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AMPP-Nuclear

Nuclear Coatings Inspection Specialty (NCIS)

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Question: 1

In a 2024 NRC inspection scenario at a pressurized water reactor (PWR) undergoing steam generator replacement, the coatings inspector identifies nonconformances in the application of epoxy-based containment liner coatings under 10 CFR 50 Appendix B Criterion XV. The licensee proposes a corrective action plan involving re-inspection protocols and material segregation. Which of the following elements must be incorporated into the plan to ensure compliance with Criterion XVI (Corrective Action), assuming a multi-vendor supply chain with potential 10 CFR 21 reportability thresholds exceeded due to coating delamination risks affecting structural integrity?

A. Calculation of delamination propagation rate using finite element analysis with parameters σ_yield = 250 MPa and E_modulus = 3.5 GPa for the epoxy matrix
B. Verification steps including ultrasonic thickness measurement at 5 mm grid spacing and adhesion pulloff testing per ASTM D4541 with minimum 1000 psi acceptance criterion
C. Root cause analysis applying Ishikawa diagram methodology integrated with probabilistic risk assessment (PRA) models updated per NRC Regulatory Guide 1.200 Revision 2
D. Segregation protocols mandating RFID tagging of nonconforming batches and quarantine storage per ANSI N45.2.2-1972, with audit trails traceable to procurement documents under Criterion VII

Answer: A, B, C

Explanation:
Under 10 CFR 50 Appendix B Criterion XVI, corrective actions for nonconforming coatings must address immediate disposition, root cause investigation, and preventive measures to mitigate recurrence, particularly in safety-related applications like containment liners where delamination could compromise leak-tightness. The delamination propagation rate calculation using finite element analysis with specified yield stress and modulus parameters quantifies the safety margin degradation under seismic loads, aligning with design control under Criterion III. Verification steps such as ultrasonic gridding and adhesion testing per ASTM D4541 ensure objective evidence of quality restoration, directly supporting inspection requirements under Criterion X. Root cause analysis via Ishikawa diagrams combined with PRA per RG 1.200 Rev. 2 evaluates broader implications, including potential core damage frequency increases, fulfilling the criterion's emphasis on systemic improvements. Segregation protocols, while essential for material control under Criterion VII, do not directly constitute corrective action elements unless tied to recurrence prevention, which is secondary here.

Question: 2

What is the correct formula relating initial contamination Ci, contamination after decontamination Cf, and Decontamination Factor (DF)?

A. DF=Cf/Ci
B. DF=Ci/Cf

C. DF=Ci×Cf
D. DF=Ci−Cf

Answer: B

Explanation:
The Decontamination Factor is the ratio of initial contamination to final residual contamination, measuring efficiency of removal.

Question: 3

CSL I dry liner weld area, post-quake check under RWP 100 mrem. Which?

A. VT-1 borescope 12x, weld indication per IWE-3510.3: height <1/64 inch accept.
B. DFT ultrasonic E797, 18-mil, echo mode for liner.
C. Holiday low V 67 V/mil D5162, brush electrode.
D. Report isometric 1:20 scale, QA NDE form.

Answer: A, B, D

Explanation:
Dry CSL I VT-1 IWE-3510.3 for weld height <1/64 inch. DFT E797 echo for steel liner. Checklists isometrics 1:20, NDE QA. Holiday possible but visual priority.

Question: 4

During a routine coating inspection within an RCA, an inspector's dosimeter alarm sounds indicating an accumulated dose approaching the RWP limit. What is the appropriate action according to NCIS?

A. Notify Radiological Control and prepare to exit the RCA once the current task is complete.
B. Adjust the dosimeter alarm thresholds to temporarily avoid interruption.
C. Continue work as scheduled without notification since dose is below limit.
D. Take a short break in a low-dose area inside the RCA to reset the dosimeter.

Answer: A

Explanation:
Hearing a dosimeter alarm signifies nearing dose limits, requiring notification to radiological control and preparation for exit to avoid dose overrun. Adjusting alarm thresholds or continuing without notification breaches safety controls. Breaking in the RCA does not reset cumulative dose and is unsafe.

Question: 5

An inspector certified under ASTM D4537 is reviewing documentation for a new coating project. Which of the following is LEAST likely a requirement of the certification process?

A. Knowledge of nuclear coating standards and inspection techniques
B. Ability to perform coating thickness measurements with calibration checks
C. Practical inspection experience including defect recognition on coated surfaces
D. Basic understanding of general construction codes unrelated to coatings

Answer: D

Explanation:
ASTM D4537 focuses competency on nuclear coatings inspection standards and procedures, including measurement and defect identification. General construction codes unrelated to coatings are not a core requirement for certification.

Question: 6

RG 1.54 sump strainer coating, debris entanglement. Tests?

A. Drag coeff $C_d = F_d / (0.5 \rho v^2 A) < 0.5$.
B. Rad 10^5 Rads, tensile >80% initial ASTM D638.
C. Snag resistance, thread pull F>10 lbf.
D. UV aging 2000 hrs, chalking <2 ASTM D4214.

Answer: A, B, C

Explanation:
Drag for flow, tensile post-rad, snag for debris. UV outdoor.

Question: 7

Scenario: A U.S. licensee integrates IAEA GSR Part 3 (2014) with NRC 10 CFR 20 for coatings in waste storage, but fails dose limit <1 mSv/y due to leaching. NRC/IAEA joint review identifies gap.
Which harmonized actions?

A. Adopt IAEA SSG-29 for waste coatings ageing per GALL AMP XI.M42
B. CNSC bilateral input on REGDOC-2.12.3 for leaching models <10^-4 cm/y
C. ONR SAP EAD.6 equivalence for public exposure in shared PRA
D. ASN RFS III.2.f for French leaching standards in transatlantic cooperation

Answer: A, B

Explanation:
IAEA/NRC harmonization per GSR Part 3 adopts SSG-29 for <1 mSv/y leaching in GALL. CNSC REGDOC-2.12.3 bilateral models <10^-4 cm/y. ONR/ASN are national.

Question: 8

For SSPC-SP 10 cleaning, what is the maximum allowable percentage of adherent mill scale and rust staining after blasting?

A. 10%
B. 1%
C. 5%
D. 0%

Answer: C

Explanation:
SSPC-SP10 allows up to 5% of the surface area to have tightly adherent staining or rust after blasting. This small amount is acceptable while maintaining the near-white blast cleaning standard.

Question: 9

Which step is essential when conducting visual inspection under low-light conditions in dry CSL III areas to fulfill ASME XI VT-3 requirements?

A. Use of infrared sensors to detect coating defects.
B. Postponement of inspection until daylight hours.
C. Inspection with thermal imaging cameras only.
D. Use of artificial lighting to supplement ambient illumination.

Answer: D

Explanation:
VT-3 requires sufficient illumination, often mandating artificial lights under low natural lighting. Postponing or using non-visual sensors does not meet visual inspection standard. Thermal or infrared methods are supplementary, not replacements.

Question: 10

A nuclear utility seeks to adopt a generic coating qualification from another plant but must verify applicability per the ANSI/ASTM framework for its unique borated water chemistry. Which ASTM D5144-integrated steps ensure compliance in this cross-plant scenario?

A. Per ASTM D8104, compare substrate parameters with ±10% variance in chloride content and pH 9.2-9.8
B. Re-test radiation per ASTM D4082 at site-specific dose rate of 2 x 10^6 rads/hour for 50 hours
C. Validate chemical resistance per ASTM D3912 using plant-specific boric acid concentration (4500 ppm) at 180°F
D. Conduct peer review audit per ASTM D5144 Section 13 for data transferability without retesting

Answer: A, C

Explanation:
ASTM D5144 leverages ASTM D8104 for determining data applicability across plants, requiring parameter matching within ±10% for critical variables like chloride and pH (9.2-9.8) to confirm environmental equivalence. For borated systems, ASTM D3912 must use site-specific concentrations (e.g., 4500 ppm) at operational temps (180°F) to validate resistance without generic assumptions. Full reradiation testing is avoided if doses align, and peer audits per Section 13 focus on QA, not substitution for testing.

Question: 11

2024 NRC Appendix B Criterion V (Instructions, Procedures, and Drawings) violation at Palo Verde involves unapproved deviations in holiday detection setup for pipeline internals coatings during a steam generator blowdown modification. Parameters: Pulse DC at 5 kV, probe speed 0.3 m/s. Which procedure adequacy checks must the inspector perform?

A. Deviation approval workflow per Criterion V, requiring engineering eval with risk matrix scoring >10 for safety impact, documented in 50.59 screening
B. Setup verification per NACE SP0490, including ground resistance <1 Ω and voltage waveform oscilloscope capture with rise time <1 µs at 5 kV
C. Procedure user feedback loop with post-job audit sampling 10% of recordings for speed compliance via video timestamp analysis, targeting <5% variance
D. Drawing update to as-built with holiday map overlays in CAD, scaled 1:50, including repair locations GPS-tagged for future inspections

Answer: A, B, C

Explanation:
Criterion V requires controlled procedures for modifications like blowdown coatings to ensure safety function. Workflow with 50.59 eval controls deviations. SP0490 verification with resistance and waveform ensures detection efficacy. Feedback audits improve procedure use. Drawing updates are Criterion VI.

Question: 12

Which inspection method is most appropriate to confirm phenolic coating thickness consistency required for steam resistance?

A. Visual inspection after radiation exposure
B. Ultrasonic thickness measurement
C. Adhesion testing per ASTM D3359
D. Decontamination efficiency testing per ASTM D4256

Answer: B

Explanation:
Ultrasonic thickness gauges provide nondestructive measurement of coating thickness and consistency, essential for ensuring uniform steam resistance.

Question: 13

During inspection of coatings in a wet environment, the adhesion pull-off test produces immediate disbondment at the fixture-coating interface but no substrate coating detachment. How should this result be interpreted?

A. Test is invalid due to adhesive failure and must be repeated.
B. Test is valid and indicates poor coating adhesion.
C. Indicates substrate corrosion causing adhesion failure.
D. Implies coating thickness exceeds test limits.

Answer: A

Explanation:
Adhesion pull-off tests require failure to occur in the coating or at the substrate interface. Adhesive (fixture-to-coating) failure invalidates the result and mandates test repetition with proper adhesive and preparation.

Question: 14

Per NQA-1 Requirement 10 (Inspection), an inspector must verify special process controls for applying a two-coat epoxy to containment penetration sleeves. In a high-radiation scenario (10^7 rads projected), which inspection hold points and instruments are mandatory?

A. Wet film thickness (WFT) check every 100 ft^2 using ASTM D4414 comb at 10 ± 1 mils per coat
B. Cure verification via ASTM D4752 solvent rub, requiring >50 double rubs without base metal exposure
C. Radiation dosimeter calibration to ±5% accuracy per ANSI N323A for worker exposure <2 mrem/hour
D. Holiday detection post-cure at 2000 volts per NACE SP0169 for 20 mils total DFT

Answer: A, B, D

Explanation:
NQA-1 inspection controls ensure epoxies on penetrations withstand radiation-induced embrittlement. WFT holds per D4414 maintain build to spec, avoiding thin spots vulnerable to dose. Solvent rub per D4752 confirms full cure, essential for intercoat bond >250 psi. Post-cure holiday detection at elevated voltage identifies voids that could propagate under irradiation, ensuring leaktightness per 10 CFR 50 Appendix J.

Question: 15

An inspector reviews ASTM D5144 testing results stating 12 Mrad gamma radiation exposure caused no chemical resistance deterioration but reduced adhesion by 15%. How should this data be interpreted?

A. Coating should be accepted as acceptable coating only
B. Coating qualification is failed based on any adhesion reduction
C. Chemical resistance carries more weight so coating remains qualified
D. Coating remains qualified as adhesion loss is below typical 20% failure limits

Answer: D

Explanation:
Generally, qualified coatings allow some adhesion loss (commonly up to 20%) postradiation. A 15% reduction is within acceptable limits if chemical resistance is unaffected.

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