Parks, Jazel

From: Lin, Bruce
Sent: Wednesday, July 07, 2010 3:06 PM
To: Bayssie, Mekonen
Subject: FW: RG 1.54 Rev 2
Attachments: RG 1 54 Rev 2 fina clean.doc; RG 1.54 Rev 2 final.doc; Staff Responses to Public Comments.docx

Mekonen,

As discussed over the phone. Please take a look at the attached files and let me know if I am off the track. After I get Tom and John's chop, I intend to send the files to you for processing. Also, let me know if you want me to send this to tech editor.

Bruce

From: Lin, Bruce
Sent: Wednesday, July 07, 2010 11:25 AM
To: Burke, John; Koshy, Thomas
Subject: RE: RG 1.54 Rev 2

Please take a look at the attached clean and markup versions of the RG and let me know if you have any comments.

John, I added your suggested changes in C.4 as footnotes.

Bruce

From: Burke, John
Sent: Tuesday, July 06, 2010 1:00 PM
To: Lin, Bruce
Subject: FW: RG 1.54 Rev 2

A few comments and suggestions as noted.

John Burke, PE
Senior Engineer
(301) 251-7628
john.burke@nrc.gov

From: Lin, Bruce
Sent: Tuesday, July 06, 2010 10:35 AM
To: Burke, John
Subject: RG 1.54 Rev 2

Comments?

Bruce

B-16

Staff Responses to Public Comments on Draft Regulatory Guide DG-1242
(Proposed Revision 2 of Regulatory Guide 1.54)

Garth Dolderer Florida Power and Light Company (MLxxxxxxxx)	John Burke (ML100960275)	Jon Cavallo Enercon Services, Inc (MLxxxxxxxxxx)
Nuclear Energy Institute (ML101530539)	Jason Lee Korea Hydro & Nuclear Power Co (MLxxxxxxxx)	Strategic Teaming and Resource Sharing (STARS) (ML101540529)

Comments				NRC Comment Resolution
	Originator	DG-1242 Section	Specific Comment	NRC Staff Response
1	G. Dolderer	C.6	The ERPI guideline rev 2 for nuclear coatings which is now a public document should be incorporated as the guidance document for meeting the intent of this reg guide.	Agree. ERPI Report No. 1003102 dated Nov 2001 will be updated to ERPI Report No. 1019157 dated Dec 2009.
2	G. Dolderer	C.4	Containment coating inspections should be completed by an ASNI level III or equal inspector and or the NCS. Since the inspections are visual until a defect is detected the level of experience should be elevated to ensure compliance.	Agree with the comment. The following statement will be added in the final version of the RG. *"An acceptable condition assessment program would be performed with qualified personnel and at a periodicity that would be able to detect potential coating degradation, and then implement repairs, before such degradation would adversely impact post-accident safety systems. The condition assessments should be performed under the direction of a Nuclear Coating Specialist as defined in ASTM D7108"*
3	J. Burke	C.4	In the discussion of ASTM D5163-08, include 1. discussion of the minimum qualifications of the personnel performing condition assessments and 2. how the results of the assessments are to be used	Agree with the comment. 1. See response to Comment 2 above 2. Add *"Degraded coatings identified during condition assessments should be evaluated*

			to evaluate ECCS suction strainer performance, i.e. RG 1.82.	*for impact on ECCS post-accident function in accordance with RG 1.82 and applicable license bases documents"* The following statement will be added in Section C.4 wrt to ASTM D 5163-08 *"While the ASTM D5163-08 standard provides reasonable assurance that qualified coatings left in service subsequent to a visual inspection will remain adhered under accident conditions, it does not provide conclusive assurance that degraded coatings will be detected by visual inspection. Therefore, licensees should account for the potential that some degraded coatings are not identified during visual inspections. This may be accomplished using margin in debris generation calculations for ECCS strainer performance or by using debris transport analysis to show the debris will not reach the strainer."*
4	J. Cavallo	C.2	Please note that ASTM 5139-90 (Reapproved 2001) has been temporarily withdrawn due to ASTM standard procedures and will be reissued in 2010.	RG will be updated to reflect D5139-10 has been approved.
5	J. Cavallo	C.2	Please note that ASTM D 3911-03 has been temporarily withdrawn due to ASTM standard procedures and will be reissued in 2010.	D3911-03 has been updated to 3911-08, not -10.
6	J. Cavallo	C.2	Please note that ASTM 4082-02 has been temporarily withdrawn due to ASTM standard procedures and will be reissued in 2010.	Agree. Updated to D4082-10.
7	NEI	Figure 1	The following issues with ASTM International (ASTM) standards potentially impact Figure 1: 1. ASTM D3912-01 is used as a coating screening/qualification standard, not as a field coating assessment standard or tool. 2. ASTM D7108-05 is used as to qualify nuclear coating specialist for the coating program and coating	1. Agree. Figure 1 will be revised. 2. Agree. However, since it is for personnel qualifications, it belongs in the middle column. 3. Agree. Fig 1 will be revised. 4. Agree. Fig 1 will be revised.

			assessment, not coating inspections. 3. ASTM D7491-08 is part of the coating condition assessment program. 4. ASTM D3911-03 has been revised to D3911-08.	
8	NEI	C.1	Page 5, parenthetical (2) states; "Service Level II coatings are used in areas where coating failure could impair, but not prevent, normal operating performance. The functions of Service Level II coatings are to provide corrosion protection and decontaminability in those areas outside the reactor containment that are subject to radiation exposure and radionuclide contamination. Service Level II coatings are not safety related." A note should be added that the associated standard ASTM D4256 - 89(1994), "Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants" (Withdrawn 1995) has been withdrawn. U.S. plants have found the test method to be faulted in that almost any coating system will pass the test. In addition, the test method generates mixed hazardous waste and does not comply with occupational dose "As Low As Reasonably Achievable" (ALARA) practices. It should also be noted that most all high performance coating used are decontaminable, and that there has been no real contamination issues identified in the industry.	Agree. The following note will be added: *"ASTM D4256 - 89(1994), "Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants" has been withdrawn. U.S. plants have found the test method to be faulted in that almost any coating system will pass the test. In addition, the test method generates mixed hazardous waste and does not comply with occupational dose As Low As Reasonably Achievable (ALARA) practices."*
9	NEI	C.4	Page 7, Section 4, "Maintenance of Coatings", states: ASTM D3912-95 (Reapproved 2001), "Standard Test Method for Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants" (Ref. 22), provides guidance that the NRC staff finds acceptable for evaluating the chemical resistance of coatings used in light-water NPPs. Usage of ASTM D3912-95 (Reapproved 2001) is not consistent with Figure 1, which uses ASTM D3912-01. Note that because ASTM D3912-01 (D3912-95 (2001)) had not been reviewed in over 5 years, this standard	Agree. D3912-01 is now D3912-10 and will move to Section C.2.

			was automatically withdrawn. However, ASTM Committee D33.02 has a revised standard (WK27577) which is currently in balloting. It may be issued by the date of publication of the Regulatory Guide revision. This is also the case for D5139-01 (D5139-90 (2001)) (WK23765) and D4082-02 (WK27576).	
10	NEI	C.6	Page 7, Section 6, "Additional Information", states: Additional information on the selection, application, inspection, and maintenance of safety-related protective coatings in NPPs is provided in Electric Power Research Institute (EPRI) Report No. 1003102, "Guideline on Nuclear Safety- Related Coatings," issued November 2001 (formerly EPRI Topical Report No. 109937) (Ref. 25), While the NRC does not formally endorse this EPRI document, it discusses in detail the important considerations related to protective coatings and can be used to supplement the ASTM standards guidelines as deemed necessary with the exception of Section 3.4.2 of EPRI Report No. 1003102, which discusses the applications of specialized coatings for restoring the structural integrity of a component. The NRC does not agree with the use of specialized coatings for restoring structural integrity. 3 All references to EPRI Report No. 1003102 should be changed to EPRI Report No. 1019157, Plant Support Engineering: Guideline on Nuclear Safety-Related Coatings, Revision 2 (Formerly TR-109937 and 1003102). This document is a public document now	Agree. See response to comment 1.
11	NEI		This Draft Regulatory guide does not address the ongoing issue of coating aging assessment. However, this is likely to be a point of discussion and disagreement well into the future. As such, at this point there are very limited ways of predicting coating lifetime, with very little supporting data that supports the coatings applied to the current fleet of US plants.	Agree. Non-mandatory appendices in D3911-08 are considered good practices. Added to Section B 5th paragraph.

			Because these predictive methods are laboratory-based in nature with no proven field applicability, visual assessment is the best available tool. For new generation plants, consideration should be given to International operating experience, such as that from Électricité de France (EDF), where coating test coupons have been placed within the plant. These test coupons, if properly placed, provide a real mechanism to test and evaluate aging of coatings. Selected coupons could be periodically removed and tested to identify changes in various physical properties, as well as, be DBA tested to provide much better and more realistic predictions of coating life. ASTM D3911-08, Appendix X2., "Witness Coupons In Primary Containment" addresses the use of a method that is directly applicable to plant specific coatings and service environments. Recommend references to ASTM D3911-03 be replaced by ASTM D3911-08 throughout is document.	
12	NEI	Figure 1	Figure 1, ASTM Standards Relevant to NPP Class I, II, III Protective Coatings (Page 4): Most ASTMs on this table are the same as the previous R.G. 1.54 Rev. 1. However, four were added and two were deleted. It is understood that ASTM D5962-96 was withdrawn with no replacement. Why was ASTM D 3359 (latest revision for this standard is ASTM D 3359-09) removed from the figure? Is this method of measuring adhesion not acceptable or is it covered under one of the new standards added?	ASTM D3359 was deleted and replaced by D6677 at the suggestion of EPRI/NUCC chairman. It was pointed out that D6677 was used more frequently than D3359. D3359 is still considered acceptable, just not mentioned in this RG.
13	J. Lee	C.4	In the discussion of ASTM D4541-09, do you mean the tester type II (test method B) is only available for this guidance?	Yes. Type II (Method B) is the test method used historically.
14	J. Lee	C.4	In the discussion of ASTM D7234-05, which portable pull-off adhesion testers are available for this guidance?	Historically, it has been the Elcomter tester used under D4541.
15	J. Lee	C.1	In the discussion of ASTM D5144-08 that specifying the adhesion property as a top-level ASTM standards,	Type II (method B) of ASTM D4541. If another device is used, then the 200 psig

			which instrument is required to meet the requirement of minimum pull-off strength 200psi on steel and concrete substrate?	acceptance criteria from D5144 may not be appropriate. This comment has also been referred to the ASTM D33 committee chair for consideration to include in the next revision of the ASTM.
16	STARS	Figure 1	Same as comment 7	See response to comment 7.
17	STARS	C.1	Same as comment 8	See response to comment 8.
18	STARS	C.4	Same as comment 9	See response to comment 9.
19	STARS	C.4	Standard D3912-95(2001) is not a field assessment standard. Therefore, it should be moved to Section 2, Quality Assurance, as it is a screening standard.	Agree. D3912-01 is now D3912-10 and will move to Section C.2.
20	STARS	C.6	Same as comment 10	See response to comment 10.
21	STARS		Same as comment 11	See response to comment 11.

U.S. NUCLEAR REGULATORY COMMISSION

August 2010
Revision 2

REGULATORY GUIDE

REGULATORY GUIDE 1.54

(Draft was issued as DG-1242, dated March 2010)

SERVICE LEVEL I, II, AND III PROTECTIVE COATINGS APPLIED TO NUCLEAR POWER PLANTS

A. INTRODUCTION

Title 10, of the *Code of Federal Regulations*, Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 1), Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 1, "Quality Standards and Records," requires, in part, that structures, systems, and components (SSCs) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions that they will perform. GDC 1 also requires that a quality assurance (QA) program be established and implemented to provide adequate assurance that these SSCs will satisfactorily perform their safety functions.

GDC 4, "Environmental and Dynamic Effects Design Bases," requires, in part, that SSCs important to safety be designed to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.

Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 establishes overall QA program requirements for the design, fabrication, construction, and operation of safety-related nuclear power plant (NPP) SSCs.

The U.S. Nuclear Regulatory Commission (NRC) maintenance rule, 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," includes in its scope safety-related SSCs that are relied on to remain functional during and following design-basis events with respect to specified functions and nonsafety-related SSCs (1) that are relied on to mitigate accidents

---

The NRC issues regulatory guides to describe and make available to the public methods that the NRC staff considers acceptable for use in implementing specific parts of the agency's regulations, techniques that the staff uses in evaluating specific problems orpostulated accidents, and data that the staff needs in reviewing applications for permits and licenses. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in regulatory guides will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

This guide was issued after consideration of comments received from the public.

Regulatory guides are issued in 10 broad divisions-1, Power Reactors; 2, Research and Test Reactors; 3, Fuels and Materials Facilities; 4, Environmental and Siting; 5, Materials and Plant Protection; 6, Products; 7, Transportation; 8, Occupational Health; 9, Antitrust and Financial Review; and 10, General.

Electronic copies of this guide and other recently issued guides are available through the NRC=s public Web site under the Regulatory Guides document collection of the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/doc-collections/ and through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. MLxxxxxxxxx

or transients or are used in plant emergency operating procedures, (2) whose failure could prevent safety-related SSCs from fulfilling their safety-related functions, and (3) whose failure could cause a reactor scram or an actuation of a safety-related system. To the extent that protective coatings meet these criteria, they are within the scope of the maintenance rule. The maintenance rule requires that licensees monitor the effectiveness of maintenance for protective coatings within its scope (as discrete systems or components or as part of any SSC) or demonstrate that their performance or condition is being effectively controlled through the performance of appropriate preventive maintenance, in accordance with 10 CFR 50.65(a)(1) or 10 CFR 50.65(a)(2), as appropriate. Regulatory Guide (RG) 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 2, issued March 1997 (Ref. 2), provides further guidance.

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

This regulatory guide contains information collection requirements covered by 10 CFR Part 50 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Protective coatings have been used extensively in NPPs to protect the surfaces of facilities and equipment from corrosion and contamination from radionuclides and for wear protection during plant operation and maintenance activities. For plants that have a design basis that includes a commitment to RG 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants," issued June 1973, the regulations cited above require that protective coatings be qualified and capable of surviving a design-basis accident (DBA) without adversely affecting safety-related SSCs needed to mitigate the accident.

The NRC issued RG 1.54 to describe an acceptable method for complying with NRC QA requirements for protective coatings applied to ferritic steels, stainless steel, zinc-coated (galvanized) steel, concrete, or masonry surfaces of water-cooled NPPs. The presumption was that protective coatings that met these guidelines would not degrade over the design life of the plant. However, operating history has shown that undesirable degradation, detachment, and other types of failures of coatings have occurred, as described in Generic Letter (GL) 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," dated July 14, 1998 (Ref. 3). Detached coatings from the substrate that are transported to emergency core cooling system intake structures may make those systems unable to satisfy the requirement in 10 CFR 50.46(b)(5) to provide long-term cooling.

RG 1.54, Revision 0, conditionally endorsed American National Standards Institute (ANSI) N101.4, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," (Ref. 4) and indirectly endorsed guidance provided in ANSI N101.2, "Protective Coatings (Paints) for Light-Water Nuclear Reactor Containment Facilities" (Ref. 5). ANSI N101.4 and N101.2 were formally withdrawn in 1988; responsibility for updating, rewriting, and issuing appropriate replacement standards was

transferred to the American Society for Testing and Materials (ASTM), specifically ASTM Committee D-33 on Protective Coating and Lining Work for Power Generation Facilities.

ASTM has developed appropriate standards to replace ANSI N101.4 and N101.2. The NRC issued RG 1.54, Revision 1, in July 2000 to provide NRC endorsement and regulatory positions on ASTM standards as applicable to NPP protective coatings. Since the issuance of RG 1.54, Revision 1, many of the ASTM standards endorsed by RG 1.54 have been updated to reflect the current industry practice. This revision to RG 1.54 is being developed to provide NRC regulatory positions on the updated ASTM standards relevant to NPP protective coatings. The NRC has reviewed the ASTM standards cited in Section C of this guide for the selection, qualification, application, and maintenance of protective coatings in NPPs and considers them acceptable with the exceptions noted.

ASTM approved and issued ASTM D 3843-00, "Standard Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities", as a partial replacement for ANSI N101.4. ASTM D 3843-00 was reapproved in 2008 with no changes as ASTM D 3843-00 (Reapproved 2008) (Ref. 6). ASTM has approved and issued ASTM D 3911-95, "Standard Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design-Basis Accident (DBA) Conditions," to replace the DBA test standard that was referenced in ANSI N101.4 and RG 1.54. ASTM revised ASTM D 3911-95; the latest revision is ASTM D 3911-08 (Ref. 7). Nonmandatory Appendix X2 of this standard discusses witness coupons in primary containment. These test coupons, if properly placed, provide a real mechanism to test and evaluate aging of coatings. Selected coupons could be periodically removed and tested to identify changes in various physical properties, as well as, be DBA tested to provide much better and more realistic predictions of coating life. New nuclear power plants should consider installation of coated test coupons at various locations in primary containment. The coated test coupons would be representative of the aged condition of the similar coatings within the primary containment. The test coupons could be used for coating condition analysis and aging studies during the commercial life of the nuclear power plant.

The ASTM developed and issued ASTM D 5144-08, "Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants" (Ref. 8), to provide a common basis on which protective coatings for the surfaces of nuclear power generating facilities may be qualified and selected by reproducible evaluation tests. This ASTM standard provides guidance for the application and maintenance of protective coatings under the expected environmental, operating, and postulated accident conditions for pressurized-water reactors and boiling-water reactors. ASTM D 5144-08 addresses, by reference, the preparation of test specimens, radiation tolerance testing, decontaminability of coatings, physical properties, chemical resistance tests, fire evaluation tests, DBA testing, surface preparation, coating application and inspection, and thermal conductivity testing. Therefore, ASTM D 5144-08 can be viewed as a top-level ASTM standard that provides detailed requirements through reference to other key ASTM standards. Figure 1 shows the additional ASTM standards that provide application-specific guidance; these standards are discussed below.

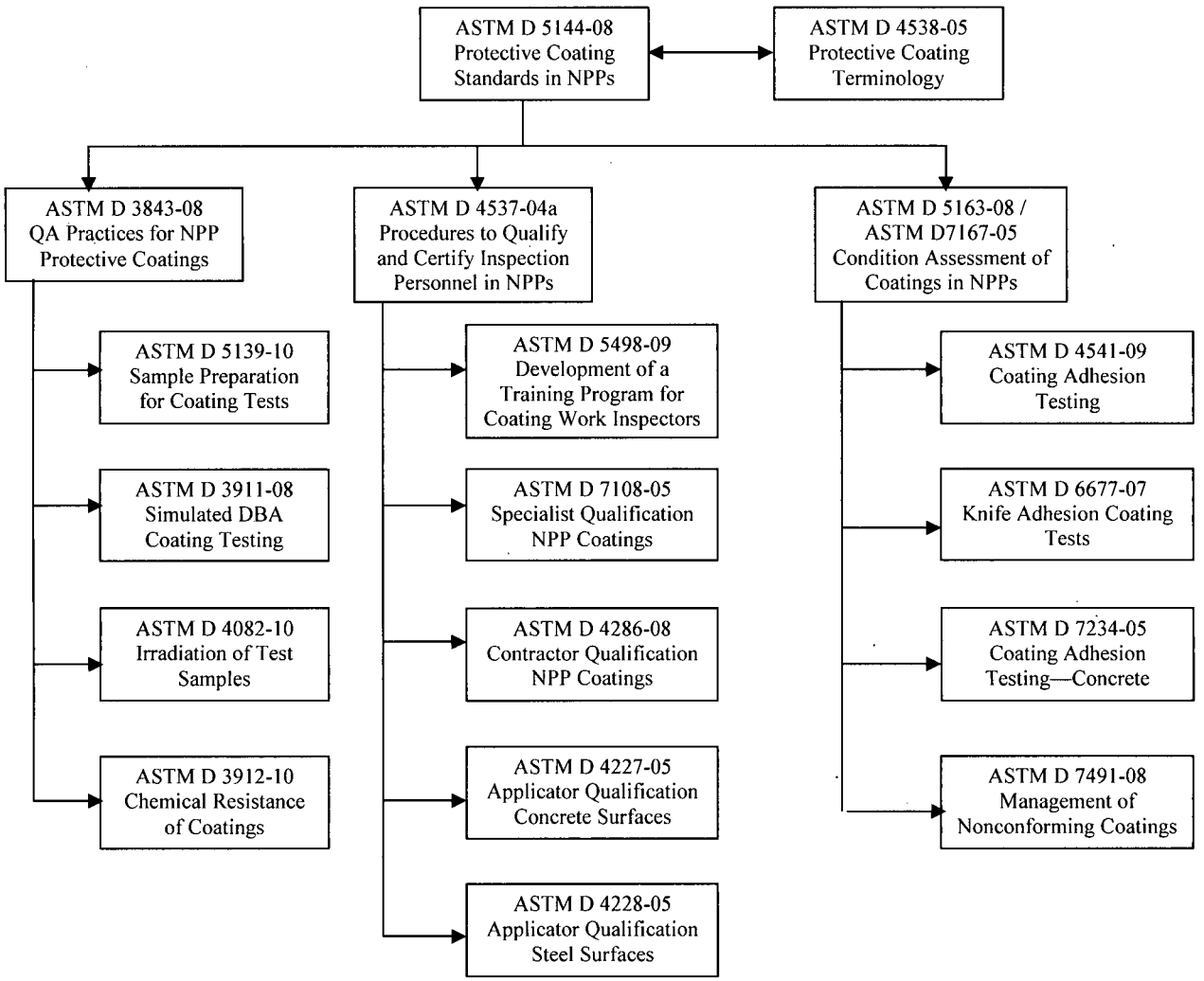

Figure 1. ASTM Standards Relevant to NPP Class I, II, and III Protective Coatings

This RG was developed using definitions and insights from operating reactors. New reactor designs may employ design features that are different from the operating reactors that formed the basis for this RG, and adjustments may be necessary. For example, a plant with passive containment cooling features may have different requirements for protective coatings on containment surfaces, or a plant might rely on the density of failed protective coating particles inside containment that limits their transport to the emergency core cooling system. Therefore, for new reactor designs, the guidance is provided with the recognition that the licensee or applicant may need to adjust some sections based on the particular plant design features.

C. REGULATORY POSITION

1. Guidance in American Society for Testing and Materials Standards

ASTM D 5144-08 and the other ASTM standards discussed below provide guidance on practices and programs that the NRC staff finds acceptable for the selection, application, qualification, inspection,

and maintenance of protective coatings applied in NPPs. ASTM D 33Committee has defined Service Level I, II, and III coating locations to include both safety-related and nonsafety-related regions as set forth below.

Service Level I, II, and III coatings are defined as follows:

(1) Service Level I coatings are used in areas inside the reactor containment where the coating failure could adversely affect the operation of post accident fluid systems and thereby impair safe shutdown.

(2) Service Level II coatings are used in areas where coating failure could impair, but not prevent, normal operating performance. The functions of Service Level II coatings are to provide corrosion protection and decontaminability[1] in those areas outside the reactor containment that are subject to radiation exposure and radionuclide contamination. Service Level II coatings are not safety related.

(3) Service Level III coatings are used in areas outside the reactor containment where failure could adversely affect the safety function of a safety-related SSC. (Note that a coating on the external surface of a reactor containment may be designated Service Level III, although no plants licensed under 10 CFR Part 50 have so applied this designation.)

The QA provisions and guidance contained in the standards in this regulatory position are generally acceptable and provide methods that the NRC staff finds acceptable for complying with the pertinent QA requirements of Appendix B to 10 CFR Part 50, subject to the following two exceptions:

a. When using this RG, NRC licensees should meet the QA provisions and guidance contained in the standards in this RG and must also meet the commitments and provisions contained in their QA program descriptions.

b. Applicants for design certifications and combined licenses under 10 CFR Part 52 have proposed using coatings in ways that do not conform to the Service Level definitions above. For example, an applicant could propose to designate coatings in certain areas of containment as Service Level II based on an evaluation demonstrating that these coatings cannot be transported to the ECCS. Such exceptions may be acceptable to the NRC staff if the applicant provides a technical justification and corresponding technical and quality requirements in a licensing basis document such as the Final Safety Analysis Report.

2. Quality Assurance

ASTM D 3843-00 (Reapproved 2008) provides QA practices that are acceptable to the NRC staff and are applicable to safety-related protective coating work in coating Service Level I areas of nuclear facilities. Applicable portions of the QA practices described in ASTM D 3843-00 (Reapproved 2008) may be used as the basis for limited QA for protective coating work in coating Service Level II areas of nuclear facilities.

---

1 ASTM D4256-94, "Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants" has been withdrawn. U.S. plants have found the test method to be faulted in that almost any coating system will pass the test. In addition, the test method generates mixed hazardous waste and does not comply with occupational dose As Low As Reasonably Achievable (ALARA) practices.

ASTM D 5139-10, "Standard Specification for Sample Preparation for Qualification Testing of Coatings To Be Used in Nuclear Power Plants" (Ref. 9), provides guidance that the NRC staff finds acceptable on the size, composition, and surface preparation for test samples of protective coatings for use in the qualification testing of coatings to be used in NPPs, as described in ASTM D 3911-08 and ASTM D 4082-10, "Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants" (Ref. 10).

ASTM D 3911-08 provides guidance that the NRC staff finds acceptable on procedures for evaluating test specimens for protective coating systems under simulated DBA conditions. ASTM D 3911-08 also provides guidance on conditions and test apparatus for temperature-pressure testing; on conditions for radiation testing; and on procedures for preparing, examining, and evaluating samples. ASTM D 3911-08 does not specify minimum acceptance criteria. For Service Level I coatings, licensees or applicants shall meet the following minimum acceptance criteria:

- Peeling and delamination shall not be permitted.
- Cracking is not considered a failure unless it is accompanied by delamination or loss of adhesion.
- Blisters shall be limited to intact blisters that are completely surrounded by sound coating bonded to the surface.

An owner may establish more stringent acceptance criteria; the above criteria are meant to establish minimum standards only.

ASTM D 4082-10 provides a standard test method that the NRC staff finds acceptable for evaluating the effects of gamma radiation on the lifetime radiation tolerance of Service Level I and II coatings.

ASTM D 3912-10, "Standard Test Method for Chemical Resistance of Coatings and Linings for Used in Nuclear Power Plants" (Ref. 22), provides guidance that the NRC staff finds acceptable for evaluating the chemical resistance of coatings used in light-water NPPs.

3. Training and Qualification of Nuclear Coating Specialists, Protective Coating Inspectors, and Coating Applicators

ASTM D 4537-04a, "Standard Guide for Establishing Procedures to Qualify and Certify Personnel Performing Coating Work Inspection in Nuclear Facilities" (Ref. 11), provides guidance that the NRC staff finds acceptable on the qualification and certification of personnel who inspect protective coatings in nuclear facilities. This standard provides guidance on the inspection of the education, training, experience, qualifications, and certification of Service Level I, II, and III coatings inspectors.

ASTM D 5498-09, "Standard Guide for Developing a Training Program for Personnel Performing Coating Work Inspection for Nuclear Facilities" (Ref. 12), provides guidance that the NRC staff finds acceptable for developing a training program for personnel who perform coating work inspection in nuclear facilities.

ASTM D 7108-05, "Standard Guide for Establishing Qualifications for a Nuclear Coatings Specialist" (Ref. 13), provides guidance that the NRC staff finds acceptable for establishing qualifications for a nuclear coatings specialist. A nuclear coatings specialist must meet one of the combinations of qualification attributes provided in Table 2 of ASTM D 7108-05.

ASTM D 4227-05, "Standard Practice for Qualification of Coating Applicators for Application of Coatings to Concrete Surfaces" (Ref. 14), provides guidance that the NRC staff finds acceptable for the

qualification of coating applicators to verify that they are proficient and can attain the quality required for the application of specified coatings to concrete surfaces, including those in a nuclear facility.

ASTM D 4228-05, "Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces" (Ref. 15), provides guidance that the NRC staff finds acceptable for the qualification of coating applicators to verify that they are proficient and able to attain the quality required for applying specified coatings to steel surfaces, including those in a nuclear facility.

ASTM D 4286-08, "Standard Practice for Determining Coating Contractor Qualifications for Nuclear Powered Electric Generation Facilities" (Ref. 16), provides criteria and methods that the NRC staff finds acceptable to assist utility owners, architects, engineers, and contractors in determining the overall qualifications of a coating contractor to execute coating work for the primary containment and other safety-related facilities of NPPs. The criteria and requirements for coating contractors address their capabilities to execute nuclear coating work.

4. Maintenance of Coatings

ASTM D 5163-08, "Standard Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants" (Ref. 17), provides guidelines that the NRC staff finds acceptable for establishing an in-service coating monitoring program for Service Level I coating systems in operating NPPs and for Service Level II and other areas outside containment (as applicable) with the following exceptions:

An acceptable condition assessment program would be performed with qualified personnel and at a periodicity that would be able to detect potential coating degradation, and then implement repairs, before such degradation would adversely impact post-accident safety systems.

The condition assessments should be performed under the direction of a Nuclear Coating Specialist as defined in ASTM D7108.

Degraded coatings identified during condition assessments should be evaluated for impact on ECCS post-accident function in accordance with RG 1.82 and applicable license bases documents.

While the ASTM D5163-08 standard provides reasonable assurance that qualified coatings left in service subsequent to a visual inspection will remain adhered under accident conditions, it does not provide conclusive assurance that degraded coatings will be detected by visual inspection. Therefore, it is recommended that licensees account for the potential that some degraded coatings are not identified during visual inspections. This may be accomplished using margin in debris generation calculations for ECCS strainer performance or by using debris transport analysis to show the debris will not reach the strainer.

ASTM D 7167-05, "Standard Guide for Establishing Procedures To Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant" (Ref. 18), provides guidelines that the NRC staff finds acceptable for establishing procedures to monitor the performance of Service Level III lining systems in an operating NPP.

ASTM D 4541-09, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" (Ref. 19), provides guidance that the NRC staff finds acceptable for a procedure for evaluating the pull off strength of coatings on metal substrates using fixed-alignment adhesion testers.[2]

ASTM D 6677-07, "Standard Test Method for Evaluating Adhesion by Knife" (Ref. 20), provides guidance that the NRC staff finds acceptable on test methods for evaluating adhesion using a knife.

ASTM D 7234-05, "Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers" (Ref. 21), provides guidance that the NRC staff finds acceptable for a procedure for evaluating the pull off strength of coatings on concrete using portable pull off adhesion testers.[3]

ASTM D 7491-08, "Standard Guide for Management of Non-Conforming Coatings in Coating Service Level I Areas of Nuclear Power Plants" (Ref. 23), provides guidance that the NRC staff finds acceptable on managing nonconforming coatings within the Service Level I areas of an NPP.

5. American Society for Testing and Materials Standard Terminology

ASTM D 4538-05, "Standard Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities" (Ref. 24), defines standard terms related to protective coating and lining work for power generation facilities that the NRC staff finds acceptable and that are also applicable to protective coatings employed in NPPs.

6. Additional Information

Additional information on the selection, application, inspection, and maintenance of safety-related protective coatings in NPPs is provided in Electric Power Research Institute (EPRI) Report No. 1019157, "Guideline on Nuclear Safety-Related Coatings, Revision 2" issued December 2009 (formerly EPRI Topical Report No. 109937 and 1003102) (Ref. 25), which discusses in detail the important considerations related to protective coatings and can be used to supplement the ASTM standards guidelines as deemed necessary with the exception of Section 3.4.2 of EPRI Report No. 1019157, which discusses the applications of specialized coatings for restoring the structural integrity of a component. The NRC does not endorse the use of specialized coatings for restoring structural integrity.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

With the exception of those cases in which an applicant proposes an acceptable alternative method for the condition monitoring and maintenance of safety-related containment coatings, unless different regulatory requirements apply, the ASTM standards endorsed in this guide will be used in evaluating the effectiveness of maintenance activities of licensees that are required to comply with 10 CFR 50.65. Current licensees may, at their option, comply with the guidance in this regulatory guide.

---

2 A fixed-alignment adhesion Tester Type II (Test method B) is the test method that has been historically used in NPPs.

3 This is a new test standard. Historically, adhesion testing of coatings on concrete was performed in accordance with the ASTM D4541.

REFERENCES[4]

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," U.S. Nuclear Regulatory Commission, Washington, DC.

2. Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 2, U.S. Nuclear Regulatory Commission, Washington, DC, March 1997.

3. GL 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," U.S. Nuclear Regulatory Commission, Washington, DC, July 14, 1998

4. ANSI N101.4-1972, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," American National Standards Institute, Washington, DC.[5]

5. ANSI N101.2-1972, "Protective Coatings (Paints) for Light-Water Nuclear Reactor Containment Facilities," American National Standards Institute, Washington, DC.

6. ASTM D 3843-00 (Reapproved 2008), "Standard Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities," American Society for Testing and Materials, West Conshohocken, PA.[2]

7. ASTM D 3911-08, "Standard Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design-Basis Accident (DBA) Conditions," American Society for Testing and Materials, West Conshohocken, PA.

8. ASTM D 5144-08, "Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

9. ASTM D 5139-10, "Standard Specification for Sample Preparation for Qualification Testing of Coatings To Be Used in Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

10. ASTM D 4082-10, "Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

11. ASTM D 4537-04a, "Standard Guide for Establishing Procedures To Qualify and Certify Personnel Performing Coating Work Inspection in Nuclear Facilities," American Society for Testing and Materials, West Conshohocken, PA.

---

4 Publicly available NRC published documents such as Regulations, Regulatory Guides, NUREGs, and Generic Letters listed herein are available electronically through the Electronic Reading room on the NRC's public Web site at: http://www.nrc.gov/reading-rm/doc-collections/. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone 301-415-4737 or (800) 397-4209; fax (301) 415-3548; and e-mail PDR.Resource@nrc.gov.

5 Copies of the non-NRC documents included in these references may be obtained directly from the publishing organization.

12. ASTM D 5498-09, "Standard Guide for Developing a Training Program for Personnel Performing Coating Work Inspection for Nuclear Facilities," American Society for Testing and Materials, West Conshohocken, PA.

13. ASTM D 7108-05, "Standard Guide for Establishing Qualifications for a Nuclear Coatings Specialist," American Society for Testing and Materials, West Conshohocken, PA.

14. ASTM D 4227-05, "Standard Practice for Qualification of Coating Applicators for Application of Coatings to Concrete Surfaces," American Society for Testing and Materials, West Conshohocken, PA.

15. ASTM D 4228-05, "Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces," American Society for Testing and Materials, West Conshohocken, PA.

16. ASTM D 4286-08, "Standard Practice for Determining Coating Contractor Qualifications for Nuclear Powered Electric Generation Facilities," American Society for Testing and Materials, West Conshohocken, PA.

17. ASTM D 5163-08, "Standard Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

18. ASTM D 7167-05, "Standard Guide for Establishing Procedures To Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant," American Society for Testing and Materials, West Conshohocken, PA.

19. ASTM D 4541-09, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," American Society for Testing and Materials, West Conshohocken, PA.

20. ASTM D 6677-07, "Standard Test Method for Evaluating Adhesion by Knife," American Society for Testing and Materials, West Conshohocken, PA.

21. ASTM D 7234-05, "Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers," American Society for Testing and Materials, West Conshohocken, PA.

22. ASTM D 3912-10, "Standard Test Method for Chemical Resistance of Coatings and Linings for Used in Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

23. ASTM D 7491-08, "Standard Guide for Management of Non-Conforming Coatings in Coating Service Level I Areas of Nuclear Power Plants," American Society for Testing and Materials, West Conshohocken, PA.

24. ASTM D 4538-05, "Standard Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities," American Society for Testing and Materials, West Conshohocken, PA.

25. EPRI Report No. 1019157 "Guideline on Nuclear Safety-Related Coatings, Revision 2" Electric Power Research Institute, Palo Alto, CA, December 2009.