TOPIC: 293010
KNOWLEDGE: K1.01 [2.4/2.8]
QID: B499 (P497)

Which one of the following comparisons will result in a higher probability of brittle fracture of the reactor vessel?

A. A high reactor gamma flux rather than a high neutron flux.

B. A high reactor vessel material strength rather than a high material ductility.

C. A high reactor coolant oxygen content rather than a low oxygen content.

D. A rapid 100°F reactor cooldown at a high temperature rather than a low temperature.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.01 [2.4/2.8]
QID: B2499 (P2496)

Brittle fracture of a low-carbon steel is more likely to occur when the temperature of the steel is __________ the nil ductility temperature, and will normally occur when the applied stress is __________ the steel's yield strength (or yield stress).

A. greater than; greater than

B. greater than; less than

C. less than; greater than

D. less than; less than

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B1299 (P1896)

Brittle fracture of the reactor vessel (RV) is most likely to occur during a ____________ of the reactor coolant system (RCS) when RCS temperature is ____________ the RV reference temperature for nil-ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B1500 (P697)

The reference temperature for nil-ductility transition (RT_{NDT}) is the temperature above which...

A. a large compressive stress can result in brittle fracture.

B. a metal exhibits more ductile tendencies.

C. the probability of brittle fracture increases.

D. no appreciable deformation occurs prior to failure.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2099 (P2096)

Which one of the following will prevent brittle fracture failure of a reactor vessel?

A. Manufacturing the reactor vessel from low carbon steel.

B. Maintaining reactor vessel pressure below the maximum design limit.

C. Operating above the reference temperature for nil-ductility transition (RT_{NDT}).

D. Maintaining the number of reactor vessel heatup/cooldown cycles within limits.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2199 (P2295)

Brittle fracture of the reactor vessel (RV) is <u>least</u> likely to occur during a _____________ of the RV when RV temperature is _____________ the reference temperature for nil-ductility transition (RT_{NDT}).

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2299 (P996)

The nil-ductility transition temperature is that temperature...

A. below which vessel failure is imminent.

B. above which vessel failure is imminent.

C. below which the probability of brittle fracture significantly increases.

D. above which the probability of brittle fracture significantly increases.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.02 [2.2/2.7]
QID: B2699 (P597)

The nil-ductility transition temperature of the reactor vessel (RV) is the temperature...

A. above which the RV metal will elastically deform as RCS pressure decreases.

B. above which the RV metal loses its ability to elastically deform as RCS pressure increases.

C. below which the RV metal will elastically deform as reactor coolant system (RCS) pressure decreases.

D. below which the RV metal loses its ability to elastically deform as RCS pressure increases.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B100 (P96)

The likelihood of brittle fracture failure of the reactor vessel is reduced by...

A. reducing gamma flux exposure.

B. reducing vessel temperature.

C. reducing vessel pressure.

D. increasing vessel age.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B300 (P1897)

Which one of the following will apply a compressive stress to the outside wall of the reactor vessel?

A. Neutron embrittlement of the reactor vessel

B. Increasing reactor coolant system (RCS) pressure

C. Performing an RCS cooldown

D. Performing an RCS heatup

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B398 (P397)

Brittle fracture of the reactor coolant pressure boundary is most likely to occur at...

A. 400°F, 10 psig.

B. 400°F, 400 psig.

C. 120°F, 10 psig.

D. 120°F, 400 psig.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B399 (P399)

The total stress on the reactor vessel inner wall is greater during cooldown than heatup because...

A. thermal heatup stress totally offsets pressure stress at the inner wall.

B. both pressure stress and thermal cooldown stress are tensile at the inner wall.

C. the tensile thermal cooldown stress at the inner wall is greater in magnitude than the compressive pressure stress at the same location.

D. thermal cooldown stress and thermal heatup stress are both tensile at the inner wall, but cooldown stress is greater in magnitude.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B400 (P398)

The probability of reactor vessel brittle fracture is <u>decreased</u> by minimizing...

A. oxygen content in the reactor coolant.

B. operation at high temperatures.

C. the time taken to cool down the reactor coolant system.

D. the amount of copper manufactured into the reactor vessel.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B899 (P97)

Pressure stress on the reactor vessel wall is...

A. compressive across the entire wall.

B. tensile across the entire wall.

C. tensile on the inner wall, compressive on the outer wall.

D. compressive on the inner wall, tensile on the outer wall.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B1899 (P1597)

Which one of the following comparisons increases the probability of brittle fracture for a reactor pressure vessel wall?

A. Using materials fabricated from stainless steel rather than carbon steel.

B. A compressive stress rather than a tensile stress.

C. A high reactor coolant temperature rather than a low reactor coolant temperature.

D. Performing a 100°F/hr cooldown rather than a 100°F/hr heatup.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2300

A reactor plant heatup is in progress. The thermal stress applied to the reactor vessel is...

A. tensile across the entire wall.

B. tensile at the inner wall and compressive at the outer wall.

C. compressive across the entire wall.

D. compressive at the inner wall and tensile at the outer wall.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2399 (P2397)

Reactor coolant system pressure-temperature limit curves are derived by using a conservative value for the reactor vessel reference temperature for nil ductility transition (RT_{NDT}).

Early in core life, the assumed value of RT_{NDT} is ___________ than actual RT_{NDT}; and actual RT_{NDT} is verified periodically over core life by _______________.

A. higher; removing and testing irradiated specimens of reactor vessel material

B. higher; inservice inspection and analysis of the reactor vessel wall

C. lower; removing and testing irradiated specimens of reactor vessel material

D. lower; inservice inspection and analysis of the reactor vessel wall

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2500 (P2497)

Which one of the following comparisons will result in a higher probability of brittle fracture failure of the reactor vessel?

A. A feedwater pH of 8.5 rather than 9.0

B. A high feedwater oxygen content rather than a low oxygen content

C. A 50°F/hr reactor cooldown rather than a 100°F/hr heatup

D. A high gamma flux rather than a high neutron flux

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2700 (P1696)

Which one of the following comparisons increases the probability of brittle fracture of a reactor pressure vessel wall?

A. Performing a 50°F/hr cooldown at 1600 psia rather than a 50°F/hr cooldown at 1200 psia.

B. A compressive stress rather than a tensile stress across the vessel wall.

C. A high reactor coolant temperature rather than a low reactor coolant temperature.

D. Changing wall design to increase toughness while maintaining the same strength.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B2999

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel?

A. Maximum setpoint for main steam safety valves

B. Maximum chloride concentration in the reactor coolant

C. Maximum reactor pressure versus vessel temperature during heatup

D. Maximum differential temperature between the vessel steam dome and the bottom head

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.04 [2.9/3.2]
QID: B3700 (P3698)

A nuclear reactor is shutdown with the shutdown cooling system maintaining reactor coolant temperature at 240°F immediately following an uncontrolled cooldown from 500°F. If reactor coolant temperature is held constant at 240°F, which one of the following describes the change in tensile stress on the inner wall of the reactor vessel (RV) over the next few hours?

A. Decreases, because the temperature gradient across the RV wall will decrease.

B. Increases, because the temperature gradient across the RV wall will decrease.

C. Decreases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

D. Increases, because the inner RV wall temperature will approach the nil-ductility transition temperature.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B299 (P1997)

Which one of the following describes the effect of fast neutron irradiation on a reactor pressure vessel?

A. Increased fatigue crack growth rate

B. Increased plastic deformation prior to failure

C. Increased ductility

D. Increased nil-ductility reference transition temperature

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B500 (P499)

Which one of the following types of radiation most significantly reduces the ductility of the metal of a reactor pressure vessel?

A. Beta

B. Thermal neutrons

C. Gamma

D. Fast neutrons

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B599 (P298)

Prolonged exposure of a reactor vessel to a fast neutron flux will cause the reference temperature for nil-ductility transition (RT_{NDT}) to...

A. decrease due to the propagation of existing flaws.

B. increase due to the propagation of existing flaws.

C. decrease due to changes in the material properties of the vessel wall.

D. increase due to changes in the material properties of the vessel wall.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1100 (P1100)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles with an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles with an average power capacity of 60%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the lower average power capacity.

B. Reactor A due to the greater number of heatup/cooldown cycles.

C. Reactor B due to the higher average power capacity.

D. Reactor B due to the fewer number of heatup/cooldown cycles.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1200 (P1898)

Which one of the following is the <u>major</u> contributor to embrittlement of the reactor vessel?

A. High-energy fission fragments

B. High operating temperature

C. High-energy gamma radiation

D. High-energy neutron radiation

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1800 (P1699)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles with an average power capacity of 60%. Reactor B has experienced 40 heatup/cooldown cycles with an average power capacity of 50%.

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the higher average power capacity

B. Reactor A due to the fewer number of heatup/cooldown cycles

C. Reactor B due to the lower average power capacity

D. Reactor B due to the greater number of heatup/cooldown cycles

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1900 (P899)

After several years of operation the maximum allowable stress to the reactor pressure vessel is more limited by the inner wall than the outer wall because...

A. the inner wall operates at a higher temperature than the outer wall.

B. the inner wall has a smaller surface area than the outer wall.

C. the inner wall experiences more neutron-induced embrittlement than the outer wall.

D. the inner wall experiences more tensile stress than the outer wall.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B1999 (P998)

Prolonged exposure to __________ will cause nil-ductility transition temperature of the reactor vessel to __________.

A. neutron radiation; increase

B. neutron radiation; decrease

C. normal operating pressure; increase

D. normal operating pressure; decrease

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2100 (P2098)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 40 heatup/cooldown cycles and has an average power capacity of 50%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the fewer number of heatup/cooldown cycles

B. Reactor A due to the higher average power capacity

C. Reactor B due to the greater number of heatup/cooldown cycles

D. Reactor B due to the lower average power capacity

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2600 (P2599)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 60% and has been operating for 15 years. Reactor B has an average lifetime power capacity of 75% and has been operating for 12 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A. Reactor A due to the lower average lifetime power capacity.

B. Reactor B due to the higher average lifetime power capacity.

C. Both reactors will have approximately the same nil ductility transition temperature because each core has produced approximately the same number of fissions.

D. Both reactors will have approximately the same nil ductility transition temperature because fast neutron irradiation in a shut down core is not significant.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2800 (P2799)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%. Reactor B has experienced 20 heatup/cooldown cycles and has an average power capacity of 80%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature and why?

A. Reactor A due to the lower average power capacity

B. Reactor A due to the greater number of heatup/cooldown cycles

C. Reactor B due to the higher average power capacity

D. Reactor B due to the fewer number of heatup/cooldown cycles

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B2900 (P2298)

Two identical nuclear reactors have been in operation for the last 10 years. Reactor A has experienced 40 heatup/cooldown cycles and has an average power capacity of 50%. Reactor B has experienced 30 heatup/cooldown cycles and has an average power capacity of 60%.

Which reactor will have the highest reactor vessel nil-ductility transition temperature?

A. Reactor A due to the greater number of heatup/cooldown cycles

B. Reactor A due to the lower average power capacity

C. Reactor B due to the fewer number of heatup/cooldown cycles

D. Reactor B due to the higher average power capacity

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3000 (P2698)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has achieved an average lifetime power capacity of 60% while operating for 15 years. Reactor B has achieved an average lifetime power capacity of 60% while operating for 12 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A. Reactor A because it has produced the greater number of fissions.

B. Reactor B because it has produced the fewer number of fissions.

C. Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

D. Both reactors will have approximately the same nil ductility transition temperature because the fission rate in a shut down core is not significant.

ANSWER: B.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3200 (P3197)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing determines that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 42°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is more likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is less likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the specimen NDT temperature would not decrease during the described 18-month period of operation.

D. The test results are questionable because the specimen NDT temperature would decrease by more than 2°F during the described 18-month period of operation.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3300 (P3297)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing determines that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 44°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is <u>more</u> susceptible to brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is <u>less</u> susceptible to brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the vessel NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D. The test results are questionable because the vessel NDT temperature would increase by <u>at least</u> 10°F during the described 18-month period of operation.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3600 (P3598)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The testing indicates that the nil-ductility transition (NDT) temperature of the specimen has decreased from 44°F to 32°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is more likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is less likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the actual specimen NDT temperature would not decrease during the described 18-month period of operation.

D. The test results are questionable because the actual specimen NDT temperature would decrease by much less than indicated by the test results.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B3900 (P3898)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 90% and has been operating for 10 years. Reactor B has an average lifetime power capacity of 80% and has been operating for 15 years.

Which reactor will have the higher reactor vessel nil ductility transition temperature and why?

A. Reactor A because it has the higher average lifetime power capacity.

B. Reactor B because it has the lower average lifetime power capacity.

C. Reactor A because it has produced significantly less fissions.

D. Reactor B because it has produced significantly more fissions.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4250 (P4250)

A nuclear reactor is shut down for refueling following 18 months of operation at an average power level of 85%. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The tests determined that the nil-ductility transition (NDT) temperature of the specimen has increased from 42°F to 72°F since the previous refueling shutdown.

Which one of the following conclusions is warranted?

A. The test results are credible and the reactor vessel is <u>more</u> likely to experience brittle fracture now than after the previous refueling shutdown.

B. The test results are credible and the reactor vessel is <u>less</u> likely to experience brittle fracture now than after the previous refueling shutdown.

C. The test results are questionable because the specimen NDT temperature would <u>not</u> increase during the described 18-month period of operation.

D. The test results are questionable because the specimen NDT temperature would increase by <u>less</u> than indicated during the described 18-month period of operation.

ANSWER: D.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4450 (P4450)

A nuclear reactor is shut down for refueling. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The specimen was last tested six years ago. During the subsequent six years, the reactor has completed several 18-month fuel cycles with an average power level of 85%.

The test determines that the nil-ductility transition (NDT) temperature of the specimen has remained unchanged at 44°F since it was last tested. Which one of the following conclusions is warranted?

A. The test results are credible, however, the reactor vessel is more susceptible to brittle fracture now than six years ago.

B. The test results are credible, however, the reactor vessel is less susceptible to brittle fracture now than six years ago.

C. The test results are questionable because the specimen NDT temperature should have increased since it was last tested.

D. The test results are questionable because the specimen NDT temperature should have decreased since it was last tested.

ANSWER: C.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B4650 (P4650)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has achieved an average lifetime power capacity of 60% while operating for 12 years. Reactor B has achieved an average lifetime power capacity of 60% while operating for 15 years.

Which reactor, if any, will have the lower reactor vessel nil ductility transition temperature?

A. Reactor A because it has produced the fewer total number of fissions.

B. Reactor B because it has produced the greater total number of fissions.

C. Both reactors will have approximately the same nil ductility transition temperature because they have equal average lifetime power capacities.

D. Both reactors will have approximately the same nil ductility transition temperature because the fission rate in a shut down core is not significant.

ANSWER: A.

TOPIC: 293010
KNOWLEDGE: K1.05 [2.5/2.8]
QID: B5550 (P5550)

Two identical nuclear reactors are currently shut down for refueling. Reactor A has an average lifetime power capacity of 90% and has been operating for 24 years. Reactor B has an average lifetime power capacity of 72% and has been operating for 30 years.

Which reactor, if any, will have the lowest reactor vessel nil ductility transition temperature?

A. Reactor A because it has produced the greater total number of fissions.

B. Reactor B because it has produced the fewer total number of fissions.

C. Both reactors will have approximately the same nil ductility transition temperature because fast neutron irradiation in a shut down core is not significant.

D. Both reactors will have approximately the same nil ductility transition temperature because each core has produced approximately the same total number of fissions.

ANSWER: D.