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

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

A. neutron absorption and the resulting fission.

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

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

D. neutron thermalization and subsequent neutron absorption.

ANSWER: C.

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

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

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

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

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

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

ANSWER: C.

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

Delayed neutrons are neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

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

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

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

ANSWER: C.

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

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

A. Prompt

B. Delayed

C. Fast

D. Thermal

ANSWER: B.

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

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

A. thermal

B. delayed

C. prompt

D. capture

ANSWER: B.

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

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

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

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

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

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

ANSWER: C.

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

Delayed neutrons are fission neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

B. are expelled as thermal neutrons.

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

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

ANSWER: C.

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

Delayed neutrons are fission 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 specific fission fragments.

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

ANSWER: C.

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

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

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

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

C. be expelled with a lower kinetic energy.

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

ANSWER: A.

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

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

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

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

C. be captured by a Xe-135 nucleus.

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

ANSWER: A.

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

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

A. cause fission of a U-238 nucleus.

B. travel to an adjacent fuel assembly.

C. be absorbed in a B-10 nucleus.

D. leak out of the core.

ANSWER: C.

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

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

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: A.

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

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

A. be captured by a Xe-135 nucleus.

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

C. leak out of the core while slowing down.

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

ANSWER: C.

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

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

A. leak out of the core.

B. cause fission of a U-238 nucleus.

C. become a thermal neutron.

D. cause fission of a Pu-240 nucleus.

ANSWER: C.

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

Which one of the following types of neutrons in a 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: 292001
KNOWLEDGE: K1.02 [3.0/3.1]
QID: B3145 (P2845)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, 1.0×10^3 delayed neutrons were emitted.

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

A. 1.5×10^5

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^8

ANSWER: A.

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

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

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

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

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: B.

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

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, 4.25 x 10^5 delayed neutrons were emitted.

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

A. 1.5 x 10^6

B. 6.5 x 10^6

C. 1.5 x 10^7

D. 6.5 x 10^7

ANSWER: D.

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

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

A. slow

B. intermediate

C. resonance

D. thermal

ANSWER: D.

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

A neutron is "thermal" when...

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

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

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

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

ANSWER: B.

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

Which one of the following ranges contains the energy level of thermal neutrons in a nuclear reactor operating at full power?

A. less than 0.1 eV

B. 1 to 10 eV

C. 100 to 1,000 eV

D. greater than 1 MeV

ANSWER: A.

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

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

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

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

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

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

ANSWER: A.

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

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

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

B. is a product of a thermal fission reaction.

C. was released by the decay of fission fragments.

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

ANSWER: D.

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

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

A. above; decreases

B. above; increases

C. below; decreases

D. below; increases

ANSWER: D.

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

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

A. hydrogen atom in a water molecule.

B. oxygen atom in a water molecule.

C. helium atom in the fuel pin fill gas.

D. zirconium atom in the fuel clad.

ANSWER: A.

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

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

A. Increasing moderator temperature

B. Reducing feedwater inlet temperature

C. Reducing reactor vessel pressure

D. Reducing reactor recirculation system flow rate

ANSWER: B.

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

Neutron moderation describes...

A. a decrease in the core neutron population from thermal neutron absorption.

B. an increase in the neutron multiplication factor due to a reduction in neutron poisons.

C. the loss of fission neutrons from the core by leakage.

D. the reduction of neutron energy due to scattering reactions.

ANSWER: D.

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

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

A. slow

B. fast

C. epithermal

D. thermal

ANSWER: C.

TOPIC: 292001
KNOWLEDGE: K1.04 [3.2/3.2]
QID: B1245

Which one of the following will increase the average distance traveled by a fission neutron to become thermal in an operating nuclear reactor? (Assume the neutron continues to migrate inside the reactor until it becomes a thermal neutron.)

A. Moderator temperature decreases

B. Average neutron energy decreases

C. Reactor coolant system pressure increases

D. Reactor coolant void percentage increases

ANSWER: D.

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

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

A. Decreasing moderator temperature.

B. Decreasing feedwater inlet temperature.

C. Decreasing reactor vessel pressure.

D. Increasing reactor recirculation system flow rate.

ANSWER: C.

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

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

A. an oxygen nucleus.

B. a hydrogen nucleus.

C. a deuterium nucleus.

D. an electron surrounding a nucleus.

ANSWER: B.

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

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

A. dense; large

B. not dense; large

C. dense; small

D. not dense; small

ANSWER: C.

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

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

A. large; small

B. large; large

C. small; small

D. small; large

ANSWER: D.

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

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

A. small; low

B. small; high

C. large; low

D. large; high

ANSWER: D.

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

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

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

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

A. core dimensions.

B. core burnup.

C. moderator-to-fuel ratio.

D. installed neutron sources.

ANSWER: D.

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

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

A. Fuel enrichment

B. Control rod worth

C. Neutron contribution from neutron sources

D. Shutdown margin when the reactor is subcritical

ANSWER: C.

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

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

A. beginning; next

B. beginning; previous

C. end; next

D. end; previous

ANSWER: D.

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

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

A. first

B. second

C. third

D. fourth

ANSWER: B.

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

A thermal neutron is about to interact with a U-238 nucleus in an operating 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 U-238 will undergo fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and U-238 will undergo fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and U-238 will undergo radioactive decay to Pu-239, thereby increasing K_{eff}.

ANSWER: A.

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

A nuclear power plant is currently operating at equilibrium 80% power near the end of its fuel cycle. During the next 3 days of equilibrium power operation <u>no</u> 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: 292002
KNOWLEDGE: K1.09 [2.4/2.6]
QID: B1147

Which one of the following combinations of core conditions at 30% power indicates the <u>largest</u> amount of excess reactivity exists in the core?

	CONTROL ROD <u>POSITION</u>	REACTOR RECIR- <u>CULATION FLOW</u>
A.	25% rod density	25%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	25%

ANSWER: D.

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

Which one of the following combinations of core conditions at 35% power indicates the <u>least</u> amount of excess reactivity exists in the core?

	CONTROL <u>ROD POSITION</u>	REACTOR RECIR- <u>CULATION FLOW</u>
A.	50% inserted	50%
B.	50% inserted	25%
C.	25% inserted	50%
D.	25% inserted	25%

ANSWER: C.

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

Which one of the following defines K-excess?

A. $K_{eff} - 1$

B. $K_{eff} + 1$

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: C.

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

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

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

	CONTROL ROD POSITION	REACTOR RECIRCULATION FLOW
A.	25% rod density	75%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	75%

ANSWER: B.

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

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

	CONTROL ROD POSITION	REACTOR RECIRCULATION FLOW
A.	25% rod density	75%
B.	50% rod density	50%
C.	25% rod density	50%
D.	50% rod density	75%

ANSWER: A.

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

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

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

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

ANSWER: B.

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

When determining the shutdown margin for an operating nuclear reactor, how many control rod assemblies 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: 292002
KNOWLEDGE: K1.10 [3.2/3.5]
QID: B1348

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

A. withdrawn, assuming an average worth rod remains fully inserted.

B. inserted, assuming an average worth rod remains fully withdrawn.

C. withdrawn, assuming the highest worth rod remains fully inserted.

D. inserted, assuming the highest worth rod remains fully withdrawn.

ANSWER: D.

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

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

A. beta.

B. lambda.

C. reactivity.

D. K-effective.

ANSWER: C.

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

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

A. 0.099 ΔK/K

B. 0.124 ΔK/K

C. 0.176 ΔK/K

D. 0.229 ΔK/K

ANSWER: B.

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

With K_{eff} equal to 0.983, how much positive reactivity must be added to make the reactor 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: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B1548 (P446)

With core K_{eff} equal to 0.987, how much reactivity must be added to make a reactor exactly 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: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B1947 (P2447)

With K_{eff} = 0.985, how much positive reactivity is required to make the 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: 292002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: B2848 (P2146)

With K_{eff} = 0.982, how much positive reactivity is required to make the 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: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B548

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

A. equal to

B. less than

C. greater than

D. independent of

ANSWER: A.

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

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

A. Fuel depletion during reactor operation

B. Buildup of Sm-149 after a reactor scram

C. Increasing moderator temperature 10°F while shutdown

D. Depletion of gadolinium during reactor operation

ANSWER: D.

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

One hour ago, a nuclear reactor scrammed from 100% steady state power due to an instrument malfunction. All systems operated normally. Given the following absolute values of reactivities added since the scram, assign a (+) or (-) as appropriate and choose the current value of core reactivity.

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

A. -8.0% ΔK/K

B. -10.0% ΔK/K

C. -14.0% ΔK/K

D. -20.0% ΔK/K

ANSWER: B.

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

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

A. Decay of Samarium-149

B. Increased core recirculation flow rate

C. Reactor coolant heatup

D. Control rod withdrawal

ANSWER: C.

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

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

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

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

A. -6.5% ΔK/K

B. -9.5% ΔK/K

C. -11.5% ΔK/K

D. -13.5% ΔK/K

ANSWER: B.

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

Twelve hours ago, a nuclear reactor scrammed from 100% steady state power due to an instrument malfunction. All systems operated normally. Given the following absolute values of reactivities added since the scram, assign a (+) or (-) as appropriate and choose the current value of core reactivity.

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

A. -5.0% ΔK/K

B. -9.0% ΔK/K

C. -14.0% ΔK/K

D. -23.0% ΔK/K

ANSWER: B.

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

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

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

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

A. -8.0% ΔK/K

B. -10.0% ΔK/K

C. -14.0% ΔK/K

D. -20.0% ΔK/K

ANSWER: A.

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

Sixteen hours ago, a nuclear reactor scrammed from 100% steady state power due to an instrument malfunction. All systems operated normally. Given the following absolute values of reactivities added since the scram, assign a (+) or (-) as appropriate and choose the current value of core reactivity.

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

A. -5.0% ΔK/K

B. -7.0% ΔK/K

C. -9.0% ΔK/K

D. -11.0% ΔK/K

ANSWER: B.

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

Which one of the following core changes will decrease shutdown margin in a nuclear reactor core? 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: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B2448

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

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

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

A. -6.5% ΔK/K

B. -9.5% ΔK/K

C. -11.5% ΔK/K

D. -13.5% ΔK/K

ANSWER: A.

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

A nuclear reactor is initially operating at steady-state 60% 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 ___________; compared to the initial 60% 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: 292002
KNOWLEDGE: K1.14 [2.6/2.9]
QID: B3748 (P3747)

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

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% thermal power.

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

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

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

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

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

ANSWER: C.

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

A nuclear reactor was initially operating at steady state 100% power when it was shut down and cooled down to 200 °F over a three-day period.

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

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

A. -3.0% ΔK/K

B. -4.0% ΔK/K

C. -8.0% ΔK/K

D. -9.0% ΔK/K

ANSWER: B.

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

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

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

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

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: A.

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

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

A. The neutron level change for successive rod increment pulls becomes smaller.

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

C. A rod withdrawal will result in the reactor becoming slightly supercritical due to a "prompt jump" and then return to a subcritical level.

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

ANSWER: B.

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

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

A. Neutron source, moderator, and fissionable material

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

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: A.

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

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

During the next 30 minutes count rate will...

A. remain essentially constant.

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

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

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

ANSWER: A.

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

Which one of the following describes the purpose of a neutron source that is installed in a 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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1170 (P1848)

A nuclear power plant that has been operating at rated power for two months experiences a reactor scram. Two months after the reactor scram, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source range nuclear instruments.

The majority of the source range 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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1449 (P1348)

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

What is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

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

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 scram from steady-state 100% power?

A. Spontaneous fission reactions

B. Photo-neutron reactions

C. Alpha-neutron reactions

D. Transuranic isotope decay

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1849 (P1448)

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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1949 (P448)

A subcritical nuclear reactor has an initial source range count rate of 150 cps with a shutdown reactivity of -2.0% ΔK/K. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5% ΔK/K

B. 1.0% ΔK/K

C. 1.5% ΔK/K

D. 2.0% ΔK/K

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2149 (P848)

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

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation for a significant time period following a reactor shutdown without installed neutron sources. This is because a sufficient number of source neutrons is being produced by intrinsic sources, with the largest contributor during the first few days after shutdown being...

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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2249 (P2248)

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 Keff 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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2449

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 80 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	4,000
B.	5,000	1,600
C.	2,000	1,600
D.	2,000	400

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2649 (P2448)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995 and count rate stabilizes at 1000 cps. No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A. Less than 1000 cps and decreasing toward the prestartup count rate.

B. Less than 1000 cps and stable above the prestartup count rate.

C. Greater than 1000 cps and increasing toward criticality.

D. 1000 cps and constant.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2949

A nuclear power plant is being cooled down from 400°F to 250°F. Just prior to commencing the cooldown, readings for all source range nuclear instruments were 32 counts per second (cps). After two hours, with reactor coolant temperature at 300°F, source range count rate is 64 cps.

Assuming that the moderator temperature coefficient remains constant throughout the cooldown, what will be the status of the reactor when reactor coolant temperature reaches 250°F?

A. Subcritical, with source range count rate below 150 cps

B. Subcritical, with source range count rate above 150 cps

C. Critical, with source range count rate below 150 cps

D. Critical, with source range count rate above 150 cps

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B3049 (P3048)

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: 292003
KNOWLEDGE: K1.01 [2.9/30]
QID: B3849 (P3848)

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%

B. 20%

C. 80%

D. 100%

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B3925 (P3925)

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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B4225 (P4225)

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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B4525 (P4525)

A nuclear power plant is being cooled down from 500°F to 190°F. Just prior to commencing the cooldown, the 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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B5225 (P5225)

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: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B5625

1. A reactor startup is in progress at a BWR nuclear power plant. The following stable conditions currently exist:

Reactor coolant temperature:	180°F
Control rod density:	50%
Source range count rate:	32 cps

Control rods are withdrawn to a control rod density of 45%, where the source range count rate stabilizes at 48 cps.

Assume that the control rod differential reactivity worth remains constant during the withdrawal. Also assume that reactor coolant temperature remains constant, and no reactor protection actuations occur.

If control rods are withdrawn further to a control rod density of 40%, 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: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B48

Which one of the following is the definition for delayed neutron fraction?

A. Fraction of the total number of delayed neutrons produced from fission, born from delayed neutron precursors

B. Fraction of the total number of fast neutrons produced from fission, born from delayed neutron precursors

C. Fraction of the total number of neutrons produced from fission, born from delayed neutron precursors

D. Fraction of the total number of thermal neutrons produced from fission, born from delayed neutron precursors

ANSWER: C.

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

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

A. Increases due to the burnup of U-238

B. Decreases due to the buildup of Pu-239

C. Increases due to the buildup of Pu-239

D. Decreases due to the burnup of U-238

ANSWER: B.

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

At the end of core life, the majority of power is generated by fission of which of the following two isotopes?

A. U-235 and U-238

B. Pu-241 and U-238

C. Pu-239 and U-238

D. Pu-239 and U-235

ANSWER: D.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: C.

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

A nuclear reactor is operating at 100% power at 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-238 and Pu-239.

C. U-235 and Pu-239.

D. U-238 and Pu-241.

ANSWER: C.

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

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

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

A. less; more

B. less; less

C. more; more

D. more; less

ANSWER: B.

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

Which one of the following distributions of fission percentages 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: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2349 (P2348)

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

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

ANSWER: D.

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

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

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

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: A.

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

A typical nuclear power plant is operating at equilibrium 50% 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 shortest reactor period? (Assume the reactivity worth of the ejected control rod is the same for each case.)

	Percentage of Fissions by Fuel		
	U-235	U-238	Pu-239
A.	90%	8%	2%
B.	80%	9%	11%
C.	70%	9%	21%
D.	60%	8%	32%

ANSWER: D.

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

The following data is given for the fuel in an operating 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: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B5425 (P5425)

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: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B249

During a nuclear reactor startup, the intermediate range monitor readings go from 30% to 65% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 357 seconds

B. 173 seconds

C. 155 seconds

D. 120 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B851

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

A. negative 80 seconds.

B. positive 80 seconds.

C. negative 130 seconds.

D. positive 130 seconds.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B2751 (P2748)

A nuclear reactor is exactly critical at 10^{-8}% 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 reactor period of 26 seconds?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B3151 (P3148)

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

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

A. Reactor A stable period will be shorter because it will have the higher positive reactivity in the core.

B. Reactor B stable period will be shorter because it has the smaller effective delayed neutron fraction.

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

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

ANSWER: A.

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

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

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

B. experience a rapid but controllable power increase.

C. begin an uncontrollable rapid power increase.

D. not be able to attain criticality.

ANSWER: C.

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

A small amount of positive reactivity is added to a critical reactor in the source/startup 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?

A. Moderator temperature coefficient

B. Fuel temperature coefficient

C. Prompt neutron lifetime

D. Effective decay constant

ANSWER: D.

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

Two nuclear reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% 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; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

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

Two nuclear reactors are identical except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the scram 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 -0.9700 $\Delta K/K$ 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1649 (P1649)

Two nuclear reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the scram and no operator action is taken, a power level of 10^{-5}% 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1751 (P1749)

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

A. Delayed neutrons make up a large fraction of the fission neutrons 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1950 (P48)

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

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 reactivity addition to a shutdown reactor at EOL yields a larger change in shutdown margin (SDM) than at BOL.

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

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

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

ANSWER: D.

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

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 lifetime of each neutron generation.

ANSWER: D.

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

Two nuclear reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is at the end of core life. Both reactors are critical at 10^{-5}% 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3249 (P3248)

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% power when a reactor scram occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the scram and no operator action is taken.

Ten minutes after the scram, 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3650 (P3648)

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

Ten minutes after the scram, 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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3749 (P3748)

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: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3851

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 0.007. The operator adds positive reactivity to establish a stable positive 60-second reactor period.

If the reactor had been at the end of core life with a core effective delayed neutron fraction of 0.005, what would be the approximate stable reactor period after the addition of the same amount of positive reactivity?

A. 28 seconds

B. 32 seconds

C. 36 seconds

D. 40 seconds

ANSWER: D.

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

Which characteristic of delayed neutrons is primarily responsible for enhancing the stability of a 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: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B251

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

A. increase; decreases

B. decrease; increases

C. decrease; decreases

D. increase; increases

ANSWER: C.

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

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

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

How much positive reactivity must be added to take this reactor "prompt critical"?

A. 0.03% ΔK/K

B. 0.05% ΔK/K

C. 0.7% ΔK/K

D. 0.993% ΔK/K

ANSWER: C.

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

A critical reactor will become prompt critical if the reactivity added is equal to the effective...

A. delayed neutron decay constant.

B. delayed neutron fraction.

C. prompt neutron decay constant.

D. prompt neutron fraction.

ANSWER: B.

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

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

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

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

A. 0.0042 $\Delta K/K$

B. 0.0058 $\Delta K/K$

C. 0.0753 $\Delta K/K$

D. 0.9942 $\Delta K/K$

ANSWER: B.

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

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

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

Upon stopping rod withdrawal, reactor period will immediately...

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

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

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

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

ANSWER: B.

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

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

When rod motion is stopped, reactor period will immediately _________ until power approaches the equilibrium subcritical multiplication source range level and then approach ________.

A. stabilize at negative 100 seconds; infinity.

B. stabilize at negative 100 seconds; zero.

C. lengthen and then stabilize; infinity.

D. lengthen and then stabilize; zero.

ANSWER: C.

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

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

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

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

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

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

A. 0.0061 ΔK/K

B. 0.0185 ΔK/K

C. 0.0227 ΔK/K

D. 0.9939 ΔK/K

ANSWER: A.

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

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

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

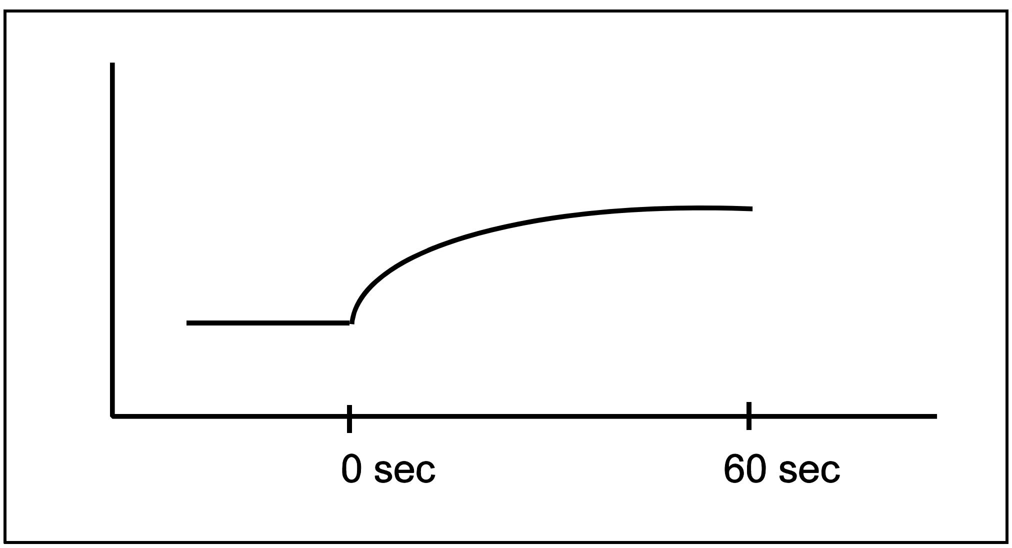
A. reactor period; subcritical

B. reactor period; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.



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

Which one of the following describes a condition in which a 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: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3450 (P3449)

Two nuclear reactors 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 reactor period observed for reactor B (EOL) will be ___________ than reactor A (BOL).

A. smaller; longer

B. smaller; shorter

C. larger; longer

D. larger; shorter

ANSWER: D.

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

Refer to the unlabeled nuclear reactor response curve shown below for a reactor that was initially subcritical in the source range. A small amount of positive reactivity was added at time = 0 sec.

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

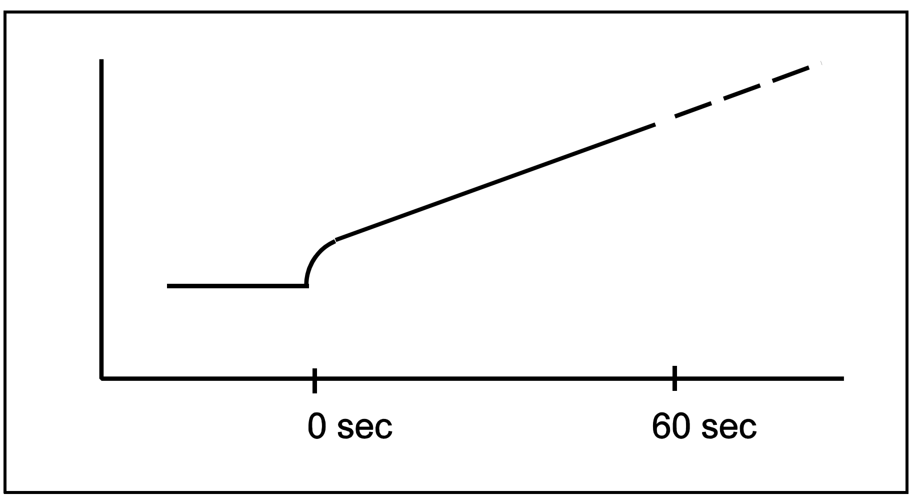
A. reactor period; exactly critical

B. reactor period; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.



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

A nuclear reactor is operating at equilibrium 75% 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: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B49

After initial criticality, the reactor period is stabilized. The source range channels are repositioned so that the count rate is 100 cps. Sufficient positive reactivity is added to establish a 120-second period. How much time will it take for the count rate to increase to 10,000 cps with no additional operator action?

A. 1.2 minutes

B. 4 minutes

C. 9.21 minutes

D. 15.82 minutes

ANSWER: C.

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

A nuclear reactor is operating at a power level of 120 watts. A control rod is inserted, which results in a stable negative 80-second period. Which one of the following is closest to the reactor power level 2 minutes after rod insertion? (Assume the period stabilized immediately after rod insertion.)

A. 27 watts

B. 32 watts

C. 49 watts

D. 54 watts

ANSWER: A.

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

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

A. 3 seconds

B. 24 seconds

C. 28 seconds

D. 35 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
K1.05 [3.7/3.7]
QID: B1651 (P2648)

During a nuclear reactor startup, the intermediate range monitor readings increase from 30% to 50% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 357 seconds

B. 235 seconds

C. 155 seconds

D. 61 seconds

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B2351 (P2349)

During a nuclear reactor startup, the intermediate range monitor readings increase from 20% to 40% on the same range 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: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3051 (P3050)

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 rod motion has been stopped.
No automatic system or operator actions occur to inhibit the power increase.
Power coefficient = -0.04 %ΔK/K / % power
Effective delayed neutron fraction = 0.006

What is the approximate power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A. 3.0%

B. 5.0%

C. 6.7%

D. 7.5%

ANSWER: D.

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

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

With the stable positive reactor period, the following is observed:

Time	Power Level
0 sec	$3.16 \times 10^{-7}\%$
90 sec	$1.0 \times 10^{-5}\%$

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

A. $3.16 \times 10^{-5}\%$

B. $5.0 \times 10^{-5}\%$

C. $6.32 \times 10^{-5}\%$

D. $1.0 \times 10^{-4}\%$

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B4325 (P4327)

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 rod motion has been stopped.
No automatic system or operator actions occur to inhibit the power increase.
Power coefficient = -0.04 %ΔK/K / % power
Effective delayed neutron fraction = 0.006

What is the approximate reactor power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A. 3.3%

B. 5.0%

C. 6.7%

D. 7.5%

ANSWER: B.

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

During a reactor startup, source range count rate is observed to double every 30 seconds. Which one of the following is the approximate reactor period?

A. 80 seconds

B. 67 seconds

C. 56 seconds

D. 43 seconds

ANSWER: D.

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

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

Given the following:

Initial reactor coolant temperature is 150°F.
Moderator temperature coefficient is -0.5 x 10^{-4} ΔK/K/°F.
Core effective delayed neutron fraction is 0.006.

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

A. 151 °F

B. 158 °F

C. 200 °F

D. 230 °F

ANSWER: B.

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

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

A. 341 seconds

B. 483 seconds

C. 697 seconds

D. 965 seconds

ANSWER: C.

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

Reactor power is increased at a constant rate from 50 kW to 370 kW in 2 minutes. What is the approximate doubling time?

A. 42 seconds

B. 60 seconds

C. 86 seconds

D. 120 seconds

ANSWER: A.

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

During a startup, a nuclear reactor is critical at 3000 cps. A control rod is notched out, resulting in a doubling time of 115.2 seconds. Which one of the following is the approximate reactor period?

A. 56 seconds

B. 80 seconds

C. 126 seconds

D. 166 seconds

ANSWER: D.

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

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

A. 90 seconds

B. 125 seconds

C. 180 seconds

D. 260 seconds

ANSWER: B.

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

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

A. reactivity; moderator temperature

B. K_{eff}; moderator temperature

C. moderator temperature; reactivity

D. moderator temperature; K_{eff}

ANSWER: A.

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

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

A. Increase in fuel burnup.

B. Decrease in fuel temperature.

C. Increase in void fraction.

D. Decrease in moderator temperature.

ANSWER: D.

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

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

A. less negative at all coolant temperatures.

B. more negative at all coolant temperatures.

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

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

ANSWER: B.

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

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

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

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

C. more negative at all coolant temperatures.

D. less negative at all coolant temperatures.

ANSWER: D.

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

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

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

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

C. Recirculation flow increases by 10%.

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: A.

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

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

A. more; decreases

B. less; decreases

C. more; increases

D. less; increases

ANSWER: D.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

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

ANSWER: B.

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

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

A. Low coolant temperature at beginning-of-life

B. Low coolant temperature at end-of-life

C. High coolant temperature at beginning-of-life

D. High coolant temperature at end-of-life

ANSWER: B.

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

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

A. a decrease in the thermal utilization factor.

B. an increase in the thermal utilization factor.

C. a decrease in the resonance escape probability.

D. an increase in the resonance escape probability.

ANSWER: D.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: A.

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

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

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

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

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

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

ANSWER: D.

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

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

A. The initially negative MTC becomes more negative.

B. The initially negative MTC becomes less negative.

C. The initially positive MTC becomes more positive.

D. The initially positive MTC becomes less positive.

ANSWER: B.

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

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

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

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

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

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

ANSWER: A.

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

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

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

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

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

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

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

ANSWER: B.

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

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

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

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

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

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

ANSWER: A.

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

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

A. decrease; increase

B. decrease; decrease

C. increase; increase

D. increase; decrease

ANSWER: A.

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

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

A. Uranium-235

B. Uranium-238

C. Samarium-149

D. Xenon-135

ANSWER: B.

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

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

A. Pu-239 and U-235

B. Pu-239 and Pu-240

C. U-238 and Pu-240

D. U-238 and Pu-239

ANSWER: C.

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

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

A. Increase in Pu-240 inventory in the core

B. Increase in moderator temperature

C. Increase in fuel temperature

D. Increase in void fraction

ANSWER: C.

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

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

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

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

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

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

ANSWER: B.

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

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

A. U-238

B. U-233

C. Pu-240

D. Pu-239

ANSWER: A.

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

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

A. U-235

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

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

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

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

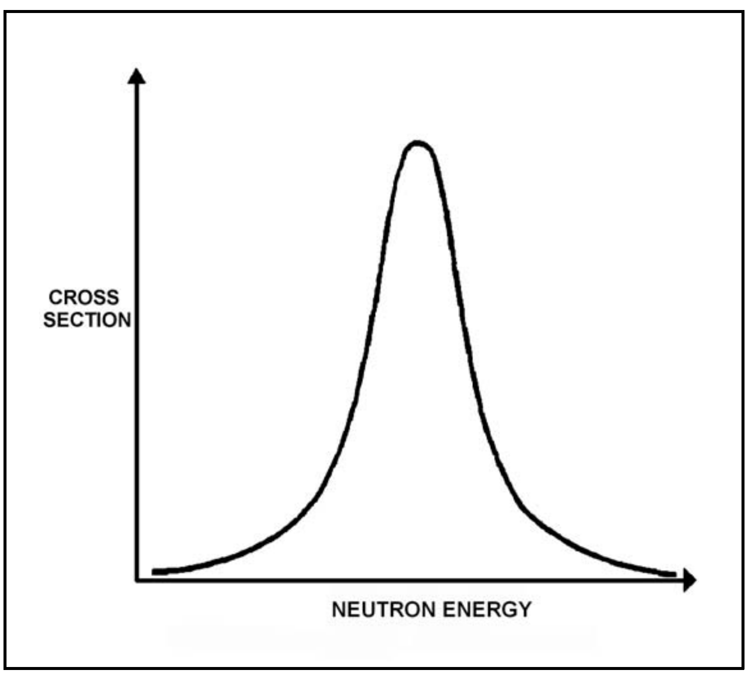
A. taller and more narrow; decrease

B. taller and more narrow; increase

C. shorter and broader; decrease

D. shorter and broader; increase

ANSWER: A.



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

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

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

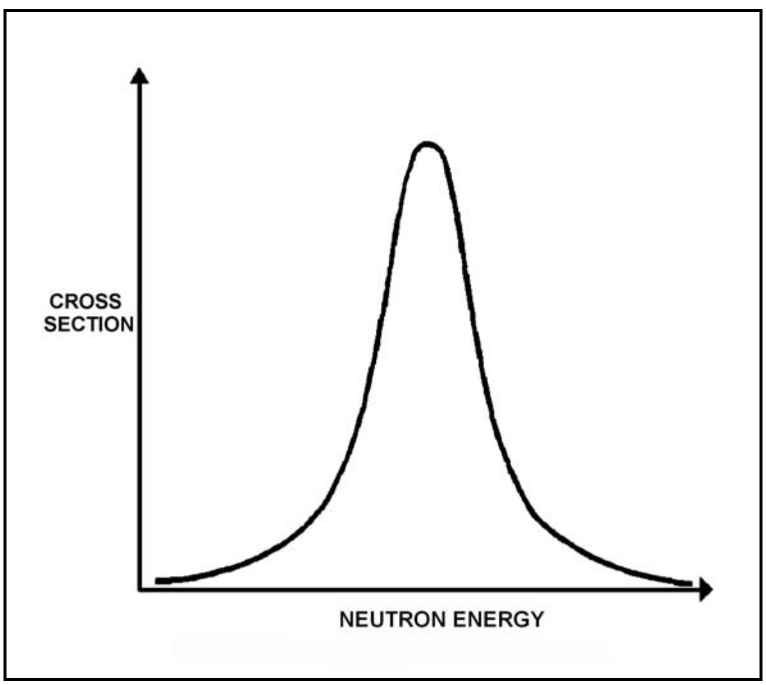
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: B.



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

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

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: B.

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

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

A. U-235 and Pu-239

B. U-235 and Pu-240

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

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

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

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

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

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

D. It remains essentially constant.

ANSWER: A.

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

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

A. less; depletion of U-238

B. more; burnout of gadolinium

C. less; buildup of fission products

D. more; buildup of Pu-240

ANSWER: D.

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

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

A. less; buildup of fission product poisons

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

C. less; higher fuel temperature

D. more; increased neutron flux

ANSWER: C.

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

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

A. U-235 and Pu-239

B. U-235 and U-238

C. U-238 and Pu-239

D. U-238 and Pu-240

ANSWER: D.

TOPIC: 292004
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2453 (P2352)

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

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

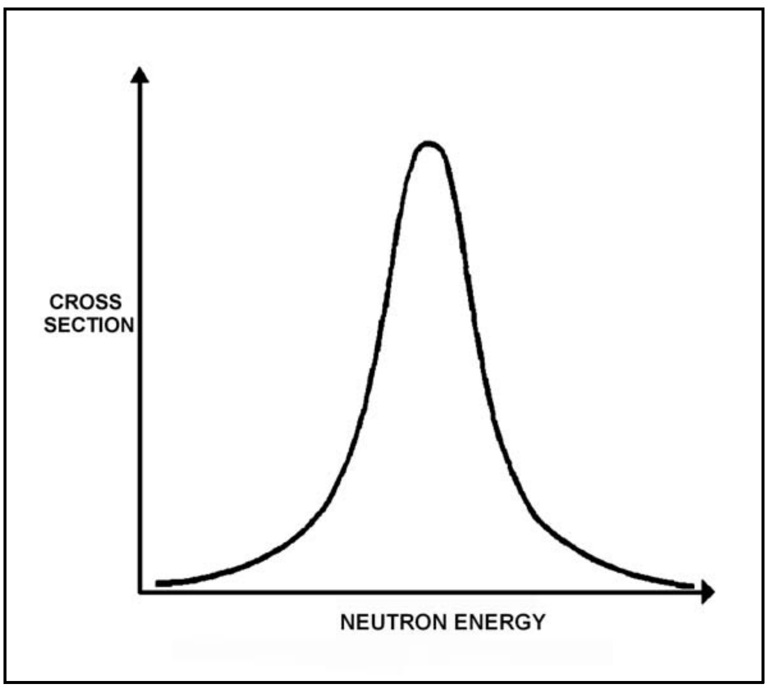
A. increase; neutrons of a wider range of energies will be absorbed by U-238

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

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

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

ANSWER: C.



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

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

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

B. end; more fission products are in the core

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

D. beginning; less fission products are in the core

ANSWER: A.

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

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

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

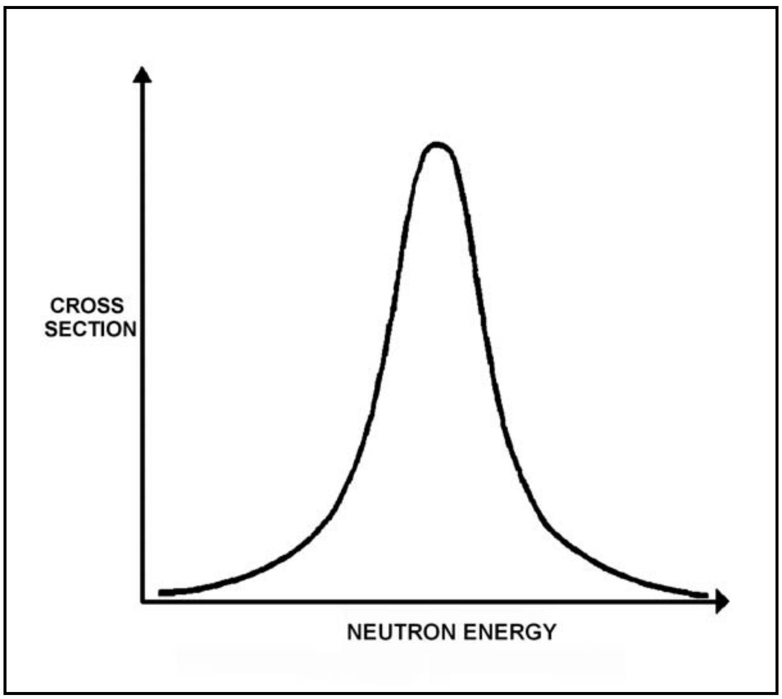
A. decrease; fewer neutrons will be absorbed by U-238 overall

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

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

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

ANSWER: C.



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

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

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

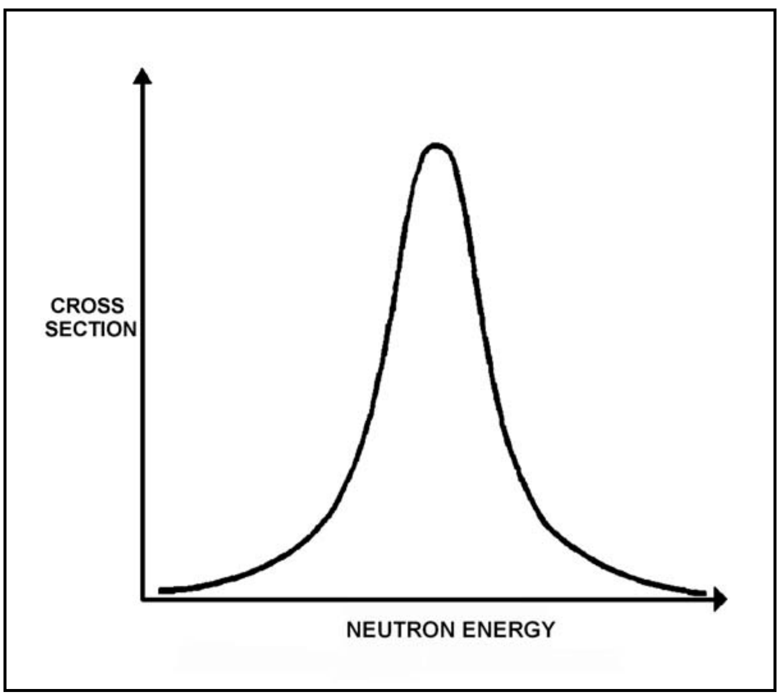
A. increase; increase

B. increase; remain the same

C. decrease; decrease

D. decrease; remain the same

ANSWER: D



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

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

A. Core void fraction increases.

B. Fuel temperature decreases.

C. Gadolinium burns out.

D. Control rods are partially inserted.

ANSWER: B.

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

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

A. The thermal neutron flux increases.

B. The thermal diffusion length decreases.

C. The fuel centerline temperature increases.

D. The control rod density decreases.

ANSWER: D.

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

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

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

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

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: D.

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

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

A. Pressure

B. Void

C. Moderator

D. Doppler

ANSWER: D.

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

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

A. void content.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

ANSWER: D.

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

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

A. FTC, VC, MTC

B. FTC, MTC, VC

C. VC, FTC, MTC

D. VC, MTC, FTC

ANSWER: D.

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

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

A. void percentage.

B. fuel temperature.

C. xenon concentration.

D. moderator temperature.

ANSWER: D.

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

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

A. 2

B. 3

C. 6

D. 12

ANSWER: C.

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

Rod position indications indicate that a control rod is at position 16. When the control rod is moved to position 22, it is being...

A. inserted 18 inches.

B. withdrawn 18 inches.

C. inserted 36 inches.

D. withdrawn 36 inches.

ANSWER: B.

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

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

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

A. 9.

B. 12.

C. 27.

D. 36.

ANSWER: B.

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

Rod position indication shows that a control rod is at position 22. If the control rod is then moved to position 12, it is being...

A. inserted 30 inches.

B. withdrawn 30 inches.

C. inserted 60 inches.

D. withdrawn 60 inches.

ANSWER: A.

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

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

A. shallow; fully inserted

B. shallow; fully withdrawn

C. deep; fully inserted

D. deep; fully withdrawn

ANSWER: C.

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

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

A. Boron

B. Carbon

C. Gadolinium

D. Stainless Steel

ANSWER: A.

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

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

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

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

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

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

ANSWER: C.

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

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

A. Axial flux shape

B. Rod shadowing

C. Radial power distribution

D. Reverse power effect

ANSWER: C.

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

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

A. increase and stabilize at a higher value.

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

C. decrease and stabilize at a lower value.

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

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B356 (P354)

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

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

B. temporarily, then return to the original 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: 292005
KNOWLEDGE: K1.04 [3.5/3.5]
QID: B755 (P754)

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

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. remain the same.

B. increase and stabilize at a new higher level.

C. increase temporarily then return to the original value.

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

ANSWER: B.

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

A nuclear reactor is stable at the point of adding heat during a reactor startup. Reactor vessel pressure is stable at 600 psig. Then, control rods are manually withdrawn for 5 seconds.

Assuming the reactor does <u>not</u> scram, when conditions stabilize, reactor power will be __________ and reactor vessel pressure will be __________.

A. higher; the same

B. higher; higher

C. the same; the same

D. the same; higher

ANSWER: B.

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

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

A. increase and stabilize above the original level.

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

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

D. remain the same during and after the withdrawal.

ANSWER: A.

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

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

Reactor power will increase...

A. continuously until control rods are reinserted.

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

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

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

ANSWER: D.

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

A nuclear reactor is operating steady state at the point of adding heat (POAH) during a reactor startup near the beginning of core life. Reactor pressure is stable at 600 psig and main steam isolation valves are closed (no steam flow from reactor).

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

A. at the POAH; 600 psig

B. at the POAH; less than 600 psig

C. less than the POAH; 600 psig

D. less than the POAH; less than 600 psig

ANSWER: B.

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

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

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

A. positive; increase exponentially

B. positive; increase linearly

C. negative; decrease exponentially

D. negative; decrease linearly

ANSWER: A.

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

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

A. inserted into; available in

B. inserted into; withdrawn from

C. withdrawn from; available in

D. withdrawn from; inserted into

ANSWER: A.

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

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

A. Increases continuously during rod insertion

B. Decreases continuously during rod insertion

C. Increases initially, then decreases after 50% of the rods are inserted

D. Decreases initially, then increases after 50% of the rods are inserted

ANSWER: A.

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

Control rod density is a measure of the...

A. percentage of control rods inserted into the core.

B. percentage of control rods withdrawn from the core.

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

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

ANSWER: A.

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

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

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

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

C. decreases whenever any of the rods are withdrawn.

D. increases whenever any of the rods are withdrawn.

ANSWER: C.

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

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

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

If the control rod is slightly withdrawn such that the control rod tip is located in a thermal neutron flux of 1×10^{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. 0.5

B. 1.4

C. 2.0

D. 4.0

ANSWER: D.

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

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

A. differential rod worth.

B. excess reactivity.

C. integral rod worth.

D. reference reactivity.

ANSWER: C.

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

A control rod is positioned in a 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: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1555

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

A. decrease, then increase.

B. increase, then decrease.

C. decrease continuously.

D. increase continuously.

ANSWER: D.

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

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

A. IRW is the slope of the DRW curve.

B. IRW is the inverse of the DRW curve.

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

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

ANSWER: C.

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

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

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

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

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

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

ANSWER: B.

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

A control rod is positioned in a 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 = 4.0×10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.2×10^{13} n/cm^2-sec, 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: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B1955

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

A. Increases, then decreases

B. Decreases, then increases

C. Increases continuously

D. Decreases continuously

ANSWER: C.

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

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

A. Increases, then decreases.

B. Decreases, then increases.

C. Increases continuously.

D. Decreases continuously.

ANSWER: A.

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

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

A. Core radial neutron flux distribution

B. Core axial neutron flux distribution

C. Core xenon distribution

D. Burnable poison distribution

ANSWER: B.

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

A control rod is positioned in a 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 = 4.0×10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.6×10^{13} n/cm^2-sec, 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: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2755 (P1384)

Integral rod worth is the...

A. change in reactivity per unit change in rod position.

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

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

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

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2855 (P1354)

Integral rod worth is the...

A. change in reactivity per unit change in rod position.

B. reactivity inserted by moving a control rod from a reference position to another position.

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

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

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2856 (P856)

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

A. fuel enrichment.

B. neutron flux distribution.

C. xenon concentration.

D. fuel temperature distribution.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.07 [2.4/2.6]
QID: B2956

A nuclear reactor is operating at steady-state 50% power at the end of core life with all control systems in manual. The radial power distribution is symmetric and peaked in the center of the core, and the axial power distribution peak is slightly below the core midplane.

The tip of the most centrally-located control rod is currently located at the core midplane. The control rod is constructed of a homogeneous neutron absorber and the active neutron absorber length is exactly as long as the adjacent fuel assembly. The rod is manually inserted fully into the core, no other operator action is taken, and reactor power stabilizes at 42%.

If, instead, the control rod had been withdrawn fully from its core midplane position, the reactor would have experienced**...**

A. a larger absolute change in integral control rod reactivity.

B. a smaller absolute change in integral control rod reactivity.

C. a larger absolute change in reactor shutdown margin.

D. a smaller absolute change in reactor shutdown margin.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B53

Which one of the following statements describes how changes in core parameters affect control rod worth (CRW)?

A. CRW decreases when the temperature of the fuel decreases.

B. CRW increases with an increase in voids.

C. CRW increases with an increase in fast neutron flux.

D. CRW decreases when approaching end of core life.

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B357

If the void fraction surrounding several centrally located fuel bundles increases, the worth of the associated control rod(s) will...

A. decrease, because the average neutron energy in the fuel bundles decreases, resulting in fewer neutrons traveling from within the fuel bundles to the affected control rod(s).

B. decrease, because more neutrons are resonantly absorbed in the fuel while they are being thermalized, resulting in fewer thermal neutrons available to be absorbed by the affected control rod(s).

C. increase, because the diffusion length of the thermal neutrons increases, resulting in more thermal neutrons traveling from within the fuel bundles to the affected control rod(s).

D. increase, because neutrons will experience a longer slowing down length, resulting in a smaller fraction of thermal neutrons being absorbed by the fuel and more thermal neutrons available to be absorbed by the affected control rod(s).

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1157

Which one of the following conditions will cause the associated individual control rod worth(s) to become more negative? (Consider only the direct effect of the indicated changes.)

A. During a small power change, fuel temperature increases.

B. With the reactor shut down, reactor coolant temperature increases from 100°F to 200°F.

C. During a small power change, the percentage of voids increases.

D. During a control pattern adjust, the local thermal neutron flux surrounding a control rod decreases while the core average thermal neutron flux remains the same.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1556

If the void fraction surrounding centrally located fuel bundles decreases, the worth of the associated control rod(s) will...

A. increase, because the average neutron energy in the area of the affected control rod(s) increases.

B. increase, because less neutrons are resonantly absorbed in the fuel while they are being thermalized, resulting in more thermal neutrons available to be absorbed by the affected control rod(s).

C. decrease, because the diffusion length of the thermal neutrons decreases, resulting in fewer thermal neutrons reaching the affected control rod(s).

D. decrease, because neutrons will experience a shorter slowing down length, resulting in a larger fraction of thermal neutrons being absorbed by the fuel and less thermal neutrons available to be absorbed by the affected control rod(s).

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2656 (P1556)

As moderator temperature increases, the magnitude of differential rod worth will...

A. increase due to longer neutron migration length.

B. decrease due to reduced moderation of neutrons.

C. increase due to decreased resonance absorption of neutrons.

D. decrease due to decreased moderator absorption of neutrons.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B2857

A nuclear reactor is operating at 85% power with control rod X-Y inserted 20%. Which one of the following will cause the differential control rod worth of control rod X-Y to become more negative? (Assume that control rod X-Y remains 20% inserted for each case.)

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

B. An adjacent control rod is fully withdrawn from the core.

C. Reactor vessel pressure drifts from 900 psig to 880 psig.

D. Fuel temperature increases as fission product gases accumulate in nearby fuel rods.

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.10
QID: B179

Which one of the following is a reason for neutron flux shaping?

A. To minimize the worth of individual control rods by evenly distributing the flux radially.

B. To reduce the reverse power effect during rod withdrawal by peaking the flux at the top of the core.

C. To equalize control rod drive mechanism wear and control rod blade neutron burnout.

D. To increase the effectiveness of power control rods by peaking the flux at the bottom of the core.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B255

Neutron flux shaping within a nuclear reactor core is designed to...

A. prevent the effects of rod shadowing during control rod motion.

B. generate more power in the top portion of the core early in core life.

C. ensure that local core thermal power limits are not exceeded.

D. minimize the reverse power effect during control rod motion.

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B1557

Which one of the following is a reason for neutron flux shaping?

A. To minimize local power peaking by more evenly distributing the core thermal neutron flux

B. To reduce the reverse power effect during rod withdrawal by peaking the thermal neutron flux at the top of the core

C. To equalize control rod drive mechanism wear and control rod blade thermal neutron burnout

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

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B1656

The primary purpose for performing control rod program changes is to...

A. evenly burn up the fuel.

B. evenly burn up the control rods.

C. reduce excessive localized reactor vessel neutron irradiation.

D. reduce control rod shadowing.

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B2457 (P2456)

Which one of the following is a reason for neutron flux shaping in a 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 shutdown the reactor following a reactor scram

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

ANSWER: A.

TOPIC: 292005
KNOWLEDGE: K1.10 [2.8/3.3]
QID: B3356 (P857)

The main reason for designing and operating a 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: 292005
KNOWLEDGE: K1.11 [2.4/2.5]
QID: B557

A control rod located at notch position ________ in the core would be considered a ________________ control rod.

A. 36; deep

B. 36; intermediate

C. 12; intermediate

D. 12; deep

ANSWER: D.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B358 (P356)

A 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: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B454

Which one of the following control rods, when repositioned, will have the largest effect on axial flux shape?

A. Deep rods at the center of the core

B. Deep rods at the periphery of the core

C. Shallow rods at the center of the core

D Shallow rods at the periphery of the core

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B656

During nuclear reactor power operations, the axial neutron flux shape is affected most by withdrawal of __________ control rods and the radial neutron flux shape is affected most by withdrawal of __________ control rods.

A. shallow; shallow

B. deep; shallow

C. shallow; deep

D. deep; deep

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1357

Which one of the following control rods, if withdrawn two notches, typically will have the greatest effect on radial neutron flux shape?

A. Shallow rod

B. Deep rod

C. Peripheral rod

D. Intermediate rod

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1457

A nuclear reactor is operating at 60% power with thermal neutron flux peaked in the bottom half of the core. Partial withdrawal of a deep control rod will generally affect total (versus local) core power because ____________ is relatively high in the area of withdrawal.

A. fuel enrichment

B. thermal neutron flux

C. void content

D. moderator temperature

ANSWER: C.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1757

Which one of the following control rods, when repositioned by 2 notches, will have the <u>smallest</u> effect on axial flux shape?

A. Deep rods at the center of the core

B. Deep rods at the periphery of the core

C. Shallow rods at the center of the core

D Shallow rods at the periphery of the core

ANSWER: B.

TOPIC: 292005
KNOWLEDGE: K1.12 [2.6/2.9]
QID: B1856

A nuclear reactor is operating at 50% power at the beginning of a fuel cycle. Assuming the reactor does not scram, which one of the following compares the effects of dropping a deep control rod out of the core to the effects of dropping the same control rod if it is shallow?

A. Dropping a deep control rod causes a greater change in shutdown margin.

B. Dropping a deep control rod causes a smaller change in shutdown margin.

C. Dropping a deep control rod causes a greater change in axial power distribution.

D. Dropping a deep control rod causes a greater change in radial power distribution.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B558

Fission fragments or daughters that have a substantial neutron absorption cross section and are not fissionable are called...

A. fissile materials.

B. fission product poisons.

C. fissionable nuclides.

D. burnable poisons.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B1558 (P2858)

A fission product poison can be differentiated from all other fission products because a fission product poison...

A. has a higher microscopic cross section for thermal neutron capture.

B. has a longer half-life.

C. is produced in a greater percentage of thermal fissions.

D. is formed as a gas and is contained in the fuel pellets.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B1858 (P858)

Fission product poisons can be differentiated from other fission products in that fission product poisons...

A. have a longer half-life.

B. are stronger absorbers of thermal neutrons.

C. are produced in a larger percentage of fissions.

D. have a higher fission cross section for thermal neutrons.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.01 [2.7/2.8]
QID: B2061 (P2058)

A fission product poison can be differentiated from all other fission products in that a fission product poison will...

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

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

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

D. migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B55

Which one of the following lists the proper order of substances from the largest to the smallest microscopic cross sections for absorption of thermal neutrons?

A. Gadolinium, U-235, Xe-135, U-238

B. Gadolinium, Xe-135, U-235, U-238

C. Xe-135, U-235, gadolinium, U-238

D. Xe-135, gadolinium, U-235, U-238

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B256 (P2658)

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: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1058 (P1858)

Which one of the following is a characteristic of xenon-135 in a nuclear reactor core?

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

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

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

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

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1259

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

A. Uranium-235

B. Uranium-238

C. Plutonium-239

D. Xenon-135

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B1658 (P2458)

Which one of the following 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: 292006
KNOWLEDGE: K1.02 [3.1/3.1]
QID: B3458

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

Which reactor has the smaller concentration of equilibrium core Xe-135?

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

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

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

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

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B257 (P1859)

The major contributor to the production of Xe-135 in a nuclear reactor that has been operating at full power for 2 weeks is...

A. the radioactive decay of iodine.

B. the radioactive decay of promethium.

C. direct production from fission of U-235.

D. direct production from fission of U-238.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B362 (P358)

Xenon-135 is produced in a 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: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B458 (P1359)

A nuclear reactor has been operating at full power for several weeks. Xenon-135 is being directly produced as a fission product in approximately _________% of all fissions.

A. 100%

B. 30%

C. 3%

D. 0.3%

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B859 (P1559)

Which one of the following correctly describes the production mechanisms of Xe-135 in a nuclear reactor that is operating at steady-state 100% power?

A. Primarily from fission, secondarily from iodine decay

B. Primarily from fission, secondarily from promethium decay

C. Primarily from iodine decay, secondarily from fission

D. Primarily from promethium decay, secondarily from fission

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.03 [2.9/2.9]
QID: B2558 (P2558)

Nuclear reactors A and B are operating at steady-state 100% 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 <u>concentration</u> of Xe-135?

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

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

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

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

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B128

Which one of the following describes the change in core xenon-135 concentration immediately following a power increase from equilibrium conditions?

A. Initially decrease due to the decreased rate of xenon-135 production from fission.

B. Initially decrease due to the increased rate of thermal neutron absorption by xenon-135.

C. Initially increase due to the increased rate of xenon-135 production from fission.

D. Initially increase due to the decreased rate of thermal neutron absorption by xenon-135.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B258

The two methods of Xe-135 removal from a nuclear reactor operating at full power are...

A. gamma decay and beta decay.

B. neutron absorption and fission.

C. fission and gamma decay.

D. beta decay and neutron absorption.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B359 (P1059)

Xenon-135 undergoes radioactive decay to...

A. iodine-135.

B. cesium-135.

C. tellurium-135.

D. lanthanum-135.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B462 (P460)

Reactor power is increased from 50% to 60% in 1 hour. The most significant contributor to the initial change in xenon reactivity is the increase in xenon...

A. production from iodine decay.

B. production from fission.

C. absorption of neutrons.

D. decay to cesium.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B860

Which one of the following values is the approximate half-life of Xe-135?

A. 19 seconds

B. 6.6 hours

C. 9.1 hours

D. 30 hours

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B959

Which one of the following describes the primary method of xenon-135 removal at the indicated steady state power level?

A. Decay of xenon-135 to cesium-135 at full power

B. Decay of xenon-135 to iodine-135 at the point of adding heat

C. Absorption of neutrons by xenon-135 at the point of adding heat

D. Absorption of neutrons by xenon-135 at full power

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.04 [2.9/2.9]
QID: B3358 (P2659)

A nuclear power plant has been operating at 100% 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: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B58 (P61)

A nuclear reactor has been operating at 50% power for one week when power is ramped in 4 hours to 100%. Which one of the following describes the new equilibrium xenon concentration?

A. Twice the 50% power concentration.

B. Less than twice the 50% power concentration.

C. More than twice the 50% power concentration.

D. Remains the same because it is independent of power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B259 (P1459)

Following a two-week shutdown, a 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: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B658 (P660)

A nuclear reactor was operating at 100% power for one week when power was decreased to 50%. Which one of the following describes the equilibrium core xenon-135 concentration at 50% power?

A. The same as the100% value.

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

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

D. One-half the 100% value.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1160 (P1158)

A nuclear reactor has been operating at 25% 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: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1363

Which one of the following indicates that core Xe-135 is in equilibrium?

A. Xe-135 is being removed equally by neutron capture and decay.

B. The reactor has been operated at a steady-state power level for five days.

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

D. The reactor is currently operating at 100% power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1859

A nuclear reactor was operating for 42 weeks at a stable reduced power level when a reactor scram occurred. The reactor was returned to critical after 12 hours and then ramped to 60% power in 6 hours.

How much time at steady state 60% power will be required to reach equilibrium core xenon-135?

A. 20 to 30 hours

B. 40 to 50 hours

C. 70 to 80 hours

D. 90 to 100 hours

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B1960 (P1360)

A nuclear reactor has been operating at a constant power level for 15 hours following a rapid power reduction from 100% to 50%. 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: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2659 (P2159)

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% 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% power.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.05 [2.9/2.9]
QID: B2760 (P2859)

Nuclear reactors A and B are operating at steady-state 100% 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: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B59

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

A. Decrease, and then build up to a higher equilibrium concentration

B. Increase, and then build up to a higher equilibrium concentration

C. Decrease, and then return to the same equilibrium concentration

D. Increase, and then return to the same equilibrium concentration

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B660

A nuclear reactor has been operating at 75% power for one week when power is decreased to 50% over a 1 hour period. Which one of the following statements explains how xenon concentration will initially change?

A. Decreases, because the xenon production rate from fission has decreased

B. Increases, because of the reduced rate of xenon burnout

C. Decreases, because the rate of xenon decay exceeds the rate of production from fission

D. Increases, because the concentration of iodine-135 increases

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B961

A nuclear reactor has been operating at 100% power for two weeks when power is reduced to 50% in 1 hour. How will the amount of core xenon change over the next 24 hours?

A. Increase and stabilize at a new higher value

B. Increase initially, then decrease and stabilize at a lower value

C. Decrease and stabilize at a new lower value

D. Decrease initially, then increase and stabilize at a higher value

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B1262 (P1960)

A nuclear reactor has been operating at 100% power for two weeks when power is decreased to 10% in 1 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: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B1860

A nuclear reactor has been operating at a steady-state power level for 15 hours following a rapid power reduction from 100% to 50%. 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: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2559 (P3362)

A nuclear reactor has been operating at 70% power for 26 hours following a one-hour power reduction from steady-state 100% 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: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2761 (P2261)

A nuclear reactor has been operating at steady-state 50% power for 12 hours following a one-hour power reduction from steady-state 100% 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: 292006
KNOWLEDGE: K1.06 [2.7/2.7]
QID: B2960 (P2961)

A nuclear reactor has been operating at steady-state 30% power for 3 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

A. Increasing toward a peak

B. Increasing toward equilibrium

C. Decreasing toward an upturn

D. Decreasing toward equilibrium

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B132

What is the difference in peak xenon concentration following a reactor scram after one week at 100% power as compared to a scram after one week at 50% power?

A. The time to reach the peak is shorter after 100% power than after 50% power, due to the higher iodine decay rate.

B. The peak from 50% is of a smaller magnitude due to the lower xenon burnout rate.

C. The peaks are equal because the decay rate of iodine remains constant.

D. The peak from 100% power is of a larger magnitude, due to the larger initial iodine concentration.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B260

A nuclear reactor has been operating at 25% power for five days when a scram occurs. Xe-135 will peak in approximately...

A. 2 hours.

B. 5 hours.

C. 10 hours.

D. 20 hours.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B861

Which one of the following equilibrium reactor prescram conditions requires the greater amount of control rod withdrawal to perform a reactor startup during peak xenon conditions after a reactor scram? (BOL = beginning of core life. EOL = end of core life.)

A. BOL and 100% power

B. EOL and 100% power

C. BOL and 20% power

D. EOL and 20% power

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1361 (P1358)

A nuclear reactor has been operating at 75% power for two months. A manual reactor scram is required for a test. The scram will be followed immediately by a reactor startup with criticality scheduled to occur 12 hours after the scram.

The greatest assurance that fission product poison reactivity will permit criticality during the startup will exist if the reactor is operated at _____________ power for 48 hours prior to the scram and if criticality is rescheduled for _____________ hours after the scram.

A. 100%; 8

B. 100%; 16

C. 50%; 8

D. 50%; 16

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1561 (P1561)

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 <u>smallest</u> after a reactor scram from equilibrium _______ reactor power at the _______ of core life.

A. 20%; beginning

B. 20%; end

C. 100%; beginning

D. 100%; end

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B3861 (P3860)

A nuclear reactor has been operating at 80% power for two months. A manual reactor scram is required for a test. The scram will be followed by a reactor startup with criticality scheduled to occur 24 hours after the scram.

The 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 scram and if criticality is rescheduled for _____________ hours after the scram.

A. 60%; 18

B. 60%; 30

C. 100%; 18

D. 100%; 30

ANSWER: B.

TOPIC 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B135

When comparing control rod worth (CRW) during a reactor startup from 100% peak xenon-135 and a reactor startup from xenon-free conditions...

A. center CRW will be higher during the peak xenon startup than during the xenon-free startup.

B. peripheral CRW will be higher during the peak xenon startup than during the xenon-free startup.

C. center and peripheral CRWs will be the same regardless of core xenon conditions.

D. it is impossible to determine how xenon will affect the worth of center and peripheral control rods.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B261

A nuclear reactor has been operating at full power for several weeks when a scram occurs. When the reactor is brought critical 5 hours later, Xe-135 concentration will be <u>highest</u> in the ___________ of the core, which causes thermal neutron flux to shift toward the ____________ of the core.

A. center; periphery

B. periphery; periphery

C. center; center

D. periphery; center

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B1062

A nuclear reactor is operating at 100% power with equilibrium core xenon-135 near the beginning of a fuel cycle when a scram occurs. When the reactor is taken critical 5 hours later, xenon distribution will be maximum at the ______________ of the core.

A. bottom and center

B. bottom and outer circumference

C. top and center

D. top and outer circumference

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2454

Sustained operation at 100% power requires periodic withdrawal of control rods to compensate for...

A. buildup of fission product poisons and decreasing control rod worth.

B. fuel depletion and buildup of fission product poisons.

C. decreasing control rod worth and burnable poison burnout.

D. burnable poison burnout and fuel depletion.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2660 (P2359)

Which one of the following explains why core Xe-135 oscillations are a concern in a nuclear reactor?

A. They can adversely affect core power distribution and can require operation below full rated power.

B. They can adversely affect core power distribution and can prevent a reactor startup following a reactor scram.

C. They can cause excessively short reactor periods during power operation and can require operation below full rated power.

D. They can cause excessively short reactor periods during power operation and can prevent a reactor startup following a reactor scram.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B2860

A nuclear reactor has been operating at 50% power for several weeks near the middle of core life with core axial power distribution evenly divided above and below the core midplane. Reactor power is to be increased to 65% over a two-hour period using shallow control rods only.

During the power increase, core axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. remain evenly divided above and below the core midplane.

D. have peaks near the top and the bottom of the core.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.08 [2.8/3.2]
QID: B3061 (P3060)

A 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 scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. Reactor power is increased to 60% 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% power?

The core axial neutron flux peak will be located _______ in the core than the pre-scram peak location, and the flux peak will be moving ________.

A. higher; upward

B. higher; downward

C. lower; upward

D. lower; downward

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B262

A nuclear reactor is being started up and taken to rated power using a constant ramp rate following a one-month outage. To compensate for the effect of core xenon-135 while increasing reactor power, it will be necessary to ___________ rods and __________ recirculation flow.

A. insert; decrease

B. insert; increase

C. withdraw; increase

D. withdraw; decrease

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B355 (P353)

A nuclear power plant is being returned to operation following a refueling outage. Fuel preconditioning requires reactor power to be increased from 10% 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: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B562 (P561)

Following a seven day shutdown, a reactor startup is performed and a nuclear power plant is taken to 100% power over a 16-hour period. After reaching 100% 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: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B2861 (P2260)

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: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B57

Following a reactor scram from a long-term, steady-state, 100% power run, a reactor is to be taken critical. The calculated estimated critical conditions (position) are based on a xenon-free core.

Which one of the following is the shortest time after the initial scram that a xenon-free core will exist?

A. 8 to 10 hours

B. 15 to 25 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.09 [2.5/2.5]
QID: B5631 (P5631)

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

Ten hours after reactor power reaches 50%, 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: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1162

A reactor scram recently occurred from steady state 100% power and a reactor startup is currently in progress. Which one of the following sets of initial startup conditions will require the most control rod withdrawal to achieve criticality? (BOC = beginning of fuel cycle; EOC = end of fuel cycle.)

	CORE AGE	TIME SINCE REACTOR SCRAM
A.	BOC	12 hours
B.	BOC	40 hours
C.	EOC	12 hours
D.	EOC	40 hours

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1461 (P1462)

A nuclear reactor has been operating at 100% power for two months when a reactor scram occurs. Four hours later, the reactor is critical and stable at 10% power.

Which one of the following operator actions is required to maintain reactor power at 10% 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: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B1763 (P1762)

A reactor startup is being conducted and criticality has been achieved 15 hours after a reactor scram from two months of operation at full power. After 1 additional hour, reactor power is stabilized at 10^{-4}% 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: 292006
KNOWLEDGE: K1.10 [2.9/2.9]
QID: B4430

A reactor scram occurred from steady state 100% power and a reactor startup is currently in progress. Which one of the following sets of initial startup conditions will require the <u>smallest</u> amount of control rod withdrawal to achieve criticality? (BOC = beginning of fuel cycle; EOC = end of fuel cycle.)

	CORE AGE	TIME SINCE REACTOR SCRAM
A.	BOC	12 hours
B.	BOC	40 hours
C.	EOC	12 hours
D.	EOC	40 hours

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B173

A nuclear reactor has been operating at 50% power for four days. Power is then increased to 100% over a 1 hour period. How much time will be required for core xenon-135 concentration to reach its minimum value after the power increase?

A. 4 to 8 hours

B. 10 to 15 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B459 (P260)

Two identical nuclear reactors have been operating at a constant power level for one week. Reactor A is at 50% power and reactor B is at 100% power. If both reactors scram at the same time, xenon-135 will peak first in reactor ______ and the highest xenon-135 reactivity peak will occur in reactor ______.

A. B; B

B. B; A

C. A; B

D. A; A

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1362

A nuclear reactor has been operating at 100% power for two weeks when power is reduced to 50%. During the next 2 hours, what must the operator do to compensate for a change in core Xe-135?

A. The operator must add positive reactivity because Xe-135 is decaying.

B. The operator must add negative reactivity because Xe-135 is decaying.

C. The operator must add positive reactivity because Xe-135 is building in.

D. The operator must add negative reactivity because Xe-135 is building in.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1759

Which one of the following describes the change in core xenon-135 concentration immediately following a 10% power increase from equilibrium 70% power over a two-hour period?

A. Xe-135 concentration will initially decrease due to the increased rate of decay of Xe-135 to Cs-135.

B. Xe-135 concentration will initially decrease due to the increased absorption of thermal neutrons by xenon-135.

C. Xe-135 concentration will initially increase due to the increased I-135 production rate directly from fission.

D. Xe-135 concentration will initially increase due to the increased production rate directly from fission.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B1761 (P1159)

Two identical nuclear reactors have been operating at a constant power level for one week. Reactor A is at 100% power and reactor B is at 50% power. If both reactors scram at the same time, xenon-135 concentration will peak first in reactor ______ and the highest peak xenon-135 concentration will occur in reactor ______.

A. B; B

B. B; A

C. A; B

D. A; A

ANSWER: B.

TOPIC: 292006
KNOWLEDGE K1.11 [2.6/2.7]
QID: B2063

A nuclear reactor had been operating at 50% power for two weeks when power was increased to 100% over a 3-hour period. To maintain reactor power stable during the next 24 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period

B. Withdraw rods slowly at first, 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: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2158 (P2061)

A nuclear reactor had been operating at 100% power for two weeks when power was reduced to 50% 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: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2259

Which one of the following describes the change in core xenon-135 concentration immediately following a power increase from 50% power 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: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2361 (P2360)

A nuclear reactor had been operating at 70% power for two weeks when power was increased to 100% over a 2-hour period. To offset core 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: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2561 (P2559)

A nuclear reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 50% over a 1- hour period. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 10 hours after the power change is completed?

A. Less than 50% and decreasing slowly.

B. Less than 50% and increasing slowly.

C. Greater than 50% and decreasing slowly.

D. Greater than 50% and increasing slowly.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2762

A nuclear reactor is initially operating at 60% power with equilibrium core xenon-135. Power is increased to 80% over a 2-hour period. No subsequent operator actions are taken.

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

A. Greater than 80% and decreasing slowly.

B. Greater than 80% and increasing slowly.

C. Less than 80% and decreasing slowly.

D. Less than 80% and increasing slowly.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B2862

A nuclear reactor has been operating at 50% power for 3 hours following a one-hour power reduction from steady-state 100% 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: 292006
KNOWLEDGE: K1.11 [2.6/2.7]
QID: B3259

A nuclear reactor is initially operating at equilibrium 100% power. An operator inserts control rods intermittently over a period of 30 minutes. At the end of this time period, reactor power is 70%.

Assuming no additional operator actions are taken, what will reactor power be after an additional 60 minutes?

A. 70% and stable.

B. Less than 70% and slowly increasing.

C. Less than 70% and slowly decreasing.

D. Less than 70% and stable.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B463

A nuclear reactor has been operating at 100% power for several weeks. Following a reactor scram the reactor <u>first</u> will be considered xenon-free after...

A. 40 to 50 hours.

B. 70 to 80 hours.

C. 100 to 110 hours.

D. 130 to 140 hours.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B1462

A reactor scram has occurred following two months operation at steady-state 100% power. How soon after the scram will the reactor first be considered xenon-free?

A. 8 to 10 hours

B. 24 to 30 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2159 (P1063)

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

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

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

C. At or approaching a peak value.

D. Approximately the same as at the time of the scram.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2262 (P2462)

Twenty-four hours after a reactor scram from a long-term, steady-state, 100% power run, the core xenon-135 concentration will be approximately...

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

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

C. 50% lower than at the time of the scram and decreasing.

D. 50% higher than at the time of the scram and increasing.

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2461 (P2262)

Fourteen hours after a reactor scram from 100% power equilibrium xenon conditions, the amount of core xenon-135 will be...

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

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

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

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

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2662 (P2662)

Given:

- A nuclear reactor was operating at 100% power for six weeks when a scram occurred.
- A reactor startup was performed and criticality was reached 16 hours after the scram.
- Two hours later, the reactor is currently at 30% power.

If no operator actions occur during the next hour, reactor power will ___________ because core Xe-135 concentration is ___________.

A. increase; decreasing

B. increase; increasing

C. decrease; decreasing

D. decrease; increasing

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.12 [2.8/2.3]
QID: B2763 (P2762)

A nuclear reactor that had been operating at 100% 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: 292006
KNOWLEDGE: K1.13 [2.6/2.6]
QID: B63

If a nuclear reactor that has operated at 100% power for 10 days is shut down rapidly, xenon concentration will...

A. slowly decay away to almost zero in 3 days.

B. increase to a new equilibrium in 3 days.

C. peak in about a half day, then decay to almost zero in 3 days.

D. ramp down with reactor power.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.13 [2.6/2.6]
QID: B1463

Which one of the following describes a reason for the direction of change in core xenon-135 reactivity immediately after a reactor shutdown from long-term power operation?

A. The production rate of Xe-135 from I-135 decay significantly decreases.

B. The production rate of Xe-135 from fission significantly decreases.

C. The removal rate of Xe-135 by decay to I-135 significantly decreases.

D. The removal rate of Xe-135 by neutron absorption significantly decreases.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B56

A nuclear reactor has been shut down for two weeks after six months of full power operation. A reactor startup is performed and reactor power is stabilized at 10%. What control rod movement is required to maintain 10% stable power over the next 2 hours?

A. Small amounts of rod insertion to compensate for samarium depletion.

B. Small amounts of rod withdrawal to compensate for samarium buildup.

C. Small amounts of rod insertion to compensate for xenon burnout.

D. Small amounts of rod withdrawal to compensate for xenon buildup.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B62

A nuclear reactor that has been operating at 100% power for about two weeks has power reduced to 50% in 1 hour. To compensate for the change in xenon-135 during the next 4 hours, the operator must add...

A. negative reactivity to compensate for xenon building in.

B. negative reactivity because xenon is rapidly decaying away.

C. positive reactivity to compensate for xenon building in.

D. positive reactivity because xenon is rapidly decaying away.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B263

A nuclear reactor has been operating at full power for 10 weeks when a scram occurs. The reactor is made critical 24 hours later, and power level is maintained low in the intermediate range.

To maintain a constant power level for the next several hours, control rods must be...

A. inserted, because xenon burnout will cause increased neutron flux peaking near the periphery of the core.

B. maintained at the present height as xenon establishes its equilibrium value for this power level.

C. inserted, because xenon will approximately follow its normal decay curve.

D. withdrawn, because xenon concentration is increasing toward equilibrium.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B363 (P2260)

A nuclear reactor is initially shut down with no xenon in the core. The reactor is taken critical and 4 hours later power is in the middle of the intermediate range monitors, range 8. The maintenance department has asked that power be maintained constant at this level for approximately 12 hours.

To accomplish this, control rods will have to be...

A. withdrawn slowly for the duration of the 12 hours.

B. inserted slowly for the duration of the 12 hours.

C. withdrawn slowly for 4 to 6 hours, then inserted slowly.

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

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B461

Four hours after a reactor scram from a long-term, steady-state, 100% power run, the reactor has been taken critical and is to be maintained at 1% to 2% power. Which one of the following operator actions is required?

A. Add positive reactivity because xenon is building in

B. Add negative reactivity because xenon is building in

C. Add negative reactivity because xenon is decaying away

D. Add positive reactivity because xenon is decaying away

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B964 (P2262)

Sixteen hours after a reactor scram from 100% power, equilibrium xenon condition, the amount of core xenon will be...

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

B. higher than 100% equilibrium xenon, and will have added a net positive reactivity since the scram.

C. lower than 100% equilibrium xenon, and will have added a net negative reactivity since the scram.

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

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1164

A nuclear reactor is operating at 100% power with equilibrium xenon conditions at the beginning of a fuel cycle when a reactor scram occurs. The reactor is taken critical 4 hours later.

Which one of the following describes the effect of xenon on control rod worth when the reactor becomes critical?

A. Increasing xenon concentration at the periphery of the core will cause periphery rods to exhibit high-worth characteristics.

B. Peak thermal flux at the periphery of the core will cause periphery rods to exhibit high-worth characteristics.

C. Peak thermal flux at the center of the core will cause center rods to exhibit high-worth characteristics.

D. Decreasing xenon concentration at the center of the core will cause center control rods to exhibit high-worth characteristics.

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1663

A reactor is initially operating at 50% power with equilibrium core xenon-135. Power is increased to 75% over a 1 hour period with no subsequent operator actions. Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 6 hours after the power change?

A. Greater than 75% and decreasing slowly

B. Greater than 75% and increasing slowly

C. Lower than 75% and decreasing slowly

D. Lower than 75% and increasing slowly

ANSWER: A.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1762

A nuclear reactor is operating at 100% power with equilibrium xenon conditions at the beginning of a fuel cycle when a reactor scram occurs. The reactor is taken critical 4 hours later.

Which one of the following describes the effect of core xenon-135 on control rod worth when the reactor becomes critical?

A. High xenon-135 concentration at the periphery of the core will cause periphery rods to exhibit relatively high-worth characteristics.

B. High xenon-135 concentration at the periphery of the core will cause central rods to exhibit relatively high-worth characteristics.

C. High xenon-135 concentration at the center of the core will cause peripheral rods to exhibit relatively high-worth characteristics.

D. High xenon-135 concentration at the center of the core will cause central rods to exhibit relatively high-worth characteristics.

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B1862 (P361)

A nuclear power plant has been operating at 100% power for two months when a reactor scram occurs. Shortly after the reactor scram a reactor startup is commenced. Six hours after the scram, reactor power is at 2%. To maintain power stable at 2% 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: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2062

A nuclear reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period and stabilized. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 10 hours after the power change?

A. Greater than 75% and decreasing slowly

B. Greater than 75% and increasing slowly

C. Less than 75% and decreasing slowly

D. Less than 75% and increasing slowly

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2263

A nuclear reactor is operating at 80% power following a power reduction from 100% over a one-hour period. To keep reactor power at 80% over the next three hours, the operator must ________ control rods or _________ reactor recirculation flow rate.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B2964 (P2963)

A nuclear reactor is operating at 60% power immediately after a one-hour power increase from equilibrium 40% power. To keep reactor power at 60% over the next two hours, the operator must ________ control rods or _________ reactor recirculation flow rate.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: B.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3063

A nuclear reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period and stabilized. No subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes reactor power 30 hours after the power change?

A. Less than 75% and increasing slowly

B. Less than 75% and decreasing slowly

C. Greater than 75% and increasing slowly

D. Greater than 75% and decreasing slowly

ANSWER: C.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3563 (P3563)

A nuclear power plant had been operating at 100% power for two months when a reactor scram occurred. Soon afterward, a reactor startup was performed. Twelve hours after the scram, the startup has been paused with reactor power at 2%.

To maintain reactor power stable at 2% 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: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B3863

A nuclear power plant has been operating at steady-state 100% reactor power for three weeks when the operator slowly adds negative reactivity to the core over a period of 15 minutes to lower power level to 90%. Which one of the following describes reactor power 60 minutes later if no additional operator action is taken?

A. Higher than 90% and increasing slowly.

B. Higher than 90% and decreasing slowly.

C. Lower than 90% and increasing slowly.

D. Lower than 90% and decreasing slowly.

ANSWER: D.

TOPIC: 292006
KNOWLEDGE: K1.14 [3.1/3.2]
QID: B4631

Six hours after a reactor scram from equilibrium full power operation, a nuclear reactor is taken critical and power is immediately stabilized. To maintain the reactor critical at a constant power level for the next hour, the operator must add __________ reactivity because core Xe-135 concentration is __________.

A. negative; increasing

B. negative; decreasing

C. positive; increasing

D. positive; decreasing

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B64

What is the definition of a "burnable poison?"

A. Isotopes manufactured into the fuel with large-scatter macroscopic cross sections to improve neutron thermalization.

B. Thermal neutron absorbing material added to the fuel during manufacturing to increase initial core fuel load.

C. Thermal neutron absorbing material produced in the non-fissionable fuel isotopes by fast neutron absorption.

D. Fast neutron absorbing material loaded into the upper one-third of the core to aid in flattening the thermal neutron flux.

ANSWER: B.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B136

Burnable poisons are placed in a nuclear reactor core to...

A. increase the amount of fuel that can be loaded into the core.

B. accommodate control rod depletion that occurs over core life.

C. compensate for the buildup of xenon-135 that occurs over core life.

D. ensure that the reactor will always operate in an undermoderated condition.

ANSWER: A.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B264

Burnable poisons are loaded into the core to...

A. reduce the rod shadowing effect between shallow rods early in core life.

B. provide for flux shaping in areas of deep rods during high power operation.

C. increase the excess reactivity that can be loaded into the core during refueling.

D. ensure the moderator coefficient of reactivity remains negative throughout core life.

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B364 (P362)

Which one of the following is not 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 fuel enrichment of initial core load.

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B1265

Gadolinium (Gd-155 and -157) is used instead of boron (B-10) as the ____________ material; when compared to gadolinium, boron has a much ____________ cross section for absorbing thermal neutrons.

A. control rod; larger

B. burnable poison; larger

C. control rod; smaller

D. burnable poison; smaller

ANSWER: D.

TOPIC: 292007
KNOWLEDGE: K1.01 [2.9/3.1]
QID: B2564 (P2164)

Why are burnable poisons installed in a nuclear reactor core?

A. To shield reactor fuel from thermal neutron flux until later in core life

B. To compensate for control rod burnout that occurs over core life

C. To flatten the radial thermal neutron flux distribution at the end of core life

D. To ensure a negative moderator temperature coefficient early in core life

ANSWER: A.

TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B564 (P264)

Just prior to refueling, control rods are nearly fully withdrawn at 100% power. After refueling, the control rods are inserted much farther into the core at 100% power.

Which one of the following is the primary reason for the change in full power control rod position?

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

B. Reactivity from void coefficient at EOL is much greater than at BOL.

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

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

ANSWER: C.

TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1163 (P1264)

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?

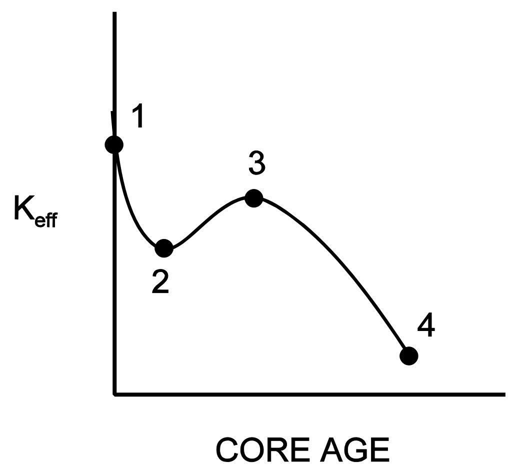
A. Depletion of fuel

B. Burnout of burnable poisons

C. Initial heat-up of the reactor

D. Buildup of fission product poisons

ANSWER: D.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1364 (P1864)

Refer to the drawing of K_{eff} versus core age (see figure below).

The change in K_{eff} from point 2 to point 3 is caused by...

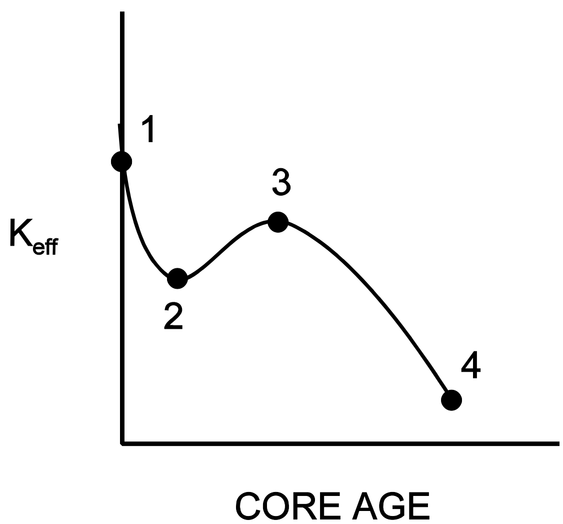
A. depletion of fuel.

B. depletion of control rods.

C. burnout of burnable poisons.

D. burnout of fission product poisons.

ANSWER: C.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B1563

Refer to the drawing of K_{eff} versus core age (see figure below).

The major cause for the change in K_{eff} from point 3 to point 4 is...

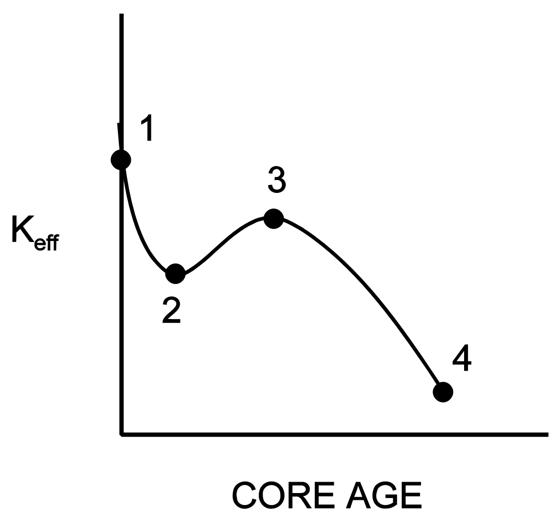
A. depletion of U-235.

B. depletion of U-238.

C. burnout of burnable poisons.

D. buildup of fission product poisons.

ANSWER: A.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B3264

Refer to the curve of K_{eff} versus core age for an operating nuclear reactor (see figure below).

The reactor has been operating at 100% power for several weeks and is currently operating between points 2 and 3 on the curve.

Assuming reactor recirculation flow rate remains the same, what general control rod operation will be necessary to maintain the reactor operating at 100% power until point 3 is reached?

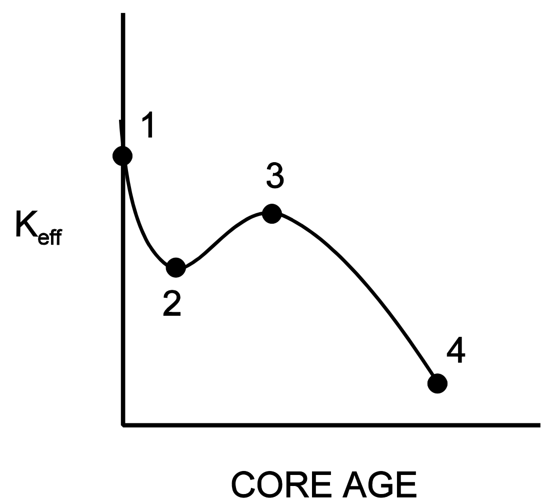
A. Withdrawal for the entire period.

B. Withdrawal at first, then insertion.

C. Insertion for the entire period.

D. Insertion at first, then withdrawal.

ANSWER: C.



TOPIC: 292007
KNOWLEDGE: K1.03 [2.4/2.7]
QID: B4832

Just prior to a refueling outage the control rod density at 100% power is relatively low. However, immediately following the outage the control rod density at 100% power is much higher.

Which one of the following contributes to the need for a much higher 100% power control rod density 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: 292008
KNOWLEDGE: K1.01 [3.8/3.9]
QID: B3365

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor scram occurred. Reactor pressure is being maintained at 600 psig in anticipation of commencing a reactor startup.

Four hours after the scram, with reactor pressure still at 600 psig, which one of the following will cause the fission rate in the reactor core to increase?

A. Reactor vessel pressure is allowed to increase by 20 psig.

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

C. The operator fully withdraws the first group of control rods.

D. An additional two hours is allowed to pass with no other changes in plant parameters.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.01 [3.8/3.9]
QID: B3465

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor scram occurred. Four hours after the scram, reactor pressure is being maintained at 600 psig 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. Core void fraction is decreased by 2%.

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

C. The operator fully withdraws the first group of control rods.

D. An additional two hours is allowed to pass with no other changes in plant parameters.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.02 [3.8/3.8]
QID: B1065

A refueling outage has just been completed and a reactor startup is being commenced. Which one of the following lists the method(s) used to add positive reactivity during the approach to criticality?

A. Control rods only

B. Recirculation flow only

C. Control rods and recirculation flow

D. Recirculation flow and steaming rate

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B266 (P65)

While withdrawing control rods during a nuclear reactor startup, the count rate doubles. If the same amount of reactivity that caused the first doubling is added again, the count rate will __________ and the reactor will be ____________.

A. more than double; subcritical

B. more than double; critical

C. double; subcritical

D. double; critical

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1565 (P1065)

During a nuclear 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: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1766 (P2468)

A nuclear 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: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B1964

A nuclear reactor startup is in progress and the reactor is slightly subcritical. Assuming the reactor remains subcritical, a short control rod withdrawal will cause the reactor period to initially shorten, and then...

A. gradually lengthen and stabilize at a negative 80 second period.

B. gradually lengthen and stabilize at infinity.

C. gradually lengthen until reactor power reaches the point of adding heat, then stabilize at infinity.

D. gradually lengthen until the neutron population reaches equilibrium, then stabilize at a negative 80 second period.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2069

A nuclear reactor startup is in progress with a current K_{eff} of 0.95 and a current equilibrium source range count rate of 120 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: C.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2165 (P1766)

A nuclear 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 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: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2365 (P2366)

A nuclear 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 equilibrium count rates will occur when K_{eff} becomes 0.97?

A. 200 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2465 (P2466)

A nuclear 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: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B2566

A nuclear reactor startup is in progress with a current K_{eff} of 0.95 and a current equilibrium source range count rate of 120 cps. Which one of the following equilibrium count rates will occur when K_{eff} becomes 0.985?

A. 250 cps

B. 300 cps

C. 350 cps

D. 400 cps

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.03 [4.1/4.0]
QID: B4533

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 60-second reactor period.

If the core effective delayed neutron fraction had been 0.005, what would be the approximate stable reactor period after the addition of the same amount of positive reactivity?

A. 28 seconds

B. 32 seconds

C. 36 seconds

D. 40 seconds

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B67

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. fraction of fission neutrons leaking from the core.

B. number of neutron generations required to reach a stable level.

C. length of time from neutron generation to absorption.

D. fraction of delayed neutrons appearing as criticality is approached.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B365 (P365)

A nuclear 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B366 (P2265)

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

A. 0.963

B. 0.972

C. 0.981

D. 0.990

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B865

During nuclear reactor startup, critical rod position is affected by...

A. core flow rate.

B. source range initial count rate.

C. recirculation ratio.

D. core age.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B966

During an initial reactor fuel load, the 1/M factor decreases from 1.0 to 0.5 after the first 100 fuel assemblies are loaded. What is the current value of K_{eff}?

A. 0.2

B. 0.5

C. 0.875

D. 1.0

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1067 (P1972)

At one point during a nuclear 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, 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1566 (P266)

During a nuclear 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1665 (P1770)

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.

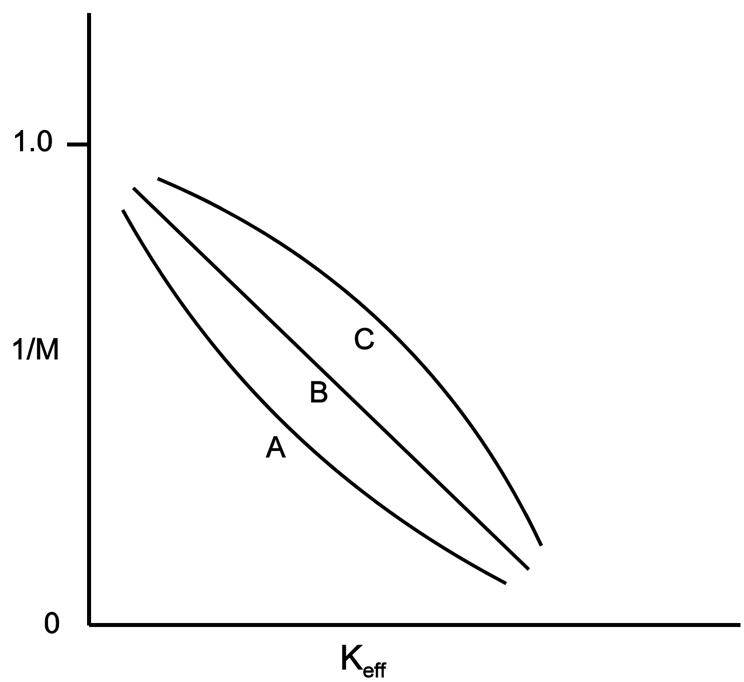
A. A; shorter

B. A; longer

C. C; shorter

D. C; longer

ANSWER: C.



1/M PLOT

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B1967 (P1265)

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 4.0 as the first 100 fuel assemblies are loaded. What is the corresponding final K_{eff}?

A. 0.25

B. 0.5

C. 0.75

D. 1.0

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2167 (P1867)

During a nuclear 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2765 (P2766)

During a nuclear 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: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B2966 (P2968)

A nuclear 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 each listed indication supports a declaration that the reactor has reached criticality?

A. Period is stable at 200 seconds; source range count rate is stable.

B. Period is stable at infinity; source range count rate is stable.

C. Period is stable at 200 seconds; source range count rate is slowly increasing.

D. Period is stable at infinity; source range count rate is slowly increasing.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.04 [3.3/3.4]
QID: B3665 (P3665)

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 ________.

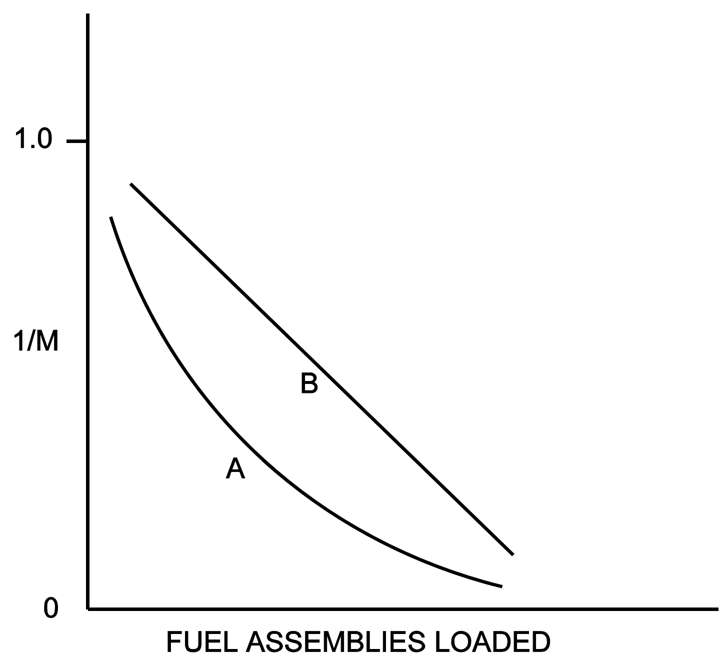
A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: D.



TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B267

A nuclear reactor startup is in progress with K_{eff} at 0.999 and stable source range indication. If a control rod is withdrawn one notch reactor period will initially become ____________; and then ____________. (Assume K_{eff} remains less than 1.0.)

A. positive; approach infinity

B. positive; stabilize at a positive value

C. negative; approach infinity

D. negative; stabilize at a negative value

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B1365 (P267)

As criticality is approached during a nuclear reactor startup, equal insertions of positive reactivity result in a ____________ change in equilibrium count rate and a ____________ time to reach each new equilibrium.

A. larger; longer

B. larger; shorter

C. smaller; longer

D. smaller; shorter

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.05 [4.3/4.3]
QID: B3566 (P3567)

A nuclear reactor startup is in progress for a reactor that is in the middle of a fuel cycle. The reactor is at normal operating temperature and pressure. The main steam isolation valves are open and the main turbine bypass (also called steam dump) valves are closed. The reactor is near criticality.

Reactor period is stable at infinity when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser. The operator immediately ensures no control motion is occurring and takes no further action. Assume that the reactor vessel water level remains stable, the reactor does not scram, and no other protective actions occur.

As a result of the valve failure, reactor period will initially become __________; and reactor power will stabilize __________ the point of adding heat.

A. positive; below

B. positive; above

C. negative; below

D. negative; above

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1267

A nuclear reactor is exactly critical during a reactor startup. Which one of the following must be closely monitored and controlled to ensure safe operation of the reactor as power is raised to the point of adding heat?

A. Reactor period

B. Reactor temperature

C. Source range count rate

D. Power peaking factors

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1567 (P1667)

The following data were obtained at steady-state conditions during a nuclear 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: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1767 (P1966)

The following data were obtained at steady-state conditions during a nuclear 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: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B1866

A nuclear reactor has just achieved criticality during a xenon-free reactor startup. Instead of stabilizing power at 10^3 cps per the startup procedure, the operator inadvertently allows reactor power to increase to 10^4 cps as indicated on the source range monitors.

Assuming reactor vessel coolant temperature and pressure do not change, the critical rod height at 10^4 cps will be ______________ the critical rod height at 10^3 cps. (Neglect any effects of changes in fission product poisons.)

A. different but unpredictable compared to

B. less than

C. greater than

D. equal to

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.06 [4.2/4.2]
QID: B2767 (P1167)

The following data were obtained at steady-state conditions during a nuclear 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: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B123 (P68)

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

A. 1.54% ΔK/K

B. 1.52% ΔK/K

C. 1.50% ΔK/K

D. 1.48% ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B667

When a nuclear reactor is exactly critical, reactivity is...

A. greater than 1.0% ΔK/K.

B. equal to 1.0% ΔK/K.

C less than 1.0% ΔK/K.

D. undefined.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.07 [3.9/3.9]
QID: B867 (P2267)

When a nuclear reactor is exactly critical, reactivity is...

A. infinity.

B. undefined.

C. 0.0 ΔK/K.

D. 1.0 ΔK/K.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B269 (P69)

During a nuclear reactor startup, a stable positive 30 second reactor period is achieved with no further reactivity addition. The reactor is...

A. exactly critical.

B. supercritical.

C. subcritical.

D. prompt critical.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B868

Which one of the following indicates that a nuclear reactor has achieved criticality during a normal nuclear reactor startup?

A. Constant positive period with no rod motion.

B. Increasing positive period with no rod motion.

C. Constant positive period during rod withdrawal.

D. Increasing positive period during rod withdrawal.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B1069

A nuclear reactor is critical just below the point of adding heat (POAH) at a temperature of 160°F. Which one of the following will result in reactor power increasing and stabilizing at the POAH? (Assume a negative moderator temperature coefficient.)

A. Reactor recirculation flow increases 10%.

B. Reactor coolant temperature increases 3°F.

C. A single control rod moves in one notch.

D. Core xenon-135 concentration decreases.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B2668 (P2667)

A nuclear reactor is critical at 10^{-6}% power. Control rods are withdrawn for 5 seconds and then stopped, resulting in a stable reactor period of positive 100 seconds.

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

A. longer than negative 100 seconds because, compared to power increases, reactor power decreases are more limited by delayed neutrons.

B. shorter than negative 100 seconds because, compared to power increases, reactor power decreases are less limited by delayed neutrons.

C. longer than negative 100 seconds because, compared to power increases, reactor power decreases result in smaller delayed neutron fractions.

D. shorter than negative 100 seconds because, compared to power increases, reactor power decreases result in larger delayed neutron fractions.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B5334 (P5334)

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 1.0×10^{-8} percent power.

The reactor that is supercritical by the greater amount of positive reactivity is reactor _______; and the first reactor to reach 1.0×10^{-1} percent power will be reactor _______.

A A; A

B. A; B

C. B; A

D. B; B

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.08 [4.1/4.1]
QID: B5534 (P5535)

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. 0.00026 ΔK/K

B. 0.00033 ΔK/K

C. 0.00067 ΔK/K

D. 0.00086 ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B468

A nuclear reactor is being started up from cold shutdown conditions with a stable positive 100-second period and power is entering the intermediate range. Assuming no operator action is taken that affects reactivity, which one of the following will occur?

A. Reactor period remains constant until saturation conditions are reached.

B. Reactor period increases to infinity as heat production in the reactor exceeds ambient losses.

C. Reactor period remains constant until void production begins in the core.

D. Reactor period decreases to zero as the fuel temperature increase adds negative reactivity to the core.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B669

A nuclear reactor is being started up with a stable positive 100-second period, and power is entering the intermediate range. Assuming no operator action, which one of the following describes the future response of reactor period?

A. Prior to reaching the point of adding heat, the fuel temperature increase will add negative reactivity and reactor period will approach infinity.

B. As heat production in the reactor exceeds ambient heat losses, the temperature of the fuel and moderator will increase, adding negative reactivity, and reactor period will approach infinity.

C. The heat produced by the reactor when operating in the intermediate range is insufficient to raise the fuel or moderator temperatures, and reactor period remains nearly constant throughout the entire intermediate range.

D. As heat production in the reactor exceeds ambient losses, positive reactivity added by the fuel temperature increase counteracts the negative reactivity added by the moderator temperature increase, and reactor period remains nearly constant throughout the entire intermediate range.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B2168 (P1870)

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

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

A. constant; constant

B. constant; increasing

C. increasing; constant

D. increasing; increasing

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.10 [3.6/3.6]
QID: B2671 (P2668)

A nuclear reactor is being started up under cold shutdown conditions with a stable positive 100-second period and power is entering the intermediate range. Assuming no operator action is taken that affects reactivity, reactor period will remain constant until...

A. void production begins in the core, then reactor period will increase toward infinity.

B. core heat production exceeds ambient losses, then reactor period will increase toward infinity.

C. xenon-135 production becomes significant, then reactor period will decrease toward zero.

D. fuel temperature begins to increase, then reactor period will decrease toward zero.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.11 [3.7/3.8]
QID: B568

After recording critical data during a cold reactor startup with main steam isolation valves open, the operator withdraws the control rods to continue the startup. Which one of the following pairs of parameters will provide the first indication of reaching the point of adding heat?

A. Reactor pressure and reactor water level

B. Reactor power and reactor period

C. Reactor pressure and turbine load

D. Reactor water level and core flow rate

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.11 [3.7/3.8]
QID: B3934 (P3935)

After taking critical data during a reactor startup, the operator establishes a stable 50-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity 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: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B133 (P1169)

A nuclear reactor is critical well below the point of adding heat when a small amount of positive reactivity is added to the core. If the same amount of negative reactivity is added to the core approximately 1 minute later, reactor power will stabilize at...

A. the initial power level.

B. somewhat higher than the initial power level.

C. somewhat lower than the initial power level.

D. the subcritical multiplication equilibrium level.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2467

Criticality has just been achieved during a nuclear reactor startup at 160°F. The operator withdraws control rods as necessary to establish a stable positive 30-second reactor period. No additional operator actions are taken.

How will reactor period and reactor power respond? (Assume a negative moderator temperature coefficient.)

A. Reactor power will increase and stabilize at the POAH; reactor period will remain constant until the POAH is reached and then stabilize at infinity.

B. Reactor power will increase and stabilize at the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

C. Reactor power will increase and stabilize above the POAH; reactor period will remain constant until the POAH is reached and then stabilize at infinity.

D. Reactor power will increase and stabilize above the POAH; reactor period will decrease slowly until the POAH is reached and then stabilize at infinity.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B1467 (P2269)

A nuclear reactor is critical at the point of adding heat when a small amount of <u>negative</u> reactivity is added to the core. If the same amount of <u>positive</u> reactivity is added to the core approximately 5 minutes later, reactor power will...

A. stabilize at the subcritical multiplication equilibrium neutron level.

B. stabilize at a level lower than the initial power level.

C. continue to decrease on a negative 80 second period.

D. stabilize at the initial power level.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2268

A nuclear reactor startup is in progress and criticality has just been achieved. After recording critical rod height, the operator withdraws control rods for 20 seconds to establish a stable positive 30-second reactor period. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the rod insertion, the reactor period will become...

A. negative during the entire period of control rod insertion.

B. negative shortly after the control rods pass through the critical rod height.

C. negative just as the control rods pass through the critical rod height.

D. negative shortly before the control rods pass through the critical rod height.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2568 (P2568)

A nuclear reactor is currently at 10^{-3}% 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 10^{-3}% power.

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: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B2969

A nuclear reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable positive 60-second reactor period. One minute later (prior to reaching the point of adding heat), the operator inserts the same control rod for 25 seconds.

During the insertion, when will the reactor period become negative?

A. Immediately when the control rod insertion is initiated.

B. After the control rod passes through the critical rod height.

C. Just as the control rod passes through the critical rod height.

D. Prior to the control rod passing through the critical rod height.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B3668 (P3668)

A nuclear reactor is slightly supercritical during a reactor startup. A short control rod withdrawal is performed to establish the desired reactor period. 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 period will initially lengthen and then...

A. stabilize at a positive value.

B. turn and slowly shorten.

C. stabilize at infinity.

D. continue to slowly lengthen.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.12 [3.6/3.7]
QID: B4034

A nuclear reactor is initially critical in the source range. Then a constant rate addition of positive reactivity commences and lasts for 120 seconds. Assume reactor power remains below the point of adding heat for the entire 120 second time interval.

During the 120 second time interval, reactor period will initially shorten and then _____; and reactor power will initially increase and then _______.

A. continue to shorten at a decreasing rate; continue to increase at an increasing rate

B. continue to shorten at a decreasing rate; continue to increase at a decreasing rate

C. continue to shorten at a increasing rate; continue to increase at an increasing rate

D. continue to shorten at an increasing rate; continue to increase at a decreasing rate

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B271

Upon reaching criticality during a reactor startup, the operator establishes a positive reactor period. Upon reaching the point of adding heat, the period will become ____________ due to the ______________ reactivity feedback of moderator and fuel temperature.

A. shorter; negative

B. shorter; positive

C. longer; negative

D. longer; positive

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B670 (P670)

After taking critical data during a reactor startup, the operator establishes a 26-second reactor period 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:

$\overline{\beta}_{eff}$ = 0.00579
l^* = 1×10^{-5} seconds
λ_{eff} = 0.1 $seconds^{-1}$

A. 0.16% ΔK/K

B. 0.19% ΔK/K

C. 0.23% ΔK/K

D. 0.29% ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B968

After taking critical data during a reactor startup, the operator establishes a positive 26-second reactor period to increase power to the point of adding heat (POAH). How much negative reactivity must be added to stabilize power at the POAH? (Assume $\overline{\beta}_{eff} = 0.00579$.)

A. 0.10% ΔK/K

B. 0.16% ΔK/K

C. 1.0% ΔK/K

D. 1.6% ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B1667

After taking critical data during a reactor startup, the operator establishes a stable 38-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate negative reactivity required to stop the power increase at the POAH? (Assume that $\overline{\beta}_{eff} = 0.00579$.)

A. 0.01% ΔK/K

B. 0.12% ΔK/K

C. 0.16% ΔK/K

D. 0.21% ΔK/K

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B1769

After taking critical data during a reactor startup, the operator establishes a positive 31-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the appropriate amount of reactivity needed to stabilize power at the POAH? (Assume $\overline{\beta}_{eff}$ = 0.00579.)

A. -0.14% ΔK/K

B. -0.16% ΔK/K

C. -1.4% ΔK/K

D. -1.6% ΔK/K

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B2369 (P2370)

After taking critical data during a reactor startup, the operator establishes a positive 48-second reactor period to increase 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. -0.010% ΔK/K

B. -0.012% ΔK/K

C. -0.10% ΔK/K

D. -0.12% ΔK/K

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.13 [3.8/3.9]
QID: B3068 (P3068)

After taking critical data during a reactor startup, the operator establishes a stable 34-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity that must be added 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: 292008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: B3934 (P3935)

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: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B769

During a nuclear reactor heat-up, a center control rod is notched outward with no subsequent operator action. The heat-up rate will...

A. increase initially, then gradually decrease.

B. decrease initially, then gradually increase.

C. increase and stabilize at a new higher value.

D. decrease and stabilize at a new lower value.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B1071

A nuclear reactor heat-up from 180°F to 500°F is in progress. To maintain a constant heat-up rate, as reactor temperature increases reactor power will have to...

A. increase due to increasing density of water.

B. decrease due to decreasing specific heat of water.

C. increase due to increasing heat losses to ambient.

D. decrease due to decreasing heat of vaporization of water.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.14 [3.5/3.5]
QID: B1468

A nuclear reactor is undergoing a startup with reactor pressure and temperature initially stable at 731.4 psia and 508°F. Main steam isolation valves are closed and reactor criticality has been achieved. The reactor currently has a stable positive 100-second reactor period with reactor power well below the point of adding heat (POAH).

Which one of the following will occur first when reactor power reaches the POAH?

A. Reactor period will shorten.

B. Reactor pressure will increase.

C. Reactor coolant temperature will decrease.

D. Intermediate range power level will decrease.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B469

A nuclear reactor is initially stable at the point of adding heat (POAH) with a reactor coolant temperature of 160°F during the reactor heat-up and pressurization phase of a reactor startup. Control rods are withdrawn a few notches to raise reactor power and establish a heat-up rate. Assume no core voiding occurs.

If no further control rod withdrawal occurs, reactor power will initially increase, and then...

A. remain stable until voiding begins to occur.

B. continue to increase until the control rods are reinserted.

C. decrease and stabilize at a subcritical power level.

D. decrease and stabilize at the POAH.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B1966

A nuclear reactor startup is in progress at the beginning of core life. Reactor power is 5 x 10^{-3}% and increasing slowly with a stable period of 87 seconds. Assuming no operator action, no reactor scram, and no steam release, what will reactor power be after 10 minutes?

A. Below the point of adding heat (POAH).

B. At the POAH.

C. Above the POAH but less than 49%.

D. Approximately 50%.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.15 [3.7/3.7]
QID: B2569

A nuclear reactor is critical at 10^{-3}% power during a cold reactor startup at the beginning of core life. Reactor period is stable at positive 60 seconds. Assuming no operator action, no reactor scram, and no steam release, what will be reactor power 10 minutes later?

A. Below the point of adding heat (POAH)

B. At the POAH

C. Approximately 22%

D. Greater than 100%

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.16 [3.6/3.7]
QID: B870

During a nuclear reactor startup, reactor pressure is increased from 5 psig to 50 psig in a 2-hour period. What was the average heat-up rate?

A. 35°F/hr

B. 60°F/hr

C. 70°F/hr

D. 120°F/hr

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.16 [3.6/3.7]
QID: B1972

A nuclear reactor is critical and a reactor coolant heat-up is in progress with coolant temperature currently at 140°F. If the point of adding heat is initially 1% reactor power, and reactor power is held constant at 3% during the heat-up, which one of the following describes the coolant heat-up rate (HUR) from 140°F to 200°F?

A. HUR will initially decrease and then increase.

B. HUR will slowly decrease during the entire period.

C. HUR will slowly increase during the entire period.

D. HUR will remain the same during the entire period.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1270

Which one of the following will add the most positive reactivity during a power decrease from 100% to 65% over a 1 hour period? (Assume the power change is performed only by changing core recirculation flow rate.)

A. Fuel temperature change

B. Moderator temperature change

C. Fission product poison change

D. Core void fraction change

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1371 (P1470)

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

A. 1% power to 4% power

B. 5% power to 15% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1570 (P1567)

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

A. 1% power to 6% power

B. 10% power to 20% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B1765

Which one of the following lists the method(s) used to add positive reactivity during a normal power increase from 10% to 100%?

A. Control rod withdrawal only

B. Recirculation pump flow increase only

C. Control rod withdrawal and recirculation pump flow increase

D. Recirculation pump flow increase and steaming rate increase

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2070 (P2071)

Neglecting the effects of changes in core Xe-135, 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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2072 (P2069)

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% power to 5% power

B. 5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2166

A nuclear power plant is operating at 80% of rated power near the end of a fuel cycle. Which one of the following lists the typical method(s) used to add positive reactivity during a normal power increase to 100%?

A. Withdrawal of deep control rods and increasing recirculation flow rate

B. Withdrawal of deep control rods only

C. Withdrawal of shallow control rods and increasing recirculation flow rate

D. Withdrawal of shallow control rods only

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2270

With a nuclear reactor on a constant period, which one of the following power changes requires the <u>shortest</u> time to occur?

A. 1% power to 4% power

B. 5% power to 15% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2470

Neglecting the effects of core Xe-135, 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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2669 (P2169)

Neglecting the effects of core Xe-135, 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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B2770 (P2770)

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

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: A.

TOPIC: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B3769 (P3753)

Neglecting the effects of changes in core Xe-135, 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: 292008
KNOWLEDGE: K1.18 [3.8/3.8]
QID: B5034 (P2953)

Neglecting the effects of core Xe-135, 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: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B69

For which one of the following events will the Doppler coefficient act <u>first</u> to change the reactivity addition to the core?

A. A control rod drop during reactor power operation

B. The loss of one feedwater heater (extraction steam isolated) during reactor power operation

C. Tripping of the main turbine at 45% reactor power

D. A safety relief valve opening during reactor power operation

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B367

Reactor power was increased from 20% to 30% in one hour using only control rod withdrawal. Which one of the following describes the response of void fraction during the power increase?

A. Void fraction initially decreases, then increases back to the original value.

B. Void fraction initially increases, then decreases back to the original value.

C. Void fraction decreases and stabilizes below the original value.

D. Void fraction increases and stabilizes above the original value.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B1169

Which one of the following describes the core void fraction response that accompanies a reactor power increase from 20% to 30% using only control rod withdrawal?

A. Decreases and stabilizes at a lower void fraction

B. Increases and stabilizes at a higher void fraction

C. Initially decreases, then increases and stabilizes at the initial void fraction

D. Initially increases, then decreases and stabilizes at the initial void fraction

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B1368

A nuclear power plant is operating at 90% of rated power late in core life. When an operator withdraws a shallow rod two notches a power decrease occurs. This power decrease can be attributed to rod worth being ____________ and ____________ bundle void content.

A. high; decreased

B. high; increased

C. low; increased

D. low; decreased

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.5/3.6]
QID: B1671 (P1672)

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%.

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

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2354

A nuclear reactor is operating at steady-state 20% power. Then reactor power is increased to 40%. In comparison to operating conditions at 20% power, when the plant stabilizes at 40% power, reactor vessel pressure will be _____________, and reactor vessel water temperature will be _____________.

A. the same; the same

B. the same; higher

C. higher; the same

D. higher; higher

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2670

A nuclear reactor is operating with the following initial conditions:

Power level = 100%
Control rod density = 60%

After a load decrease reactor conditions are as follows:

Power level = 80%
Control rod density = 62%

All parameters attained normal steady-state values before and after the power change.

Given the following:

Total control rod
reactivity change = $-2.2 \times 10^{-1}\%\ \Delta K/K$
Power coefficient = $-1.5 \times 10^{-2}\%\ \Delta K/K/\%$ power

How much reactivity was added by changes in core recirculation flow rate during the load decrease? (Assume fission product poison reactivity does not change.)

A. $0.0\%\ \Delta K/K$

B. $-5.2 \times 10^{-1}\%\ \Delta K/K$

C. $-2.0 \times 10^{-1}\%\ \Delta K/K$

D. $-8.0 \times 10^{-2}\%\ \Delta K/K$

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.19 [3.1/3.2]
QID: B2970

If a nuclear reactor power increase is accomplished using only the control rods, which one of the following would result in the greatest amount of negative reactivity feedback from the void coefficient?

A. A void fraction increase from 5% to 10% at beginning of core life

B. A void fraction increase from 5% to 10% at end of core life

C. A void fraction increase from 40% to 45% at beginning of core life

D. A void fraction increase from 40% to 45% at end of core life

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.20 [3.3/3.4]
QID: B70

A nuclear power plant is operating at 100% power and core flow rate. Reactor power is reduced to 90% by inserting control rods. (Recirculating pump speed remains constant.)

What is the effect on core flow rate?

A. Core flow rate will decrease due to an increase in core voiding.

B. Core flow rate will increase due to the decrease in recirculation ratio.

C. Core flow rate will increase due to the decrease in two-phase flow resistance.

D. Core flow rate will decrease due to an increase in two-phase flow resistance.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.20 [3.3/3.4]
QID: B1469

Which one of the following parameter changes will occur if reactor power is increased from 70% to 90% by only changing recirculation flow?

A. Core void fraction increases.

B. Feedwater temperature decreases.

C. Reactor vessel outlet steam pressure increases.

D. Condensate depression in the main condenser hotwell increases.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B270

A nuclear power plant has been operating at full power for several months. Following a normal reactor shutdown, steam production will continue for a period of time, with the rate (Btu/hr) of steam production dependent upon the...

A. rate of reactor power decrease from full power to the point of adding heat.

B. pressure being maintained in the reactor pressure vessel (RPV).

C. previous power history of the plant and the time elapsed since shutdown.

D. recirculation flow rate and the water level being maintained in the RPV.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B1372 (P1272)

Following a reactor shutdown from three-months operation at full power, core heat production will continue for a period of time. The rate of core heat production will be dependent upon 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: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B3169 (P3171)

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle when a turbine control system malfunction closes the turbine steam inlet valves an additional 5 percent. Which one of the following describes the initial reactor power change and the cause for the power change?

A. Decrease, because the rate of neutron absorption in the moderator initially increases.

B. Decrease, because the rate of neutron absorption at U-238 resonance energies initially increases.

C. Increase, because the rate of neutron absorption in the moderator initially decreases.

D. Increase, because the rate of neutron absorption at U-238 resonance energies initially decreases.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B4036

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle when a turbine control system malfunction opens the turbine steam inlet valves an additional 5 percent. Which one of the following describes the initial reactor power change and the cause for the power change?

A. Decrease, because the rate of neutron absorption in the moderator initially increases.

B. Decrease, because the rate of neutron absorption at U-238 resonance energies initially increases.

C. Increase, because the rate of neutron absorption in the moderator initially decreases.

D. Increase, because the rate of neutron absorption at U-238 resonance energies initially decreases.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.21 [2.9/3.0]
QID: B4735

A nuclear power plant is initially operating at steady-state 60% power when a main steamline break develops that continuously releases 5% of rated main steam flow. The plant stabilizes as follows:

- No operator or protective actions occur.
- Automatic pressure control returns reactor pressure to its initial value.

Ignore any reactivity effects from feedwater injection temperature changes. Compared to the initial operating conditions, current reactor power is approximately __________; and current turbine power is approximately _________.

A. the same; 5% lower

B. the same; the same

C. 5% higher; 5% lower

D. 5% higher; the same

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B570

A nuclear power plant is initially operating steady-state at 50% power when a steam line break occurs that releases a constant 5% of rated steam flow. Assume no operator or protective actions occur, automatic pressure control returns reactor pressure to its value prior to the break, and feedwater injection temperature remains the same.

How will reactor power respond to the steam line break?

A. Decrease and stabilize at a lower power level.

B. Increase and stabilize at a higher power level.

C. Decrease at first, then increase and stabilize near the initial power level.

D. Increase at first, then decrease and stabilize near the initial power level.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B971

A nuclear power plant is operating at 85% of rated power when a failure of the steam pressure control system opens the turbine control valves to admit 10% more steam flow to the main turbine. No operator actions occur and no protective system actuations occur.

How will reactor power respond? (Assume the control valves remain in the failed position.)

A. Increase until power level matches the new steam demand.

B. Increase continuously and exceed reactor protection set points.

C. Decrease and stabilize at a lower power level above the point of adding heat.

D. Decrease and stabilize at a critical power level below the point of adding heat.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B1670

A nuclear power plant is operating normally at 50% of rated power when a main steamline break occurs that continuously releases 5% of rated steam flow. Assume no operator or protective actions occur, automatic pressure control returns reactor pressure to its initial value, and feedwater injection temperature remains the same.

How will turbine power respond to the main steamline break?

A. Decrease and stabilize at a lower power level.

B. Increase and stabilize at a higher power level.

C. Initially decrease, then increase and stabilize at the previous power level.

D. Initially increase, then decrease and stabilize at the previous power level.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B2371

A nuclear power plant is operating at 90% of rated power near the end of a fuel cycle. If a turbine control system malfunction opens the turbine control valves an additional 5 percent, reactor power will initially...

A. increase due to positive reactivity addition from the void coefficient only.

B. increase due to positive reactivity addition from the void and moderator temperature coefficients.

C. decrease due to negative reactivity addition from the void coefficient only.

D. decrease due to negative reactivity addition from the void and moderator temperature coefficients.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.22 [3.5/3.6]
QID: B2571

A nuclear power plant is operating normally at 50% of rated power when a steam break occurs that releases 5% of rated steam flow. Reactor power will initially...

A. increase due to positive reactivity addition from the void coefficient only.

B. increase due to positive reactivity addition from the void and moderator temperature coefficients.

C. decrease due to negative reactivity addition from the void coefficient only.

D. decrease due to negative reactivity addition from the void and moderator temperature coefficients.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.23 [2.6/3.1]
QID: B368

Which one of the following is the purpose of a rod sequence exchange?

A. Ensures proper rod coupling

B. Prevents rod shadowing

C. Promotes even fuel burnout

D. Minimizes water hole peaking

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.23 [2.6/3.1]
QID: B2572

During continuous reactor power operation, rod pattern exchanges are performed periodically to...

A. ensure some control rods remain inserted as deep control rods until late in the fuel cycle.

B. allow the local power range monitoring nuclear instruments to be asymmetrically installed in the core.

C. increase the rod worth of control rods that are nearly fully withdrawn.

D. prevent the development of individual control rods with very high reactivity worths.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B72 (P71)

Shortly after a reactor scram, reactor power indicates 5×10^{-2}% when a stable negative reactor period is attained. Approximately how much additional time is required for reactor power to decrease to 5×10^{-3}%?

A. 90 seconds

B. 180 seconds

C. 270 seconds

D. 360 seconds

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B771 (P770)

Which one of the following is responsible for the negative 80-second stable reactor period experienced shortly after a reactor scram?

A. The shortest-lived delayed neutron precursors

B. The longest-lived delayed neutron precursors

C. The shutdown margin just prior to the scram

D. The worth of the inserted control rods

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B1369 (P1965)

Shortly after a reactor scram, reactor power indicates 10^{-3}% where a stable negative period is attained. Reactor power will decrease to 10^{-4}% in approximately ______________ seconds.

A. 380

B. 280

C. 180

D. 80

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B1770 (P2171)

Following a reactor scram, reactor power indicates 0.1% when the typical stable post-scram reactor period is observed. Which one of the following is the approximate time required for reactor power to decrease to 0.05%?

A. 24 seconds

B. 55 seconds

C. 173 seconds

D. 240 seconds

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B2071

A nuclear power plant is operating at 100% power at the end of core life when a single main steam isolation valve suddenly closes. Prior to a reactor scram, reactor power will initially...

A. increase due to positive reactivity addition from the void coefficient only.

B. increase due to positive reactivity addition from the void and moderator coefficients.

C. decrease due to negative reactivity addition from the Doppler coefficient only.

D. decrease due to negative reactivity addition from the Doppler and moderator temperature coefficients.

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B2769 (P2768)

Nuclear reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

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: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3271 (P3271)

Nuclear reactors A and B are identical and have operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod remains fully withdrawn.

After ten minutes, when compared to reactor B, 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: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3472 (P3468)

A nuclear reactor is critical just below the point of adding heat when an inadvertent reactor scram occurs. All control rods fully insert except for one rod, which remains fully withdrawn. Five minutes after the reactor scram, with reactor period stable at approximately negative (-) 80 seconds, the remaining withdrawn control rod suddenly and rapidly fully inserts.

Which one of the following describes the reactor response to the insertion of the last control rod?

A. The negative period will remain stable at approximately -80 seconds.

B. The negative period will immediately become shorter, and then lengthen and stabilize at approximately -80 seconds.

C. The negative period will immediately become shorter, and then lengthen and stabilize at a value more negative than -80 seconds.

D. The negative period will immediately become shorter, and then lengthen and stabilize at a value less negative than -80 seconds.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B3771

A nuclear plower plant that has been operating at rated power for two months experiences a reactor scram. Five minutes after the scram, with all control rods still fully inserted, a count rate of 5,000 cps is indicated on the source range nuclear instruments with a reactor period of negative 80 seconds.

The majority of the source range detector output is currently 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: D.

TOPIC: 292008
KNOWLEDGE: K1.25 [2.8/2.9]
QID: B4736

Nuclear reactors A and B are identical and have operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod remains fully withdrawn.

After ten minutes, when compared to reactor A, the core fission rate in reactor B will be _____________, and the reactor period in reactor B will be ______________.

A. higher; longer

B. higher; the same

C. the same; longer

D. the same; the same

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.26 [3.4/3.7]
QID: B471

A nuclear power plant is operating at 100% power when one recirculation pump trips. Reactor power decreases and stabilizes at a lower power level. Which one of the following reactivity coefficients caused the initial decrease in reactor power?

A. Void coefficient

B. Pressure coefficient

C. Moderator temperature coefficient

D. Fuel temperature (Doppler) coefficient

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.26 [3.4/3.7]
QID: B672

A nuclear power plant is operating at 70% of rated power when one recirculation pump trips. Reactor power will initially __________ because of the effects of the __________ coefficient.

A. decrease; void

B. increase; moderator temperature

C. decrease; moderator temperature

D. increase; void

ANSWER: A.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B126

A nuclear reactor is exactly critical in the source range when a fully withdrawn control rod fully inserts into the core.

If no operator or automatic actions occur, how will the source range count rate respond?

A. Decrease to zero.

B. Decrease to the value of the source neutron strength.

C. Decrease to a value above the source neutron strength.

D. Decrease initially and then slowly increase and stabilize at the initial value.

ANSWER: C.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B1472

A nuclear power plant is initially operating at 100% power when a control rod fully inserts into the core. Assuming no operator action, reactor power will initially decrease and then...

A. return to the original power level with the void boundary lower in the core.

B. stabilize at a lower power level with the void boundary lower in the core.

C. return to the original power level with the void boundary higher in the core.

D. stabilize at a lower power level with the void boundary higher in the core.

ANSWER: D.

TOPIC: 292008
KNOWLEDGE: K1.27 [3.4/3.5]
QID: B1969 (P672)

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

A. zero.

B. an equilibrium value less than 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: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B131 (P2672)

Which one of the following percentages most closely approximates the decay heat produced in a nuclear reactor at 1 second and at 1 hour, respectively, following a scram from extended operation at 100% 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: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B372 (P370)

After one month of operation at 100% reactor power, the fraction of thermal power being produced from the decay of fission products in the operating nuclear reactor is:

A. greater than 10%.

B. greater than 5% but less than 10%.

C. greater than 1% but less than 5%.

D. less than 1%.

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2272 (P572)

A nuclear power plant has been operating at 100% power for several weeks when a reactor scram occurs. How much time will be required for core heat production to decrease to 1% following the scram?

A. 1 to 8 days

B. 1 to 8 hours

C. 1 to 8 minutes

D. 1 to 8 seconds

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2872 (P2872)

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).

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
Reactor vessel coolant inventory:	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: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B2972 (P2972)

A nuclear power plant has been operating for one hour at 50% of rated power following six months of operation at steady-state 100% power. Which one of the following is the percentage of rated thermal power currently being generated by decay heat?

A. 1% to 2%

B. 3% to 5%

C. 6% to 8%

D. 9% to 11%

ANSWER: B.

TOPIC: 292008
KNOWLEDGE: K1.30 [3.2/3.5]
QID: B4336 (P4336)

A nuclear power plant has been operating at rated power for six months when a reactor scram occurs. Which one of the following describes the source(s) of core heat generation 30 minutes after the reactor scram?

A. Fission product decay is the only significant source of core heat generation.

B. Delayed neutron-induced fission is the only significant source of core heat generation.

C. Fission product decay and delayed neutron-induced fission are both significant sources and produce approximately equal rates of core heat generation.

D. Fission product decay and delayed neutron-induced fission are both insignificant sources and generate core heat at rates that are less than the rate of ambient heat loss from the core.

ANSWER: A.