TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P97 (B899)

The pressure stress on a reactor vessel wall is...

A. tensile across the entire wall.

B. compressive 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P296

Brittle fracture is the fragmentation of metal resulting from the application of __________ stress at relatively __________ temperatures.

A. compressive; high

B. compressive; low

C. tensile; high

D. tensile; low

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P397 (B398)

The conditions for brittle fracture of the reactor vessel are most closely approached at…

A. 400°F, 10 psig.

B. 400°F, 400 psig.

C. 120°F, 10 psig.

D. 120°F, 400 psig.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P497

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

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

B. A high oxygen content in the reactor coolant rather than a low oxygen content.

C. A high material strength in the reactor vessel rather than a high material ductility.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1200

Which one of the following reduces the probability of brittle fracture of the reactor vessel?

A. The presence of a preexisting flaw.

B. The presence of a tensile stress.

C. Operation at low temperatures.

D. Small heatup and cooldown rates.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1296

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. A high temperature rather than a low temperature.

B. A tensile stress rather than a compressive stress.

C. Performing a 100°F/hour heatup rather than a 100°F/hour cooldown.

D. Fabricating the vessel from stainless steel rather than carbon steel.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1396

Which one of the following statements describes the relationship between brittle fracture and the nil-ductility transition temperature?

A. Operation below the nil-ductility transition temperature will result in brittle fracture.

B. Operation above the nil-ductility transition temperature will result in brittle fracture.

C. Operation below the nil-ductility transition temperature will increase the probability of brittle fracture.

D. Operation above the nil-ductility transition temperature will increase the probability of brittle fracture.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1597 (B1899)

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. Using a vessel fabricated from stainless steel rather than carbon steel.

B. Subjecting the vessel wall to 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 of the reactor rather than a 100°F/hr heatup.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1696

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

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

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

C. Performing a 50°F/hr cooldown at 1,600 psia rather than a 50°F/hr cooldown at 1,200 psia.

D. Changing the reactor vessel manufacturing process to increase toughness while maintaining the same yield strength.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1796

Brittle fracture of the reactor vessel wall is <u>least likely</u> to occur at...

A. 120°F; 2,200 psig.

B. 120°F; 400 psig.

C. 400°F; 2,200 psig.

D. 400°F; 400 psig.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P1896 (B1299)

Brittle fracture of the reactor vessel (RV) is most likely to occur during a reactor ___________ when RV temperature is ___________ the nil-ductility transition temperature.

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P2096 (B2099)

Which one of the following will normally 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 nil-ductility transition temperature.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P2196

Brittle fracture of the reactor vessel (RV) is least likely to occur during a __________ of the RV when RV temperature is __________ the nil-ductility transition temperature.

A. cooldown; above

B. heatup; above

C. cooldown; below

D. heatup; below

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P2496 (B2499)

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

A. less than; less than

B. less than; greater than

C. greater than; less than

D. greater than; greater than

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P2497

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. A reactor coolant pH of 8.5 rather than 9.0.

B. A high oxygen content in the reactor coolant rather than a low oxygen content.

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

D. A high gamma flux in the reactor rather than a high neutron flux.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.01 [2.8/3.2]
QID: P2896

Which one of the following comparisons results in a lower probability for brittle fracture of a reactor vessel?

A. A reactor coolant pH of 9.0 rather than 8.5.

B. A low oxygen content in the reactor coolant rather than a high oxygen content.

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

D. A high gamma flux in the reactor rather than a high neutron flux.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P98

The nil-ductility transition temperature for a reactor vessel is the temperature...

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

B. determined by fracture mechanics to be equivalent to the reference transition temperature.

C. determined by Charpy V-notch test to be equivalent to the reference transition temperature.

D. below which the yield stress of the metal is inversely proportional to Young's modulus of elasticity.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P597 (B2699)

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

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

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

C. below which the RV metal will elastically deform as RV pressure decreases.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P697 (B1500)

The nil-ductility transition temperature 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P996 (B2299)

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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P96 (B100)

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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P142

Which one of the following reactor coolant system (RCS) conditions is least effective in preventing brittle fracture of the reactor vessel?

A. Operating within prescribed RCS heatup and cooldown rate limitations.

B. Operating with RCS temperature greater than the nil-ductility transition temperature.

C. Operating with low RCS pressure when RCS temperature is low.

D. Operating with a ramped RCS temperature as reactor power level increases.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P297

Why are reactor coolant system cooldown rate limitations established?

A. Prevent excessive reactivity additions.

B. Prevent brittle fracture of the reactor vessel.

C. Prevent excessive reactor coolant system subcooling.

D. Prevent impurities from precipitating out of solution in the reactor vessel.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P300

The thermal stress experienced by the reactor vessel during a reactor coolant system heatup is...

A. compressive at the inner wall and tensile at the outer wall of the vessel.

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

C. tensile across the entire vessel wall.

D. compressive across the entire vessel wall.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P399 (B399)

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

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

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

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

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P898

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

A. increasing reactor vessel age.

B. reducing reactor vessel pressure.

C. reducing reactor vessel temperature.

D. increasing the reactor vessel gamma flux exposure.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P1098

Which one of the following will increase the compressive stress on the outside surface of the reactor vessel wall?

A. Neutron irradiation

B. Gamma irradiation

C. Reactor coolant system cooldown

D. Reactor coolant system heatup

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P1298

Which one of the following applies a compressive stress to the inner wall of the reactor vessel during a reactor coolant system heatup?

A. Embrittlement stress

B. Yield stress

C. Pressure stress

D. Thermal stress

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P1397

Which one of the following is the most limiting component for establishing reactor coolant system heatup/cooldown rate limits?

A. Pressurizer

B. Reactor vessel

C. Fuel rod

D. Steam generator

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P1598

Which one of the following stresses is compressive on the outer wall of the reactor vessel during a reactor coolant system cooldown?

A. Yield stress

B. Thermal stress

C. Pressure stress

D. Embrittlement stress

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P1897 (B300)

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

A. Decreasing reactor coolant system pressure.

B. Increasing reactor coolant system pressure.

C. Performing a reactor coolant system cooldown.

D. Performing a reactor coolant system heatup.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P2397 (B2399)

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

The conservative value used for the reactor vessel NDTT is __________ than the actual NDTT; the actual NDTT is verified periodically by __________.

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

B. higher; in-service inspection and analysis of the reactor vessel wall

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

D. lower; in-service inspection and analysis of the reactor vessel wall

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P2998

Which one of the following operating limitations is designed to prevent brittle fracture of the reactor vessel and/or the reactor coolant system (RCS)?

A. Maximum setpoint for the pressurizer safety valves.

B. Maximum differential pressure between the RCS and the steam generators.

C. Maximum RCS pressure versus RCS temperature for a given RCS heatup rate.

D. Maximum differential temperature between the RCS and the pressurizer.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.04 [3.3/3.7]
QID: P3698 (B3700)

A reactor is shutdown with the shutdown cooling system maintaining reactor coolant temperature at 240°F immediately following an uncontrolled rapid 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P95

Fast neutron irradiation of the reactor vessel results in __________ stresses within the vessel metal, thereby __________ the nil-ductility transition temperature.

A. decreased; increasing

B. decreased; decreasing

C. increased; increasing

D. increased; decreasing

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P143

Fast neutron irradiation adversely affects the reactor vessel primarily by causing...

A. metal embrittlement.

B. brittle fracture.

C. flaw initiation.

D. flaw propagation.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P298 (B599)

Prolonged exposure of a reactor vessel to a fast neutron flux will cause the nil-ductility transition temperature 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P398 (B400)

The likelihood of reactor vessel brittle fracture is decreased by minimizing...

A. the oxygen content in the reactor coolant.

B. operation at high reactor coolant temperatures.

C. the time taken to cool down the reactor.

D. the amount of copper contained in the metal used for the reactor vessel.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P499 (B500)

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

A. Beta

B. Thermal neutrons

C. Gamma

D. Fast neutrons

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P899 (B1900)

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

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

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

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

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P998 (B1999)

Prolonged exposure to __________ will cause the 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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P1100 (B1100)

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

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

A. Reactor A, due to the lower average capacity factor.

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

C. Reactor B, due to the higher average capacity factor.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P1498

The two factors that have the greatest effect on the nil-ductility transition temperature of the reactor vessel over its life are...

A. thermal neutron flux and vessel copper content.

B. thermal neutron flux and vessel carbon content.

C. fast neutron flux and vessel copper content.

D. fast neutron flux and vessel carbon content.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P1699 (B1800)

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

Which reactor will have the <u>lower</u> reactor vessel nil-ductility transition temperature, and why?

A. Reactor A, due to the higher average capacity factor.

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

C. Reactor B, due to the lower average capacity factor.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P1898 (B1200)

Which one of the following is the major contributor to embrittlement of a reactor vessel?

A. High-energy fission fragments

B. High operating temperature

C. High-energy gamma radiation

D. High-energy neutron radiation

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P1997 (B299)

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

A. Increased fatigue crack growth rate

B. Increased plastic deformation prior to failure

C. Increased ductility

D. Increased nil-ductility transition temperature

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P2098 (B2100)

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

Which reactor will have the <u>higher</u> reactor vessel nil-ductility transition temperature, and why?

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

B. Reactor A, due to the higher average capacity factor.

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

D. Reactor B, due to the lower average capacity factor.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P2298

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

Which reactor will have the <u>higher</u> 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 capacity factor.

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

D. Reactor B, due to the higher average capacity factor.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P2599 (B2600)

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

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

A. Reactor A, due to the lower average lifetime capacity factor.

B. Reactor B, due to the higher average lifetime capacity factor.

C. Both reactors will have approximately the same nil-ductility transition temperature because each reactor 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 shutdown reactor is not significant.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P2698 (B3000)

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

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

A. Reactor A, because it has produced more total fissions.

B. Reactor B, because it has produced less total 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 shutdown reactor is not significant.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P2799 (B2800)

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

Which reactor will have the <u>higher</u> reactor vessel nil-ductility transition temperature, and why?

A. Reactor A, due to the lower average capacity factor.

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

C. Reactor B, due to the higher average capacity factor.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P3197 (B3200)

A reactor is shut down for refueling following 18 months of operation at an average power level of 85 percent. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The testing determined that the nil-ductility transition (NDT) temperature of the specimen 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 <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> decrease during the described 18-month period of operation.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P3297 (B3300)

A reactor is shut down for refueling following 18 months of operation at an average power level of 85 percent. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The testing determined that the nil-ductility transition (NDT) temperature of the specimen 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 more susceptible to brittle fracture now than after the previous refueling shutdown.

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

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

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P3598 (B3600)

A reactor is shut down for refueling following 18 months of operation at an average power level of 85 percent. 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P3898 (B3900)

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

B. Reactor B, because it has the lower average lifetime capacity factor.

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

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P4250 (B4250)

A reactor is shut down for refueling following 18 months of operation at an average power level of 85 percent. 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 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 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 increase during the described 18-month period of operation.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P4450 (B4450)

A reactor is shut down for refueling. During the shutdown, a reactor vessel metal specimen was removed from the reactor vessel for testing. The specimen was last tested six years ago and then returned to its original location in the reactor vessel. During the subsequent six years, the reactor has completed several 18 month fuel cycles with an average power level of 85 percent.

The tests determined 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.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P4650 (B4650)

Two identical reactors are currently shut down for refueling. Reactor A has achieved an average lifetime capacity factor of 60 percent while operating for 12 years. Reactor B has achieved an average lifetime capacity factor of 60 percent 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 less total fissions.

B. Reactor B, because it has produced more total 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 shutdown reactor is not significant.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P5550 (B5550)

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

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

A. Reactor A, because it has produced more total fissions.

B. Reactor B, because it has produced less total fissions.

C. Both reactors will have approximately the same nil-ductility transition temperature because fast neutron irradiation in a shutdown reactor is not significant.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P6350 (B6350)

Which one of the following comparisons results in a higher probability for brittle fracture of a reactor vessel?

A. A high fast neutron flux in the reactor rather than a high gamma flux.

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

C. A rapid 100°F reactor heatup at a high temperature rather than at a low temperature.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P6950 (B6950)

Two identical reactors are currently shut down for refueling. Reactor A has an average lifetime capacity factor of 90 percent and has been operating for 16 years. Reactor B has an average lifetime capacity factor of 80 percent and has been operating for 18 years.

Which reactor, if any, will have the <u>lower</u> reactor vessel nil-ductility transition temperature, and why?

A. Reactor A, due to the higher average lifetime capacity factor.

B. Reactor B, due to the lower average lifetime capacity factor.

C. Both reactors will have approximately the same nil-ductility transition temperature because each reactor 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 shutdown reactor is <u>not</u> significant.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.05 [2.9/3.0]
QID: P7640 (B7640)

Which one of the following comparisons results in a lower probability for brittle fracture of a reactor vessel?

A. A high gamma flux in the reactor rather than a high fast neutron flux.

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

C. A rapid 100°F reactor heatup at a low temperature rather than at a high temperature.

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

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.06 [3.6/3.8]
QID: P99

A nuclear power plant is shut down with the reactor coolant system at 1,200 psia and 350°F. Which one of the following would be most likely to cause a pressurized thermal shock to the reactor vessel?

A. A rapid depressurization followed by a rapid heatup.

B. A rapid depressurization followed by a rapid cooldown.

C. A rapid cooldown followed by a rapid pressurization.

D. A rapid heatup followed by a rapid pressurization.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.06 [3.6/3.8]
QID: P299

Pressurized thermal shock is a condition that can occur following a rapid __________ of the reactor coolant system if system pressure is rapidly __________.

A. cooldown; decreased

B. cooldown; increased

C. heatup; decreased

D. heatup; increased

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.06 [3.6/3.8]
QID: P2800

Which one of the following reactor coolant system (RCS) events would be <u>most</u> likely to cause a pressurized thermal shock to the reactor vessel?

A. Starting a reactor coolant pump in an idle RCS loop with the associated steam generator temperature less than the loop temperature.

B. Starting a reactor coolant pump in an idle RCS loop with the associated steam generator temperature greater than the loop temperature.

C. Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a steam generator steam outlet nozzle.

D. Continuous emergency coolant injection to the RCS during and after a complete and unisolable rupture of a reactor vessel coolant outlet nozzle.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.07 [3.8/4.1]
QID: P100

During a severe reactor coolant system overcooling transient, a major concern is...

A. accelerated zirconium hydriding.

B. loss of reactor vessel water level.

C. loss of reactor coolant pump net positive suction head.

D. brittle fracture of the reactor vessel.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.07 [3.8/4.1]
QID: P1000

An uncontrolled cooldown is a brittle fracture concern because it creates a large __________ stress at the __________ wall of the reactor vessel.

A. tensile; inner

B. tensile; outer

C. compressive; inner

D. compressive; outer

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.07 [3.8/4.1]
QID: P1099

During an uncontrolled cooldown of a reactor coolant system, the component most susceptible to brittle fracture is the...

A. reactor vessel.

B. steam generator tube sheet.

C. cold leg accumulator penetration.

D. loop resistance temperature detector penetration.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.07 [3.8/4.1]
QID: P1199

Which one of the following describes the thermal stress placed on the reactor vessel wall during a cooldown of the reactor coolant system?

A. Tensile across the entire wall.

B. Compressive across the entire wall.

C. Tensile at the inner wall, compressive at the outer wall.

D. Compressive at the inner wall, tensile at the outer wall.

[redacted]

TOPIC: 193010
KNOWLEDGE: K1.07 [3.8/4.1]
QID: P2797

A nuclear power plant heatup is in progress using reactor coolant pumps. 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.

[redacted]