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Standard Guide for Qualification Testing of Coatings Used in Coating Service Level I in Nuclear Power Plants¹

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1. Scope

1.1 This guide provides an approach to identifying the need for and development of a test document to qualify coatings for Coating Service Level I (CSLI) service in nuclear power plants.

1.2 It is the intent of this guide to provide a recommended basis for establishing a coatings qualification test document, not to mandate a singular basis for all test documents. Variations or simplifications of the process described in this guide may be appropriate for any given operating or new construction nuclear power plant depending on its licensing commitments.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of

the Guarded-Hot-Plate Apparatus

D3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions

D3912 Test Method for Chemical Resistance of Coatings and Linings for Use in Nuclear Power Plants

D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

D4082 Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants

D4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities

D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

D5139 Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants

D5144 Guide for Use of Protective Coating Standards in Nuclear Power Plants

D5163 Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants

D7108 Guide for Establishing Qualifications for a Nuclear Coatings Specialist

D8104 Guide for Determining Coating Qualification Test Data Applicability

E84 Test Method for Surface Burning Characteristics of Building Materials

E648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

E1269 Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry

E1461 Test Method for Thermal Diffusivity by the Flash Method

E1530 Test Method for Evaluating the Resistance to Thermal Transmission by the Guarded Heat Flow Meter Technique

2.2 ANSI Standards:³

ANSI N5.12 Protective Coatings (Paints) for the Nuclear Industry, 1974

¹ This guide is under the jurisdiction of ASTM Committee D33 on Protective Coating and Lining Work for Power Generation Facilities and is the direct responsibility of Subcommittee D33.04 on Quality Systems and Inspection.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from IHS, 15 Inverness Way East, Englewood, CO 80112, <http://www.global.ihs.com>.

ANSI N101.2 Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities, 1972

2.3 *ASME Standard*.⁴

NQA-1 (2008 and 2009 Addenda) Quality Assurance Program Requirements for Nuclear Facility Applications

2.4 *NFPA Standards*.⁵

NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials

2.5 *USNRC*.⁶

Regulatory Guide 1.54 Quality Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants, Revision 0, June 1973

Regulatory Guide 1.54 Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants, Revision 1, July 2000

Regulatory Guide 1.54 Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants, Revision 2, October 2010

Regulatory Guide 1.54 Service Level I, II, and III and In-Scope License Renewal Protective Coatings Applied to Nuclear Power Plants, Revision 3, April 2017

2.6 *Code of Federal Regulations*.⁶

10 CFR Appendix B Title 10, Chapter 1, Energy, Part 50, Domestic Licensing of Production and Utilization Facilities, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

3. Terminology

3.1 *Definitions*—Definitions for use with this standard are shown in Terminology **D4538** or other applicable standards.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *test document, n*—a detailed plan of coating system qualification invoking appropriate standards, tests, and procedures.

4. Significance and Use

4.1 This guide presents concise guidance and approach to developing a test document for qualifying a coating for CSLI service, whether a new or existing coating. Guidance for evaluating existing qualification test data for applicability is presented in Guide **D8104**.

4.2 The requirements for qualification testing can be found in Quality Assurance Criteria III (Design Control), IX (Control of Special Processes), and XI (Test Control) of 10 CFR 50, Appendix B, as implemented, respectively, by Requirements III, IX, and XI of NQA-1. A test document developed per this guide is intended to be compliant with these requirements.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁵ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁶ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

4.3 This guide implements the guidance provided in Guide **D5144** for qualification of coatings for use in CSLI service. Additional guidance is provided in Regulatory Guide 1.54, Revisions 0 through 3, as may be invoked by the licensee.

4.4 For plants with a license basis that predates the requirements of ANSI N5.12 and N101.2, this guide also is applicable. For these plants, the coatings or coating systems may be designated as acceptable, rather than qualified.

4.5 All qualification testing shall comply with the licensee's approved quality assurance program.

5. Identifying a Need for Testing

5.1 Testing is required to demonstrate a coating's or coating system's ability to withstand the exposure conditions postulated for a design basis accident (DBA) as defined by the plant safety analysis report (SAR), as well as other exposure conditions identified in Guide **D5144**, for the plant intending to use the coating in CSLI service. Such testing may be required if the coating or coating system previously has been, or will be, applied in CSLI service at the plant and there is no currently existing qualification test data for the coating or coating system that envelopes the DBA and other exposure conditions for the plant.

5.2 Condition assessment of existing coatings, for example, in accordance with Guide **D5163**, may identify necessary repairs to coatings in CSLI service. Coating materials chosen to make the repairs may require qualification that addresses the new material as well as the combination of the repair coating applied over the existing coating.

6. Responsibilities

6.1 The licensee is responsible for:

6.1.1 Preparation or review of the test document for qualification of coatings for CSLI application in the plant.

6.1.2 Evaluation of the test report data, verification that the test data satisfies the plant licensing basis, and acceptance of the report.

6.1.3 Translation of the test data into plant specifications and procedures.

6.2 The testing organization is responsible for:

6.2.1 Detailed implementation of the test document.

6.2.2 Preparation of a report documenting the testing performed and the results obtained.

7. Test Document

7.1 The test document should provide a detailed plan for qualification of a coating or coating system for use in CSLI applications for a given set of normal and accident exposure conditions. It is intended to be the controlling document for the qualification process and address each of the following requirements:

7.1.1 *Coatings to be Tested*—Specific detail should include the coating products to be tested, including combinations of coatings such as sealer/primer/finish or primer/intermediate/finish. If the coating product is offered in different colors, the color of the coating to be tested should be considered if a