C.

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

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

Initial boron concentration	= 500 ppm
Moderator temperature coefficient	= -0.012 %ΔK/K per °F
Differential boron worth	= -0.008 %ΔK/K per 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:

Total power coefficient	= -0.020 %ΔK/K/%
Boron worth	= -0.010 %ΔK/K/ppm
Control rod worth	= -0.025 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30 percent to 80 percent by boration/dilution with 10 inches of outward control rod motion? (Assume no 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:

Total power coefficient	= -0.020 %ΔK/K/%
Boron worth	= -0.010 %ΔK/K/ppm
Control rod worth	= -0.025 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

Which one of the following is the final RCS boron concentration required to support decreasing plant power from 80 percent to 30 percent by boration/dilution with 10 inches of inward control rod motion? (Assume no 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:

Total power coefficient	= -0.020 %ΔK/K/%
Boron worth	= -0.010 %ΔK/K/ppm
Control rod worth	= -0.025 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration	= 600 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant 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:

Reactor power	= 100%
Total power coefficient	= -0.020 %ΔK/K/%
Boron worth	= -0.010 %ΔK/K/ppm
Control rod worth	= -0.025 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration	= 500 ppm

Which one of the following is the final RCS boron concentration required to support decreasing plant power to 30 percent by boration/dilution with 20 inches of inward control rod motion? (Assume no 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:

Total power coefficient:	-0.020 %ΔK/K/%
Boron worth:	-0.010 %ΔK/K/ppm
Control rod worth:	-0.020 %ΔK/K/inch
Initial reactor coolant system (RCS) boron concentration:	600 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant 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: P53

During power operation, while changing power level, core reactivity is affected most quickly by...

A. boron concentration adjustments.

B. power defect (deficit).

C. xenon transients.

D. fuel depletion.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P131

Which one of the following statements concerning the power defect is correct?

A. The power defect necessitates the use of a ramped T_{ave} program to maintain an adequate reactor coolant system subcooling margin.

B. The power defect increases the rod height requirements necessary to maintain the desired shutdown margin following a reactor trip.

C. The power defect is more negative near the beginning of core life because of the higher boron concentration.

D. The power defect causes control rods to be withdrawn as reactor power is decreased.

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 greatest amount of positive reactivity addition?

A. 3% power to 5% power

B. 5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

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% power to 5% power

B. 5% power to 15% power

C. 15% power to 30% power

D. 30% power to 50% power

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% power to 10% power

B. 10% power to 25% power

C. 25% power to 60% power

D. 60% power to 100% power

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% power to 10% power

B. 10% power to 25% power

C. 25% power to 65% power

D. 65% power to 100% power

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P3050 (B3051)

A nuclear 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 per % power.
- Core effective delayed neutron fraction equals 0.006.

What is the approximate 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: 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% power to 10% power

B. 10% power to 15% power

C. 15% power to 30% power

D. 30% power to 40% power

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P4327 (B4325)

A nuclear reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.2 %ΔK/K reactivity.

Given:

- All control rod motion has been stopped.
- No automatic system or operator actions occur to inhibit the power increase.
- Power coefficient equals -0.04 %ΔK/K per % power.
- Core effective delayed neutron fraction equals 0.006.

What is the approximate 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: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P6727 (B6736)

A nuclear 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 caused a rod withdrawal that increased 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 per % power.
- Core effective delayed neutron fraction equals 0.006.

Assuming the reactor does not trip, what is the approximate 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: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P254

A nuclear reactor is exactly critical below the point of adding heat (POAH) during a reactor startup at the end of core life. 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 increase...

A. continuously until control rods are reinserted.

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

C. temporarily, then stabilize at the original value.

D. and stabilize at a value slightly above the POAH.

ANSWER: D.

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

A nuclear reactor is initially critical below the point of adding heat with a constant reactor coolant temperature. If control rods are manually inserted for 5 seconds, reactor power will decrease...

A. to a shutdown power level low in the source range.

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

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

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

ANSWER: A.

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

A nuclear reactor is exactly critical below the point of adding heat (POAH) during a normal reactor startup. If a control rod is manually withdrawn for 5 seconds, reactor power will...

A. increase to a stable critical power level below the POAH.

B. increase temporarily, then decrease and stabilize at the original value.

C. increase to a stable critical power level at the POAH.

D. increase temporarily, then decrease and stabilize below the original value.

ANSWER: C.

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

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

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

A nuclear reactor is critical at 50 percent power. Control rods are inserted a short distance. Assuming that the main turbine-generator load remains constant, actual reactor power will 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 nuclear reactor is operating at steady state 50 percent power near the end of core life when the operator inserts a group of control rods for 5 seconds. Assume turbine load remains constant and the reactor does not scram/trip.

Actual reactor power will stabilize _______________ the initial power level and 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 nuclear reactor has been shut down for three weeks with all control rods fully inserted. If a single control rod is withdrawn from the core, neutron flux 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 nuclear 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 population will: (Assume the reactor remains subcritical.)

A. increase and stabilize at a new higher level.

B. increase temporarily then return to the original value.

C. increase exponentially until the operator inserts the control rod.

D. remain the same.

ANSWER: A.

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 is the change in ____________ per ____________ 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 nuclear reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1×10^{12} neutrons/cm^2-sec
Control rod tip 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 neutron flux of 1×10^{13} neutrons/cm^2-sec, then the differential control rod worth will increase by a factor of _______. (Assume the average 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 rod position.

B. rod worth associated with the most reactive control rod.

C. change in worth of a control rod per unit change in reactor power.

D. reactivity added by moving a control rod from a reference point to another point.

ANSWER: D.

TOPIC: 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 neglecting changes in fission product poison reactivity, what is the differential control rod worth?

Power coefficient:	-0.03 %ΔK/K/%
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 nuclear 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, then the differential control rod worth will increase by a factor of _______. (Assume the average 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 nuclear reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1.0 x 10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 4.0 x 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 x 10^{13} n/cm^2-sec, then the differential control rod worth will be increased 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 nuclear reactor is initially operating at steady state 70 percent power with the following conditions:

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 neglecting fission product poison reactivity changes, what is the differential control rod worth?

Power coefficient:	-0.03 %ΔK/K/%
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 nuclear reactor with the following neutron flux parameters:

Core average thermal neutron flux = 1.0 x 10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 4.0 x 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 x 10^{13} n/cm^2-sec, then 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 IRW at a specific rod position.

B. DRW is the square root of the IRW at a specific rod position.

C. DRW is the slope of the IRW curve at a specific rod position.

D. DRW is the area under the IRW curve at a specific rod position.

ANSWER: C.

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

Which one of the following parameters typically has the greatest effect 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. decreased moderator density causes more neutron leakage out of the core.

B. moderator temperature coefficient decreases, causing decrease competition.

C. fuel temperature increases, decreasing neutron absorption in fuel.

D. decreased moderator density increases 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 system (RCS) temperature is __________ and RCS 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

With a nuclear power plant operating normally at full power, a 5°F decrease in moderator temperature will cause the differential control rod worth to become...

A. more negative due to better moderation of neutrons.

B. less negative due to shorter neutron migration length.

C. more negative due to increased neutron absorption in moderator.

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 will become...

A. more negative due to longer neutron migration length.

B. less negative due to reduced moderation of neutrons.

C. more negative due to decreased resonance absorption 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 nuclear 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 group differential rod worth to become less 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 RCS heatup phase of the startup, control rod differential reactivity worth ($\Delta K/K$ per inch insertion) becomes _______ negative; and during the complete withdrawal of the initial bank of control rods, control rod differential reactivity worth becomes _______.

A. more; more negative and then less negative

B. more; less negative 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 group differential control rod worth to become less negative? (Assume the affected group of control rods remains 10 percent inserted for each case.)

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 a core refueling.

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

D. Early in core life, the concentration of burnable poison decreases.

ANSWER: B.

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

The main reason for designing and operating a nuclear reactor with a flattened neutron flux distribution is to...

A. provide even burnup of control rods.

B. reduce neutron leakage from the core.

C. allow 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 nuclear 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 edge of the reactor core

C. To reduce the size and number of control rods needed to ensure the reactor remains subcritical following a reactor trip

D. To increase 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

What is a purpose of control rod bank overlap?

A. Provides a more uniform differential rod worth and axial flux distribution.

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

The purposes of using control rod bank overlap are to...

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

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

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

D. maintain individual and group rod position indicators within allowable tolerances and to 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 flux oscillation.

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

ANSWER: B.

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

Which one of the following describes why most of the power is produced in the lower half of a nuclear reactor core that has been operating at 100 percent power for several weeks with all control rods withdrawn at the beginning of core life?

A. Xenon 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 U-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 nuclear reactor is operating at 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 nuclear reactor has been operating at 100 percent power for 3 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: P255

A comparison of the heat flux in the hottest coolant channel to the average heat flux in the core describes...

A. a core correction calibration factor.

B. a hot channel/peaking factor.

C. a heat flux normalizing factor.

D. an axial/radial flux deviation factor.

ANSWER: B.

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

A nuclear reactor has been taken critical following a refueling outage and is currently at the point of adding heat during a normal reactor startup. Which one of the following describes the change in core axial power distribution as reactor power is increased to five percent by control rod withdrawal?

A. Shifts toward the bottom of the core.

B. Shifts toward the top of the core.

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

D. Shifts away from the top and bottom 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 nuclear 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 nuclear reactor is operating at equilibrium full power when a single control rod fully inserts (from the fully withdrawn position). Reactor power is returned to full power with the control rod still fully inserted.

Compared to the initial axial neutron flux shape, the current flux shape will have a...

A. minor distortion, because a fully inserted control rod has 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 loosely coupled.

D. major distortion, because power production along the length of the rod drastically decreases.

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

Why do the control rod insertion limits generally rise as reactor power increases?

A. Power defect increases as power increases.

B. Control rod worth decreases as power increases.

C. Doppler (fuel temperature) coefficient decreases as power increases.

D. Equilibrium core xenon-135 negative reactivity increases 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 postulated dropped control rod.

B. To maintain a negative moderator temperature coefficient in the reactor.

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

Which one of the following will be most significantly affected by inserting the controlling group an additional 5 percent? (Assume reactor power does not change.)

A. Total xenon 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 nuclear reactor is operating at 75 percent power. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping 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 nuclear reactor is operating at 75 percent power with all control rods fully withdrawn. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping (full insertion) a single 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 nuclear reactor is operating at 75 percent power with all control rods fully withdrawn. Assuming reactor power does not change, which one of the following compares the effects of dropping (full insertion) a single 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 nuclear reactor is operating at 85 percent power with all control rods fully withdrawn. Assuming reactor power does not change, which one of the following compares the effects of partially inserting (50 percent) a single 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 nuclear reactor is operating at 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 nuclear 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 reactor power does not change.)

A. Total xenon 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 nuclear reactor is operating at steady state full power with all control rods fully withdrawn when one control rod at the core periphery falls completely into the core. Assuming no reactor trip and no operator action, which one of the following will have changed 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...

A. will be produced in direct proportion to the fission rate in the core.

B. will remain radioactive for thousands of years after the final reactor criticality.

C. will depress the power production in some core locations and cause peaking in others.

D. will 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 in a nuclear reactor core?

A. Xenon-135 is produced from the radioactive decay of barium-135.

B. Xenon-135 is primarily a resonance absorber of epithermal neutrons.

C. Thermal neutron flux level affects both the production and removal of xenon-135.

D. Thermal neutrons interact with xenon-135 primarily through scattering reactions.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.02 [3.0/1.1]
QID: P2458 (B1658)

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

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 poisons in the core, the two characteristics that cause Xe-135 to be a major reactor poison are its relatively _________ 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 nuclear reactor will...

A. increase due to the decay of iodine already in the core.

B. decrease because xenon is produced directly from fission.

C. remain the same because the decay of iodine and xenon balance each other out.

D. decrease initially, then slowly increase due to the differences in the half-lives of iodine and xenon.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P358 (B362)

Xenon-135 is produced in a nuclear 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 nuclear 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. 0.3

B. 3.0

C. 30

D. 100

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.03 [2.7/2.8]
QID: P1559 (B859)

Which one of the following lists the production mechanisms of Xe-135 in an operating power reactor?

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 Xe-135 in a nuclear 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: K1.04 [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 to 60 percent in 1 hour. What is the most significant contributor to the initial change in core xenon-135 reactivity?

A. Production xenon-135 from fission.

B. Production of xenon-135 from iodine-135 decay.

C. Loss of xenon-135 due to absorption of neutrons.

D. Loss of xenon-135 due to decay to cesium-135.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P859

In a shut down nuclear 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. $^{135}Xe \xrightarrow{\beta^+} {}^{135}I$

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: K1.05 [2.8/2.8]
QID: P2558 (B2558)

Nuclear reactors A and B are operating at steady-state 100 percent power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating at the end of core life (EOL) and reactor B is operating at the beginning of core life (BOL).

Which reactor core has the greater concentration of Xe-135?

A. Reactor A (EOL) due to the smaller 100 percent power thermal neutron flux.

B. Reactor A (EOL) due to the larger 100 percent power thermal neutron flux.

C. Reactor B (BOL) due to the smaller 100 percent power thermal neutron flux.

D. Reactor B (BOL) due to the larger 100 percent power thermal neutron flux.

ANSWER: C.

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 Xe-135 removal from the reactor core?

A. Primary - neutron capture; secondary - beta decay.

B. Primary - beta decay; secondary - 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 nuclear reactor has been operating at 50 percent power for one week when power is ramped in 4 hours to 100 percent. Which one of the following describes the new equilibrium core xenon-135 concentration?

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 nuclear 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 core xenon-135 concentration at 50 percent power?

A. The same as the100 percent value.

B. More than one-half the 100 percent value.

C. Less than one-half the 100 percent value.

D. One-half the 100 percent value.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P1158 (B1160)

A nuclear reactor has been operating at 25 percent power for 24 hours following a 2-hour power reduction from steady-state full power. Which one of the following describes the current status of core xenon-135 concentration?

A. At equilibrium

B. Decreasing toward an upturn

C. Decreasing toward an equilibrium value

D. Increasing toward a peak value

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P1459 (B259)

Following a two-week shutdown, a nuclear reactor is taken critical and ramped to full power in 6 hours. How long will it take to achieve an equilibrium xenon condition after the reactor reaches full 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 Xe-135 is in equilibrium?

A. Xe-135 production and removal rates are momentarily equal five hours after a power increase.

B. A reactor has been operated at 80 percent power for five days.

C. Xe-135 is being produced equally by fission and I-135 decay.

D. A reactor is currently operating at 100 percent power.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05 [3.1/3.1]
QID: P2859 (B2760)

Nuclear reactors A and B are operating at steady-state 100 percent power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating near the end of core life and reactor B is operating near the beginning of core life.

Which reactor is experiencing the most negative reactivity from equilibrium core Xe-135?

A. Reactor A due to a greater concentration of equilibrium core Xe-135.

B. Reactor A due to lower competition from the fuel for thermal neutrons.

C. Reactor B due to a greater thermal neutron flux in the core.

D. Reactor B due to a smaller accumulation of stable fission product poisons.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P259

A nuclear reactor has been operating at 50 percent power for one week when power is quickly ramped (over 4 hours) to 100 percent. How will the core xenon-135 concentration respond?

A. Decrease initially, then build to a new equilibrium concentration in 8 to 10 hours

B. Increase steadily to a new equilibrium concentration in 20 to 30 hours

C. Decrease initially, then build to a new equilibrium concentration in 40 to 50 hours

D. Increase steadily to a new equilibrium concentration in 70 to 80 hours

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P659

A nuclear reactor has been operating at a steady-state power level for 15 hours following a rapid power reduction from 100 percent to 50 percent using boration for reactivity control. Which one of the following describes the current core Xe-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 nuclear reactor was operating for 42 weeks at a stable reduced power level 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 equilibrium xenon?

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 nuclear 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 core xenon-135 level will be ____________ the initial 100 percent equilibrium value.

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 (B1960)

A nuclear reactor has been operating at a constant power level for 15 hours following a rapid power reduction from 100 percent to 50 percent. Which one of the following describes the current core 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 nuclear reactor was operating for 24 weeks at a constant power level 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 equilibrium core xenon-135?

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 nuclear reactor has been operating at 100 percent power for two weeks when power is decreased to 10 percent in one hour. Immediately following the power decrease, core 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

A nuclear reactor is initially operating at 50 percent of rated power with equilibrium core xenon-135. 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 core 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 nuclear reactor was operating at 100 percent power for two weeks when power was reduced to 50 percent over a 1-hour period. In order 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, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, then withdraw rods slowly.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2160

A nuclear reactor had been operating at 50 percent power for two weeks when power was increased to 100 percent over a 3-hour period. In order 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, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, 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 core Xe-135 oscillations are a concern in a nuclear 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 rapid reactor power changes during power operation and they can require operation below full rated power.

D. They can cause rapid reactor power changes 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 nuclear reactor had been operating at 70 percent power for two weeks when power was increased to 100 percent over a 2-hour period. To offset Xe-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, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, then withdraw rods slowly.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.06 [3.2/3.4]
QID: P2559

A nuclear reactor is initially operating at 100 percent power with equilibrium core xenon-135. Power is decreased to 50 percent over a 1-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 core 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

A nuclear reactor is initially operating at 80 percent power with equilibrium core xenon-135. Power is increased to 100 percent over a 2-hour period and average reactor coolant temperature is adjusted to 585°F using control rods. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 24 hours after the power change is completed?

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

A nuclear reactor is initially operating at 100 percent power with equilibrium core xenon-135. Power is decreased to 40 percent over a 2 hour period and average reactor coolant temperature is adjusted to 562°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

If only the reactivity effects of core xenon-135 changes are considered, which one of the following describes the status of the average reactor coolant temperature 2 hours after the power change is completed?

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 nuclear 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/scram at the same time, Xe-135 will peak first in reactor ______ and the highest Xe-135 reactivity peak will occur in reactor ______.

A. A; B

B. A; A

C. B; B

D. B; A

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1159 (B1761)

Two identical nuclear 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/scram at the same time, Xe-135 will peak first in reactor ______ and the highest Xe-135 reactivity peak will occur in reactor ______.

A. A; B

B. A; A

C. B; B

D. B; A

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.07 [3.4/3.4]
QID: P1358 (B1361)

A nuclear 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 (B1561)

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to overcome peak core xenon-135 negative reactivity will be smallest after a reactor trip from equilibrium _________ reactor power at the _________ of core life.

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

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to compensate for peak core xenon-135 negative reactivity will be greatest after a reactor trip from equilibrium _______ reactor power at the _______ of core life.

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 nuclear 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 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 (B6031)

A reactor trip occurred <u>one</u> <u>hour</u> 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. Assume a constant shutdown neutron flux. If no operator action is taken, how will the source range count rate respond during the next 24 hours?

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: K1.08 [3.3/3.4]
QID: P62

Slow changes in axial power distribution in a nuclear reactor that has operated at a steady-state power for a long time can be caused by xenon...

A. peaking.

B. override.

C. burnup.

D. oscillation.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P261

Xenon oscillations that tend to dampen themselves toward equilibrium 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 to fluctuate between the top and bottom of the core when steam demand is constant?

A. Steam generator level transients

B. Iodine spiking

C. Xenon oscillations

D. Inadvertent boron dilution

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08 [3.3/3.4]
QID: P463

A nuclear reactor has been operating at 100 percent power for several weeks with a symmetrical axial power distribution that is 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 nuclear reactor is operating at 100 percent power at the beginning of core life with equilibrium core xenon-135. Reactor power is reduced, within a 2 hour period, to 50 percent. Control rods are maintained fully withdrawn. The following parameter values are given:

	Prior to Power Change	After Power Change
Reactor power:	100 percent	50 percent
Reactor coolant system 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 nuclear reactor experiences xenon 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 nuclear 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 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 oscillation

D. Samarium oscillation

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 nuclear reactor is operating at 80 percent power at the beginning of core life with equilibrium core xenon-135. Reactor power is increased, over a 2-hour period, to 100 percent. The following information is provided:

	Prior to Power Change	After Power Change
Reactor power:	80 percent	100 percent
Reactor coolant system 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 nuclear reactor has been operating at full power for one month following a refueling outage with core 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 stabilized.

How will core axial neutron flux distribution be affected during the 1-hour period immediately following the return to 60 percent power?

The core axial neutron flux peak will be located __________ in the core than the pre-trip peak location, and the flux peak will be moving ___________.

A. higher; downward

B. higher; upward

C. lower; downward

D. lower; upward

ANSWER: A.

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 requires reactor power to be increased from 10 percent to full power 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. fuel burnup.

B. xenon buildup.

C. fuel temperature increase.

D. moderator temperature increase.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P1263

A nuclear reactor has been shut down for seven 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 core xenon 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 nuclear 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 core 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 nuclear reactor was shut down for seven days to perform maintenance. A reactor startup was performed, and power level was increased from 1 percent to 50 percent over a two hour period.

Ten hours after reactor power reaches 50 percent, the magnitude of core xenon-135 negative reactivity 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: K1.09 [3.0/3.1]
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 later, the reactor is critical at the point of adding heat with normal operating reactor coolant temperature and pressure. Power level will be raised to 100 percent over the next 3 hours.

During this power level increase, most of the positive reactivity added by the operator will be required to overcome the negative reactivity from...

A. fuel burnup.

B. xenon-135 buildup.

C. fuel temperature increase.

D. moderator temperature increase.

ANSWER: C.

TOPIC: 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 equilibrium power. The nuclear power plant is being returned to rated power at 2.0 percent/minute instead of the normal rate of 0.5 percent/minute.

At the faster rate of power increase, the minimum amount of core xenon will occur ____________ and the amount of equilibrium core xenon 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 nuclear reactor has been operating at 100 percent power for eight weeks when a reactor trip occurs. The reactor is critical 6 hours later and power is increased to 100 percent over the next 6 hours.

What is the status of core xenon-135 concentration when power reaches 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 poisoning in a nuclear reactor core 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 nuclear power plant startup is in progress 5 hours after a reactor trip from 100 percent equilibrium power. The power plant is currently at 10 percent power and 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 maximum amount of core xenon-135 will occur ____________ than normal; and the amount of equilibrium core 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: K1.11 [3.1/3.1]
QID: P63

A nuclear reactor that has been operating at rated power for 2 weeks is quickly reduced in power to 50 percent. Xenon-135 will reach a new equilibrium condition 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 nuclear reactor that has been operating at rated power for about two weeks is reduced in power to 50 percent. What happens to the Xe-135 concentration in the core?

A. There will be no change because iodine concentration is constant.

B. Xenon will initially build up, then decrease to a new equilibrium value.

C. Xenon will initially decrease, then build up to a new equilibrium value.

D. Xenon 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 change in core xenon-135 concentration immediately following a power increase from equilibrium conditions?

A. Initially decreases due to the increased rate of xenon-135 radioactive decay.

B. Initially decreases due to the increased absorption of thermal neutrons by xenon-135.

C. Initially increases due to the increased xenon-135 production from fission.

D. Initially increases due to the increased iodine-135 production from fission.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P2261 (B2761)

A nuclear reactor has been operating at steady-state 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 core 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 nuclear reactor that had been operating at 100 percent power for about two months was shutdown over a 2-hour period. Following the shutdown, core xenon-135 will reach a long-term 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 nuclear reactor has been operating at steady-state 30 percent power for 3 hours following a one-hour power reduction from steady-state 100 percent power. Which one of the following describes the current core xenon-135 concentration?

A. Increasing toward a peak

B. Decreasing toward an upturn

C. Increasing toward equilibrium

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 (RCS) 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 only the reactivity effects of core 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 nuclear 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 core 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

Compare a nuclear reactor that has been operating at 50 percent power for several days when a reactor trip occurs, to a reactor that had been operating at full power prior to the trip. For the reactor at 50 percent power, xenon would peak _____________ and the peak xenon reactivity 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 initially increases due to...

A. xenon production from the decay of iodine-135.

B. xenon production from the spontaneous fission of uranium.

C. the reduction of xenon removal by decay.

D. the reduction of xenon 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 a long-term, steady-state, 100 percent power run, the core xenon-135 concentration will be approximately...

A. the same as at the time of the trip and decreasing.

B. the same as at the time of the trip and increasing.

C. 50 percent lower than at the time of the trip and decreasing.

D. 50 percent higher than 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 nuclear reactor has been operating at full power for several days when it is shut down rapidly (within 2 hours) for maintenance. How will core xenon reactivity change?

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 nuclear reactor has been operating at 100 percent power for three weeks when a reactor trip occurs. Which one of the following describes the concentration of Xe-135 in the core 24 hours after the trip?

A. At least 2 times the concentration at the time of the trip and decreasing

B. Less than ½ the concentration at the time of the trip and decreasing

C. At or approaching a peak value

D. Approximately the same as 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 equilibrium xenon conditions, the amount of core xenon-135 will be...

A. lower than 100 percent equilibrium xenon, and will have added a net positive reactivity since the trip.

B. lower than 100 percent equilibrium xenon, and will have added a net negative reactivity since the trip.

C. higher than 100 percent equilibrium xenon, and will have added a net positive reactivity since the trip.

D. higher than 100 percent equilibrium xenon, and will have added a net negative reactivity since the trip.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2363

How does core xenon-135 change immediately following a reactor trip from equilibrium 100 percent power operation?

A. Decreases due to xenon removal by decay.

B. Decreases due to the reduction in xenon production directly from fission.

C. Increases due to xenon production from the decay of iodine-135.

D. Increases due to xenon production from the spontaneous fission of uranium.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P2662

Given:

- A nuclear 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 core Xe-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 nuclear reactor has been operating at 100 percent power for 2 months when a reactor trip occurs. 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, then negative reactivity.

D. Add negative reactivity, then positive reactivity.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.13 [2.9/3.0]
QID: P562

After a reactor shutdown from equilibrium core xenon conditions, the maximum xenon -135 negative reactivity (height of the xenon peak) is _______________ the pre-shutdown equilibrium 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 nuclear power plant was shut down following three months of operation at full power. The shutdown occurred over a 3 hour period with a constant rate of power decrease.

Which one of the following describes the reactivity added by core xenon during the shutdown?

A. Xenon buildup added negative reactivity.

B. Xenon buildup added positive reactivity.

C. Xenon burnout added negative reactivity.

D. Xenon burnout added positive reactivity.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P262

Four hours after a reactor trip from equilibrium full power operation, 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 core Xe-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. Six hours after the trip, reactor power is at 2 percent. To maintain power stable at 2 percent over the next hour, the operator must add...

A. positive reactivity because core xenon-135 is building up.

B. negative reactivity because core xenon-135 is building up.

C. positive reactivity because core xenon-135 is decaying away.

D. negative reactivity because core xenon-135 is decaying away.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P561 (B562)

Following a seven day shutdown, a reactor startup is performed and the nuclear power plant is taken to 100 percent power over a 16-hour period. After reaching 100 percent power, what type of reactivity will the operator need to add to compensate for core 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 (B1461)

A nuclear reactor has been operating at 100 percent power for two weeks. Power is then decreased over a 1-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, then negative reactivity

D. Add negative reactivity, then positive reactivity

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P1762 (B1763)

A reactor startup is being conducted and criticality has been achieved 15 hours after a reactor scram from 2 months of operation at full power. After 1 additional hour, reactor power is stabilized at 1.0 x 10^{-4} percent power and all control rod motion is stopped.

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 the shutdown neutron level due to the buildup of Xe-135.

D. Power decreases toward the shutdown neutron level due to the buildup of Sm-149.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2260 (B2861)

A nuclear reactor is initially shut down with no xenon in the core. Over the next four hours, the reactor is made critical and power level is increased to the point of adding heat. The shift supervisor has directed that power be maintained constant at this level for 12 hours for testing.

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, then withdrawn periodically.

D. withdrawn periodically for 4 to 6 hours, then inserted periodically.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2561

A nuclear reactor is initially shut down with no xenon in the core. A reactor startup is performed and 4 hours later power level is at 25 percent. The shift supervisor has directed that reactor power and reactor coolant temperature be maintained constant at this level for 12 hours.

To accomplish this, 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, then inserted periodically.

D. inserted periodically for 4 to 6 hours, then withdrawn periodically.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2863

A nuclear reactor is operating at 100 percent power immediately following a one-hour power ascension from steady-state 70 percent power. To keep reactor coolant system 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: P2963

A nuclear reactor is operating at 60 percent power immediately after a one-hour power increase from equilibrium 40 percent power. To keep the average 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

A nuclear power plant was initially operating at 100 percent power with equilibrium core xenon-135. Then, power was decreased to 75 percent over a 1-hour period. The operator is currently adjusting control rod height as necessary to maintain average reactor coolant temperature constant.

What will the rod position and directional trend be 30 hours after power reaches 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 2 percent.

To maintain reactor power and reactor coolant temperature stable over the next hour, the operator must add ___________ reactivity because core 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

A nuclear power plant is initially operating at steady-state 100 percent reactor power in the middle of a fuel cycle. The operators then slowly decrease main generator load to 90 percent while adding boric acid to the RCS. 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.

Assuming no other operator actions are taken, which one of the following describes the average reactor coolant temperature after an additional 60 minutes?

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 nuclear reactor has been shut down for seven days following two 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 in the core over the next 24 hours?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, then withdraw rods slowly.

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 nuclear 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: P864

Instead of using a higher concentration of soluble boric acid, burnable poisons are installed in a new nuclear reactor core to...

A. prevent boron precipitation during normal operation.

B. establish a more negative moderator temperature coefficient.

C. allow control rods to be withdrawn farther 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 nuclear reactor core <u>instead</u> of using a larger reactor coolant boron concentration?

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 nuclear 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?

A. The reactivity worth of the boron has increased so much that reactivity changes from RCS boron dilution cannot be safely controlled by the operator.

B. The reactivity worth of the boron 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. 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. 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 full-power reactor coolant boron concentration?

A. Reactivity from power defect at beginning of core life (BOL) is much greater than at end of core life (EOL).

B. Differential boron worth at BOL is much less than at EOL.
[Inverse boron worth at BOL is much greater than at EOL.]

C. The excess reactivity in the core at BOL is much greater than at EOL.

D. The integral control rod worth at BOL is much less than at EOL.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE K1.04 [3.1/3.4]
QID: P464

During a six-month period of continuous full power reactor operation, the reactor coolant boron concentration must be decreased steadily 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 for a nuclear reactor core following a refueling outage (see figure below).

Which one of the following is responsible for the majority of the decrease in K_{eff} from point 1 to point 2?

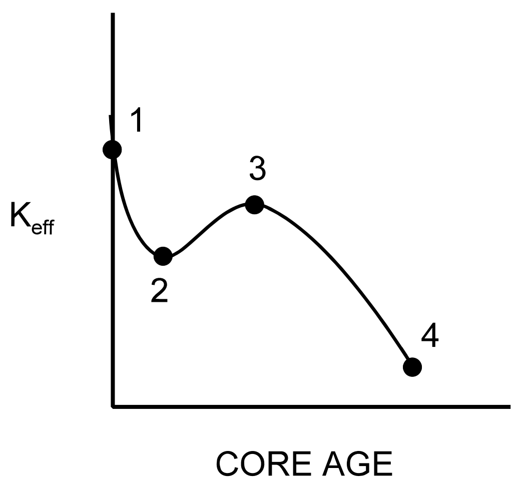
A. Depletion of fuel.

B. Burnout of burnable poisons.

C. Initial heat-up 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 burnup for a nuclear reactor core 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?

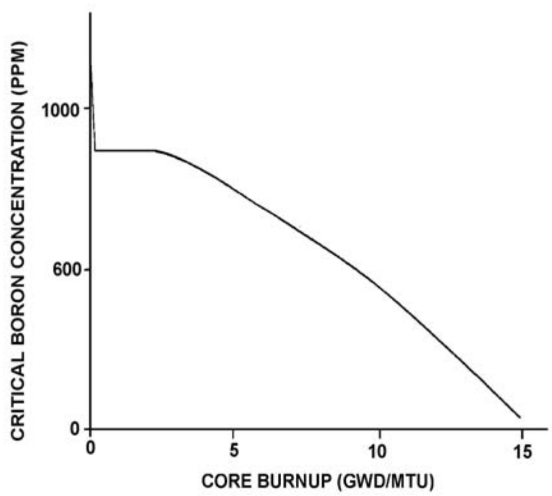
A. Fuel depletion

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 nuclear reactor core 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?

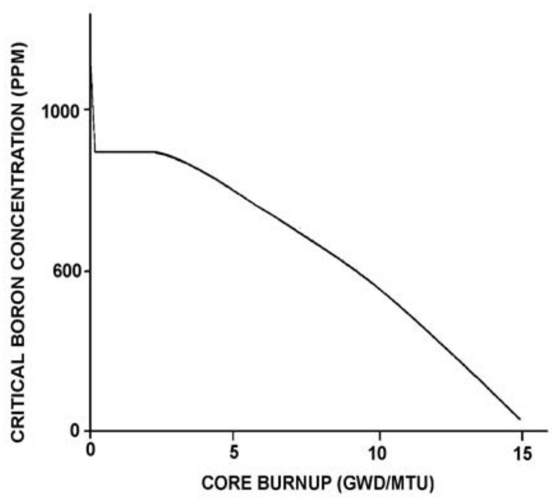
A. Buildup of fission product poisons is being offset by burnable poison burnout and fuel depletion.

B. Burnable poison burnout and fuel depletion are being offset by buildup of fission product poisons.

C. Fuel depletion is being offset by the buildup of fissionable plutonium and fission product poison buildup.

D. Fission product poison buildup and fuel depletion are being offset by burnable poison burnout.

ANSWER: D.



TOPIC: 192007
KNOWLEDGE K1.04 [3.1/3.4]
QID: P2763

During continuous full-power nuclear reactor 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 nuclear reactor has been operating at 100 percent power for three months following a refueling outage. If the reactor is operated at 100 percent power without making RCS boron additions or dilutions for the next month, 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 100 percent power reactor coolant boron concentration was 50 ppm. Immediately following the outage the 100 percent power boron concentration was 1,000 ppm.

Assume that burnable poisons were installed during the outage. Also assume that control rods were fully withdrawn from the core at 100 percent power for both cases.

Which one of the following contributes to the need for a much higher 100 percent power reactor coolant boron concentration at the beginning of a fuel cycle (BOC) compared with the end of a fuel cycle (EOC)?

A. The negative reactivity from burnable poisons is greater at BOC than at EOC.

B. The negative reactivity from fission product poisons is smaller at BOC than at EOC.

C. The positive reactivity from the fuel in the core is smaller at BOC than at EOC.

D. The positive reactivity from a unit withdrawal of a typical control rod is greater at BOC than at EOC.

ANSWER: B.

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 due to faster changes in boron concentration.

B. Faster near EOL due to greater control rod worth.

C. Faster near BOL due to faster changes in boron concentration.

D. Faster near BOL due to greater control rod worth.

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) and 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 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 control rod worth.

ANSWER: A.

TOPIC: 192007
KNOWLEDGE: K1.05 [3.0/3.2]
QID: P3364

Compared to adding boric acid to the RCS during forced circulation, adding boric acid during natural circulation requires _________ time to achieve complete mixing in the RCS; and, once completely mixed at a given coolant temperature, a 1 ppm increase in RCS boron concentration during natural circulation will cause a/an ________ change in core reactivity.

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 source range count rate to increase from 20 to 40 cps. The second reactivity addition caused the count rate to increase from 40 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 data given to determine the relationship of 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 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. Assume K_{eff} was 0.97 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 50 percent larger than the second.

B. The second reactivity addition was approximately 50 percent larger than the first.

C. The first and second reactivity additions were approximately equal.

D. There is not enough information given to determine the relationship of the reactivity values.

ANSWER: C.

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 the shutdown control rods.

B. Reactor coolant temperature is allowed to increase by 3°F.

C. Reactor coolant boron concentration is increased by 10 ppm.

D. An additional two hours is allowed to pass with no 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 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 the shutdown control rods.

B. Reactor coolant temperature is allowed to decrease by 3°F.

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

D. An additional 2 hours is allowed to pass with no 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 count rate doubled. If the same amount of reactivity that caused the first doubling is added again, 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 and the reactor is slightly subcritical in the source range. Assuming the reactor remains subcritical, a short control rod withdrawal will cause the reactor startup rate indication to increase sharply in the positive direction, and then...

A. rapidly decrease and stabilize at a negative 1/3 dpm.

B. gradually decrease and stabilize at zero.

C. stabilize until the point of adding heat (POAH) is reached; then decrease to zero.

D. continue increasing until the POAH is reached; then decrease to zero.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.03 [3.9/4.0]
QID: P1065 (B1565)

During a reactor startup, equal increments of positive reactivity are being sequentially added and the count rate is allowed to reach equilibrium after each addition. Which one of the following statements concerning the equilibrium count rate applies after 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 increases.

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 change in neutron 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 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 count rate will be the same.

C. The prompt jump in count rate will be the same, but the increase in count rate will be greater with K_{eff} at 0.99.

D. The prompt jump in count rate will be greater, and the increase in count rate will be greater with K_{eff} at 0.99.

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 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. Both the prompt jump in count rate and the increase in stable count rate will be the same.

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 rate will be the same.

D. The prompt jump in count rate 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 neutron population to stabilize. As the reactor approaches criticality, the numerical change in stable neutron population after each reactivity addition __________, and the time required for the neutron population to stabilize after each reactivity addition ___________.

A. increases; remains the same

B. increases; increases

C. remains the same; remains the same

D. remains the same; increases

ANSWER: B.

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 decades per minute (dpm). A short control rod insertion will cause the reactor startup rate indication to initially decrease (become negative), and then...

A. gradually become less negative and return to 0.0 dpm.

B. gradually become more negative until neutron population reaches the source range equilibrium level, and then return to 0.0 dpm.

C. stabilize until neutron population reaches the source range equilibrium level, 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: P4534

A nuclear 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

B. 0.66

C. 0.7

D. 0.76

ANSWER: D.

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 equilibrium source range neutron level from 220 cps to 440 cps.

Approximately how much additional positive reactivity is required to raise the equilibrium source range neutron level 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

During a reactor startup, control rods are withdrawn such that 1.05 %ΔK/K of reactivity is added. Before the rod withdrawal K_{eff} was 0.97 and count rate was 500 cps.

Which one of the following will be the approximate final steady-state count rate following the rod withdrawal?

A. 750 cps

B. 1000 cps

C. 2000 cps

D. 2250 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 count rate before the rod withdrawal was 500 cps, which one of the following will be the final count rate?

A. 707 cps

B. 1000 cps

C. 1500 cps

D. 2000 cps

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P1866 (B2266)

As a nuclear reactor approaches criticality during a reactor startup, it takes longer to reach an equilibrium neutron 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 neutrons being produced as criticality is approached.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P1867 (B2167)

During a reactor startup, the first reactivity addition caused the count rate to increase from 20 to 40 cps. The second reactivity addition caused the count rate to increase from 40 to 80 cps. Assume 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)

At one point during a reactor startup and approach to criticality, count rate is noted to be 780 cps, and K_{eff} is calculated to be 0.92. Later in the same startup, stable count rate is 4,160 cps.

What is the new 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: P2265 (B366)

During a reactor startup, source range indication is stable at 100 cps, and K_{eff} is 0.95. After a number of control rods have been withdrawn, source range indication stabilizes at 270 cps. Which one of the following is the new K_{eff}? (Assume reactor startup rate is zero before and after the rod withdrawal.)

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 current 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 current equilibrium source range count rate of 150 cps. Which one of the following equilibrium 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)

During a reactor startup, source range indication is stable at 120 cps with K_{eff} at 0.95. After a period of control rod withdrawal, source range indication stabilizes at 600 cps. Which one of the following is the approximate new 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: P4734

During a reactor startup, positive reactivity addition X caused the stable source range count rate to increase from 20 to 40 cps. Later in the startup, after several other additions of positive reactivity, positive reactivity addition Y caused the stable source range count rate to increase from 320 cps to 640 cps.

Which one of the following statements describes how the magnitudes of the two positive reactivity additions (X and Y) compare?

A. Reactivity addition X was several times greater in magnitude than reactivity addition Y.

B. Reactivity addition X was several times smaller in magnitude than reactivity addition Y.

C. Reactivity additions X and Y were about equal in magnitude.

D. There is not enough information given to determine the relationship between the reactivity additions.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04 [3.8/3.8]
QID: P6133 (B6134)

A subcritical nuclear reactor has an initial source range count rate of 2.0×10^5 cps with a core K_{eff} of 0.98. Positive reactivity is added to the core until a stable count rate of 5.0×10^5 cps is achieved. What is the new K_{eff}?

A. 0.984

B. 0.988

C. 0.992

D. 0.996

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.05 [3.8/3.9]
QID: P66

In a nuclear reactor with a source, a constant neutron flux over a few minutes is indicative of criticality or...

A. the point of adding heat.

B. supercriticality.

C. subcriticality.

D. equilibrium subcritical count rate.

ANSWER: D.

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 ____________ change in the equilibrium neutron count rate and a ____________ time to reach each new equilibrium 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 previous 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 the core 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).

The least conservative approach to criticality is represented by plot _____ and could possibly be the result of recording count rates at ________ time intervals after incremental fuel loading steps compared to the situations represented by the other plots.

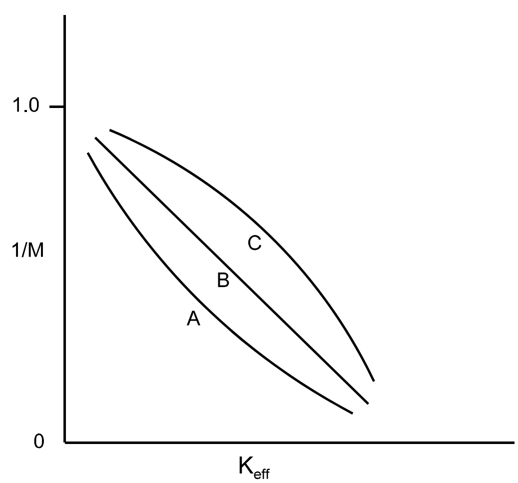
A. A; shorter

B. A; longer

C. C; shorter

D. C; longer

ANSWER: C.



1/M PLOT

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 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 no control rod motion is occurring and takes no further action. Assume that the steam generator water levels remain stable, the reactor does not trip, and no other 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). Assume that 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 ________.

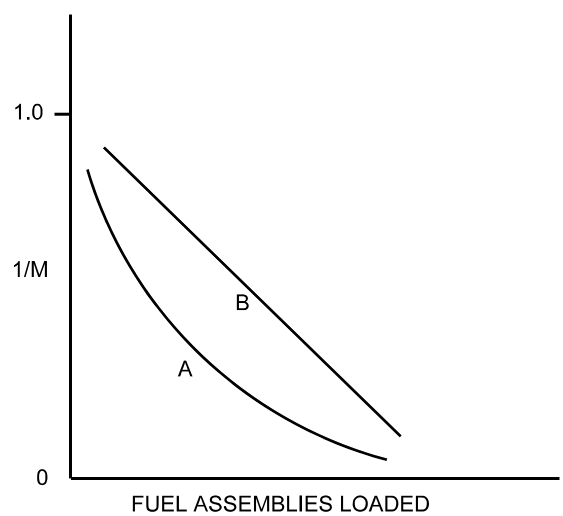
A. small; fuel enrichment

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 core 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 source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal ________.

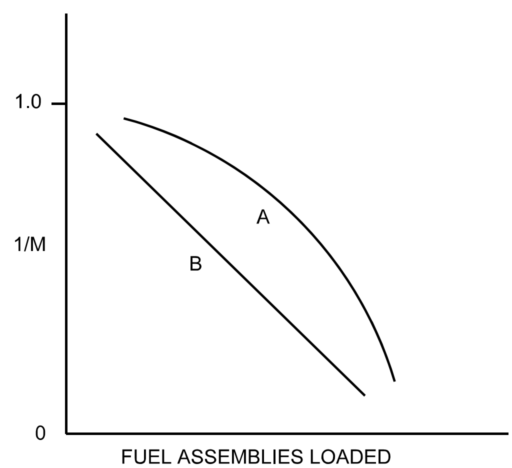
A. small; fuel enrichment

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 were obtained during a reactor startup:

Control Rod Units Withdrawn	Source Range Count Rate (cps)
0	20
10	25
15	28
20	33
25	40
30	50

Assuming a uniform differential control 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 were obtained at steady-state conditions during a reactor startup:

Control Rod 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 were obtained at steady-state conditions during a reactor startup:

Control Rod 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 should criticality occur?

A. Approximately 40 units withdrawn

B. Approximately 50 units withdrawn

C. Approximately 60 units withdrawn

D. Approximately 70 units withdrawn

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P1966 (B1767)

The following data were obtained at steady-state conditions during a reactor startup:

Control Rod 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

Near the end of core life, critical rod position has been calculated for a reactor startup 4 hours after a trip from 100 percent power equilibrium conditions. The actual critical rod position will be lower than the predicted 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: P268

To predict critical control rod position prior to commencing a reactor startup, the operator must consider the amount of reactivity added by post-shutdown changes in...

A. reactor coolant boron concentration, neutron flux level, and burnable poisons.

B. control rod positions, core xenon-135 concentration, and reactor coolant temperature.

C. neutron flux level, reactor coolant boron concentration, and control rod positions.

D. reactor coolant temperature, burnable poisons, and core xenon-135 concentration.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07 [3.5/3.6]
QID: P367

Which one of the following is <u>not</u> 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 reactivity in the core just prior to the trip

D. Samarium 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 correctly calculated for a reactor startup that is to be performed 6 hours after a trip from a 60 day full power run. Which one of the following events or conditions will result in the actual critical rod position being <u>lower</u> 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 lower than 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 a reactor startup to be performed 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 predicted critical rod position?

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 nuclear 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 at the end of core life. Which one of the following will result in reactor criticality at a rod height above 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 at the end of core life. Which one of the following conditions will result in criticality occurring at a higher than 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 a reactor startup to be performed 15 hours after a reactor trip that ended three months of operation at 100 percent power.

Which one of the following conditions will result in criticality occurring at a lower than estimated critical rod position?

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 end 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 control rod position that is higher 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: K1.09 [3.2/3.3]
QID: P68 (B123)

With K_{eff} = 0.985, how much reactivity must be added to make a nuclear reactor <u>exactly</u> critical?

A. 1.54 %ΔK/K

B. 1.52 %ΔK/K

C. 1.50 %ΔK/K

D. 1.48 %ΔK/K

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.09 [3.2/3.3]
QID: P469

A nuclear reactor is subcritical by 1.0 %ΔK/K when the operator dilutes the reactor coolant system by 30 ppm boron. Assuming boron worth is -0.025 %ΔK/K per ppm and that no other reactivity changes occur, the reactor is...

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 nuclear reactor is exactly 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

If, during a reactor startup, the startup rate is constant and positive without any further reactivity addition, then the reactor is...

A. exactly critical.

B. supercritical.

C. subcritical.

D. prompt critical.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P125

A nuclear reactor is initially critical at 10,000 cps 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 reactor coolant average 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; above

C. less; at

D. less; above

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/startup 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 (B2168)

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a positive 80-second period and stops control rod motion.

After an additional five minutes, reactor power will be __________ and reactor period will be __________. (Assume reactor power remains below the point of adding heat.)

A. constant; constant

B. constant; increasing

C. increasing; constant

D. increasing; increasing

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P2667

A nuclear reactor is critical at 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 decades per minute (dpm).

If control rods had been inserted (instead of withdrawn) for 5 seconds with the reactor initially critical at 10^{-6} percent power, the stable SUR would have been: (Assume equal absolute values of reactivity are added in both cases.)

A. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in smaller delayed neutron fractions.

B. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases are less limited by delayed neutrons.

C. slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in larger delayed neutron fractions.

D. slower 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 nuclear reactor core is exactly critical well below the point of adding heat during a nuclear power 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 is 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 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:

- Nuclear 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 x 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 x 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 nuclear reactor is currently operating in the source range with a stable period of 90 seconds. The core effective delayed neutron fraction ($\overline{\beta}_{eff}$) is 0.006. How much additional positive reactivity must be added to establish a stable period of 60 seconds?

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 nuclear 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)

Nuclear reactors A and B are identical except that reactor A has an effective delayed neutron fraction of 0.007 and reactor B has an effective delayed neutron fraction of 0.006. Both reactors are initially critical at 1.0 x 10^{-8} percent of rated thermal power when +0.1 %ΔK/K is simultaneously added to both reactors.

Five minutes following 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: K1.11 [3.8/3.8]
QID: P868

Which one of the following indicates that a nuclear 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 in which <u>each</u> listed indication supports 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 nuclear reactor has just achieved criticality at 10^{-8} percent reactor power during a reactor startup from xenon-free conditions. The operator establishes a 0.5 decade per minute 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 startup rate to continue increasing power. Within a few 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 stable 1 DPM startup rate to increase power to the point of adding heat (POAH). How much negative reactivity feedback must be added at the POAH to stop the power increase? (Assume that $\overline{\beta}_{eff}$ = 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 is defined as that power level where the nuclear reactor is producing enough heat...

A. for Doppler coefficient to produce a positive reactivity feedback.

B. for 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 48-second reactor period to increase reactor power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize power at the POAH? (Assume $\overline{\beta}_{eff}$ = 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 decade per minute (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 nuclear 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 no 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 stable 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 $\overline{\beta}_{eff}$ = 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 stable 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 that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff} = 0.006$.)

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) level. The critical data was taken again at the proper IR level with the same reactor coolant temperature and boron concentration.

The critical rod position taken at the proper IR level ________ the critical rod position taken two decades below the proper IR level.

A. cannot be compared to

B. is greater than

C. is the same as

D. is less than

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P669

During a xenon-free reactor startup, critical data were inadvertently taken one decade above the required intermediate range (IR) level. The critical data were taken again at the proper IR level with the same reactor coolant temperatures and boron concentration.

The critical rod position taken at the proper IR level is ________ the critical rod position taken one decade above the proper IR 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 nuclear 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 to the core 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 nuclear 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 10^{-5} percent per the startup procedure, the operator inadvertently stabilizes power at 10^{-4} percent.

Assuming reactor coolant system (RCS) temperature and RCS boron concentration do not change, the critical rod height at 10^{-4} percent power will be __________________ the critical rod height at 10^{-5} percent power. (Neglect any effects of source neutrons.)

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 nuclear reactor is exactly critical two decades below the point of adding heat when -0.01 %ΔK/K of reactivity is added to the core. If +0.01 %ΔK/K is then added to the core 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. the subcritical multiplication equilibrium level.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P1669

A nuclear reactor is critical at 10^{-5} percent power and critical data is being taken when a steam generator relief valve fails open. The reactor is at middle of core life and control rods are in manual.

Assuming no operator actions and no reactor trip, when the reactor stabilizes, average coolant temperature will be _____________ initial coolant temperature and final 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 nuclear reactor is critical at the point of adding heat (POAH) when a small amount of negative reactivity is added to the core. If the same amount of positive reactivity is added to the core 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 on a negative 80 second period until the shutdown equilibrium neutron level is reached.

D. continue to decrease with an unknown period until the shutdown equilibrium neutron level is reached.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P2568 (B2568)

A nuclear reactor is currently at 1.0 x 10^{-3} percent power with a positive 60 second reactor period. An amount of negative reactivity is added to the core that places the reactor on a negative 40 second reactor period.

If the same amount of positive reactivity is added to the core approximately 5 minutes later, reactor power will...

A. increase and stabilize at the point of adding heat.

B. increase and stabilize at 1.0 x 10^{-3} percent.

C. continue to decrease on a negative 40 second period until the equilibrium source neutron level is reached.

D. continue to decrease with an unknown period until the equilibrium source neutron level is reached.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14 [3.1/3.1]
QID: P3668

A nuclear reactor is slightly supercritical during a reactor startup. A short control rod withdrawal is performed to establish the desired 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 reactor 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 drawing that shows two graphs (see figure below). The axes on each graph have linear scales.

A nuclear reactor is initially critical in the source range. At time = 0 seconds, a constant rate addition of positive reactivity commences. Assume 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.)

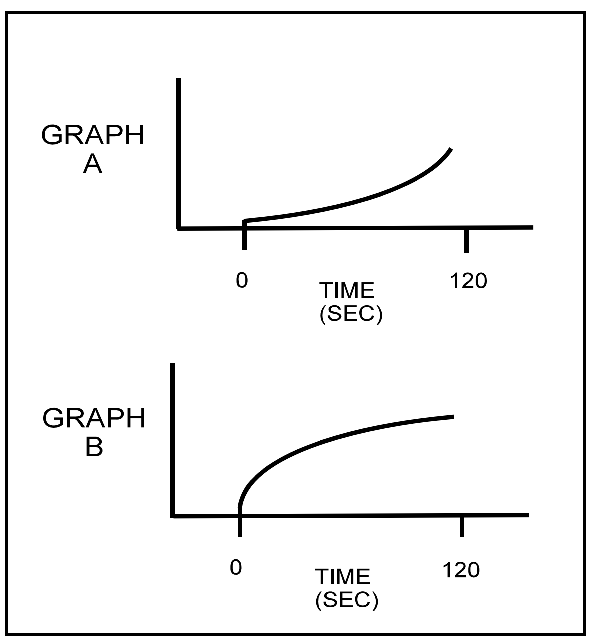
A. A; A

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, occurring at time = 0 seconds, would cause the reactor response shown on the graph?

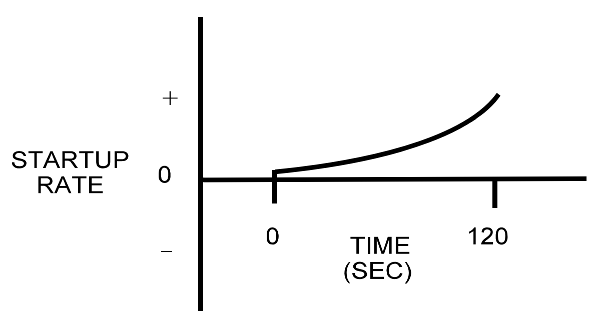
A. A step addition of positive reactivity to a reactor that is initially stable in the power range and remains in the power range for the duration of the 120-second interval shown.

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 in decades per minute (dpm)?

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, beginning at time = 0 seconds, would cause the reactor response shown on the graph?

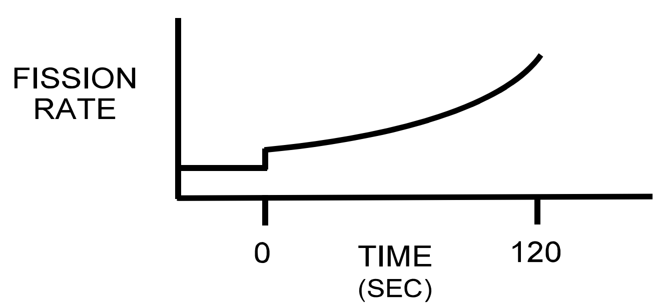
A. A step addition of positive reactivity to a reactor that is initially subcritical in the source range and remains subcritical for the duration of the 120-second interval shown.

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 nuclear 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?

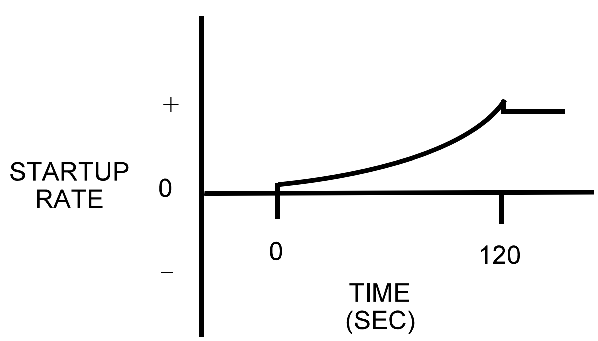
A. A step addition of positive reactivity to a reactor that is initially critical in the source range. Reactor power enters the power range at 120 seconds.

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 nuclear 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 first 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

Given a critical nuclear reactor operating below the point of adding heat (POAH), what reactivity effects are associated with reaching the POAH?

A. There are no reactivity effects because the reactor is critical.

B. The increase in fuel temperature will begin to create a positive reactivity effect.

C. The decrease in fuel temperature will begin to create a negative reactivity effect.

D. The 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 nuclear reactor is operating just above the point of adding heat. To raise reactor power to a higher stable power level, the operator must increase...

A. steam generator levels.

B. steam demand.

C. T_{ave}.

D. reactor coolant system boron concentration.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1070

A nuclear 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 nuclear reactor near the end of core life is at 5 x 10^{-2} percent power with a 0.3 DPM startup rate. With no operator action, what will be the approximate reactor power 10 minutes later? (Assume <u>no</u> protective system actuation.)

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 nuclear 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 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 nuclear reactor on a constant period, which one of the following power changes requires the longest time to occur?

A. 1.0×10^{-8}% to 4.0×10^{-8}%

B. 5.0×10^{-8}% to 1.5×10^{-7}%

C. 2.0×10^{-7}% to 3.5×10^{-7}%

D. 4.0×10^{-7}% to 6.0×10^{-7}%

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1567 (B1570)

With a nuclear reactor on a constant period of 30 minutes, which one of the following power changes requires the least amount of time to occur?

A. 1.0×10^{-8}% to 6.0×10^{-8}%

B. 1.0×10^{-7}% to 2.0×10^{-7}%

C. 2.0×10^{-7}% to 3.5×10^{-7}%

D. 4.0×10^{-7}% to 6.0×10^{-7}%

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P2069 (B2072)

With a nuclear reactor on a constant period of 180 seconds, which one of the following power changes requires the longest amount of time to occur?

A. 3.0×10^{-8}% to 5.0×10^{-8}%

B. 5.0×10^{-8}% to 1.5×10^{-7}%

C. 1.5×10^{-7}% to 3.0×10^{-7}%

D. 3.0×10^{-7}% to 6.0×10^{-7}%

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P2168

A nuclear reactor is stable at the point of adding heat (POAH) with the average reactor coolant temperature at 550°F during a startup. Control rods are then 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 nuclear reactor on a constant period of 180 seconds, which one of the following power changes requires the <u>least</u> amount of time to occur?

A. 3.0×10^{-8}% to 5.0×10^{-8}%

B. 5.0×10^{-8}% to 1.5×10^{-7}%

C. 1.5×10^{-7}% to 3.0×10^{-7}%

D. 3.0×10^{-7}% to 6.0×10^{-7}%

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 steady-state initial conditions:

Power level	= 100 percent
Coolant boron	= 620 ppm
Coolant temperature	= 587°F

After a load decrease, steady-state conditions were as follows:

Power level	= 80 percent
Coolant boron	= 650 ppm
Coolant temperature	= 577°F

Given the following, how much reactivity was added by control rod movement during the load decrease? (Disregard any fission product poison reactivity change.)

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 is operating with the following stable initial conditions:

Power level	= 100 percent
Coolant boron	= 630 ppm
Coolant temperature	= 582°F

After a load decrease, stable conditions are as follows:

Power level	= 80 percent
Coolant boron	= 640 ppm
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 is operating with the following initial conditions:

Power level	= 80 percent
Coolant boron	= 630 ppm
Coolant temperature	= 582°F

After a normal load decrease, conditions are as follows:

Power level	= 50 percent
Coolant boron	= 650 ppm
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 is operating with the following initial conditions:

Power level	= 100 percent
Coolant boron	= 620 ppm
Average coolant temperature	= 587°F

After a load decrease, conditions are as follows:

Power level	= 80 percent
Coolant boron	= 630 ppm
Average 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 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 in the core.

Assume reactor power and control rod position do <u>not</u> change. If <u>no</u> operator action is taken, how and why will reactor coolant average temperature change during the next week?

A. Decrease slowly due to fuel burnup only.

B. Decrease slowly due to fuel burnup <u>and</u> fission product poison buildup.

C. Increase slowly due to burnable poison burnout only.

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 in which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to mark the beginning of the sixth fuel cycle and reactor power is being increased to 100 percent.

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

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: 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 core life. 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 in 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 be providing the greatest contribution to core heat production when the reactor reaches 100 percent power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.20 [3.8/3.9]
QID: P271

A nuclear reactor is critical at 2×10^{-8} percent power. The operator withdraws rods as necessary to immediately establish and maintain a 0.10 Dpm startup rate. How long will it take for the reactor to reach 7×10^{-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 nuclear reactor is critical at 3 x 10^{-8} percent power. The operator withdraws rods as necessary to immediately establish and maintain a stable, positive 0.10 dpm startup rate. How long will it take for the reactor to reach 7 x 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 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 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: K1.21 [3.6/3.8]
QID: P272

A nuclear power plant has been operating at 75 percent power for several weeks. A partial steam line break occurs and 3 percent total steam flow is escaping. Assuming no operator or automatic actions, stable reactor power will __________ and stable reactor coolant temperature will __________.

A. increase; increase

B. not change; increase

C. increase; decrease

D. not change; decrease

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P368

A nuclear 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 no reactor trip, which one of the following describes the response of the reactor? (Assume a negative moderator temperature coefficient.)

A. T_{ave} will decrease. The reactor will go subcritical.

B. T_{ave} will remain the same. The reactor will go to 3 percent power.

C. T_{ave} will decrease. The reactor will go to 3 percent power.

D. T_{ave} will decrease. Power will not 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. A partial steam line break occurs and 2 percent total steam flow is escaping. Turbine load and control rod position remain the same.

Assuming no operator or automatic actions, 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 85 percent power and 580°F average reactor coolant temperature (T_{ave}) at the end of core life. 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 90 percent power near the end of core life with manual rod control when a turbine control system malfunction opens the turbine control 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 resonant 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 resonant 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 core life when the main turbine trips. If the reactor does not immediately trip, which one of the following will act first to change reactor power?

A. Positive reactivity addition from the Doppler coefficient will cause reactor power to initially increase.

B. Positive reactivity addition from the moderator temperature coefficient will cause reactor power to initially increase.

C. Negative reactivity addition from the Doppler coefficient will cause reactor power to initially decrease.

D. Negative reactivity addition from the moderator temperature coefficient will cause reactor power to initially decrease.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21 [3.6/3.8]
QID: P2771

A nuclear power plant is operating at 80 percent power and 580°F average reactor coolant temperature (T_{ave}) at the end of core life 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 60 percent power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction closes the turbine steam inlet valves an additional 5 percent. Which one of the following is mostly responsible for the initial reactor power decrease?

A. The rate of neutron absorption by core Xe-135 initially increases.

B. The rate of neutron absorption by the moderator initially increases.

C. The rate of neutron absorption at U-238 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 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 ___________; 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 60 percent power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction opens the 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

A nuclear power plant is initially operating at steady-state 100 percent reactor power with the main generator producing 1,100 MW. 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: P72

The major reason boron is used in a nuclear reactor is to permit...

A. a reduction in the shutdown margin.

B. an increase in the amount of control rods installed.

C. an increase in core life.

D. a reduction in the effect of resonance capture.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22 [2.6/3.8]
QID: P671

The use of boron as a burnable poison in a nuclear reactor core...

A. increases the amount of fuel required to produce the same amount of heat.

B. allows the plant to operate longer on a smaller amount of fuel.

C. allows more fuel to be loaded and prolongs core life.

D. absorbs neutrons that would otherwise be lost from the core.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22 [2.6/3.8]
QID: P1072

A high boron concentration is necessary at the beginning of core life to...

A. compensate for excess reactivity in the fuel.

B. ensure a negative moderator temperature coefficient exists.

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 core refueling, fuel assemblies with higher enrichments of U-235 were installed 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 with a higher concentration of boron in the reactor coolant?

A. Boron will precipitate out of the reactor coolant during a cooldown.

B. An RCS temperature decrease will result in a negative reactivity addition.

C. Power changes requiring dilution of RCS boron will take longer.

D. The differential boron worth will become positive.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P71 (B72)

Shortly after a reactor trip, reactor power indicates 5×10^{-2} percent when a stable negative startup rate is attained. Approximately how much additional time is required for reactor power to decrease to 5×10^{-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 is responsible for the negative 80-second stable reactor period experienced shortly after a reactor scram/trip?

A. The longest-lived fission product poisons

B. The shortest-lived fission product poisons

C. The longest-lived delayed neutron precursors

D. The shortest-lived delayed neutron precursors

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P1965 (B1369)

Shortly after a reactor trip, when reactor power indicates 10^{-3} percent, a stable negative period is attained. Reactor power will decrease to 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 stable post-trip reactor period is observed. Which one of the following is the approximate time 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 decay heat produced in a nuclear reactor at 1 second and at 1 hour, respectively, following a reactor trip from extended operation at 100 percent power?

	One Second	One Hour
A.	15.0%	1.0%
B.	7.0%	1.0%
C.	1.0%	0.1%
D.	0.5%	0.1%

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P2768 (B2769)

Nuclear reactors A and B are identical and have been 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 longest reactor period five minutes after the scram?

A. Reactor A due to the greater shutdown reactivity.

B. Reactor B due to the smaller shutdown reactivity.

C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, 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

Nuclear reactors A and B are identical and have been 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.

Which reactor, if any, will have the longer reactor period five minutes after the trip?

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 reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, 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)

Nuclear reactors A and B are identical and have been 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.

When compared to reactor B, after five minutes the core fission rate in reactor A will be _____________, and the reactor period in reactor A will be ______________.

A. the same; shorter

B. the same; the same

C. lower; shorter

D. lower; the same

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23 [2.9/3.1]
QID: P3468

A nuclear 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 on a period that is much ___________ than -80 seconds; the period will become approximately -80 seconds about ___________ minutes after the trip.

A. longer; 3

B. longer; 30

C. shorter; 3

D. shorter; 30

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.24 [3.5/3.6]
QID: P672 (B1969)

A nuclear reactor is exactly critical below the point of adding heat when a single control rod fully inserts into the core. Assuming no operator or automatic action, reactor power will slowly decrease to...

A. zero.

B. an equilibrium value equal to the source neutron strength.

C. an equilibrium value greater than the source neutron strength.

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 nuclear reactor is exactly critical just below the point of adding heat when a single 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

A nuclear reactor is initially 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: K1.25 [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 oscillations

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.25 [2.9/3.1]
QID: P2971

Which one of the following describes the process for inserting control rods during a normal reactor shutdown?

A. Control rods are inserted in reverse order one bank at a time to maintain acceptable power distribution.

B. Control rods are inserted in reverse order one bank at a time to maintain a rapid shutdown capability from the remainder of the control rods.

C. Control rods are inserted in reverse order in a bank overlapping sequence to maintain a relatively constant differential control rod worth.

D. Control rods are inserted in reverse order 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 rated thermal power, the fraction of rated thermal power being produced from the decay of fission products in the operating nuclear 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 full power, core heat production will continue for a period of time. The rate of core heat production will depend on the...

A. amount of fuel that has been depleted.

B. amount of time that has elapsed since K_{eff} decreased below 1.0.

C. amount of time required for the reactor pressure vessel to cool down.

D. rate at which the photoneutron source strength decays following shutdown.

ANSWER: B.

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 an RCS heatup began.

Given the following information, what was be the average RCS heatup rate during the 5 minutes immediately after all SGs became empty?

Reactor rated thermal power:	3,400 MWt
Decay heat:	1.0% rated thermal power
Reactor coolant pumps heat input to the RCS:	15 MWt
RCS total heat loss:	Negligible
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	475,000 lbm

A. 8 to 15°F/hour

B. 50 to 75°F/hour

C. 100 to 150°F/hour

D. 300 to 350°F/hour

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.

Given the following information, what was be the average RCS heatup rate during the 5 minutes immediately after all SGs became empty?

Reactor rated thermal power:	2,400 MWt
Decay heat:	1.0% rated thermal power
Reactor coolant pumps heat input to the RCS:	13 MWt
RCS total heat loss:	2.4 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	325,000 lbm

A. 8 to 15°F/hour

B. 25 to 50°F/hour

C. 80 to 150°F/hour

D. 300 to 400°F/hour

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P2872 (B2872)

A nuclear reactor has been shutdown for several weeks when a loss of all ac power results in a loss of forced decay heat removal flow.

Given the following information, what will be the average reactor coolant heatup rate during the 20 minutes immediately after decay heat removal flow is lost? Assume that only ambient losses are removing heat from the reactor coolant system (RCS), and that natural circulation provides adequate thermal mixing.

Reactor rated thermal power:	2,800 MWt
Decay heat rate:	0.2% rated thermal power
RCS ambient heat loss rate:	2.4 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	325,000 lbm

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 heat?

A. 1% to 2%

B. 3% to 5%

C. 6% to 8%

D. 9% to 11%

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P4336 (B4336)

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 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.