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Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants[1]

This standard is issued under the fixed designation D 5144; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Protective coatings (paints) have been used extensively in the nuclear industry to protect the surfaces of facilities and equipment from corrosion and contamination by radioactive nuclides in accordance with ALARA. In the absence of a standard method of selecting, testing, and evaluating coatings, many sites evaluated paints by empirical tests to determine which were useful in their particular operation. Understandably, the methods of testing were not uniform throughout the industry. It has been very difficult, consequently, to compare the results obtained at one site with those obtained at another. Standard tests whereby industrial (nuclear) users of paints systematically prepare specimens and subject them to selected evaluations, thus permitting uniform comparisons, are advantageous, internationally as well as domestically.

The designer of light water-moderated nuclear reactor systems must consider the possibility of a Design Basis Accident (DBA) and the subsequent events which might lead to the release or expulsion of a fraction of the fission-product inventory of the core to the reactor containment facility. Engineered safety features, principally a reactor containment facility, are provided to prevent the release of fission products to the biological environment during and after this improbable event. The design, fabrication, quality assurance, and testing of these engineered safety features ensure reliable operation and safety under all anticipated conditions.

Large areas of the reactor-containment facility are painted with safety-related coatings. If severe delamination, peeling, or flaking causes significant portions of the coating to be discharged into the common water reservoir, the performance of the safety systems could be seriously compromised by the plugging of strainers, flow lines, pumps, spray nozzles, and core coolant channels. Safety-related coatings may also exist outside of the reactor-containment.

This guide is the result of a comprehensive examination of the experience and data that have been developed on protective coatings in the nuclear industry over approximately 40 years. Standards pertaining to nuclear coatings have historically been covered by ANSI N5.12, N101.2, and N101.4. Responsibility for updating, rewriting, and issuing appropriate ANSI replacement standards has been transferred to ASTM, specifically ASTM Committee D-33, on Protective Coating and Lining Work for Power Generation Facilities.

The objective of this guide is to provide a common basis on which to define and specify the performance requirements for the coatings that will be used in nuclear facilities. Quality assurance in the nuclear industry is a mandatory requirement for all aspects of safety-related nuclear coatings work. Licensees of nuclear power plants are required to determine if coated surfaces are within the scope of 10CFR50.65," The Maintenance Rule". Any coated surfaces found to be within the scope of 10CFR50.65 must satisfy the requirements of 10CFR50.65. ASME Section XI, Subsection IWE contains the requirements for periodic evaluation of the reactor-containment steel pressure boundary.

1. Scope

1.1 This guide provides 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 guide also provides guidance for application and maintenance of protective coatings. Under the environmental operating and accident conditions of nuclear power generation facilities, encompassing pressurized water reactors (PWR's) and boiling water reactors (BWR's), coating performance may be affected by exposure to any one, all, or a combination of the following conditions: ionizing radiation; contamination by radioactive nuclides and subsequent decontamination processes; chemical and water sprays; high-temperature high-pressure steam; and abrasion or wear.

1.2 The content of this guide includes:

1.2.1 In addition, this guide addresses technical topics within ANSI N5.12 and ANSI N 101.2 that are covered by separate ASTM standards, for example, surface preparation, (shop and field) and coating application, (shop and field).

1.2.2 Applicable sections of this guide and specific acceptance criteria may be incorporated into specifications and other documents where appropriate.[2]

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[3]

D 3843 Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities[4]

D 3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions[4]

D 3912 Test Method for Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants[4]

D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser[5]

D 4082 Test Method for Effects of Radiation on Coatings Used in Light-Water Nuclear Power Plants[4]

D 4227 Practice for Qualification of Coating Applicators for Application of Coatings to Concrete Surfaces[4]

D 4228 Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces[4]

D 4537 Guide for Establishing Procedures to Qualify and Certify Inspection Personnel for Coating Work in Nuclear Facilities[4]

D 4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities[4]

D 4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers[4]

D 5139 Specification for Sample Preparation for Qualification Testing of Coatings to Be Used in Nuclear Power Plants[4]

E 84 Test Method for Surface Burning Characteristics of Building Materials[6]

E 1461 Test Method for Thermal Diffusivity of Solids by the Flash Method[7]

E 1530 Test Method for Evaluating the Resistance to Thermal Transmission of Materials by the Guarded Heat Flow Meter Technique[7]

2.2 *Other Standards:*

ANSI N5.12 Protective Coatings (Paints) for the Nuclear Industry[8]

ANSI N 101.2 Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities[8]

ANSI N101.4 Quality Assurance for Protective Coatings Applied to Nuclear Facilities[8]

ASME Boiler and Pressure Vessel Code (BPVC), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components,"Subsection IWE "Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants"[9]

EPRI TR-109937 (1998) Guideline on Nuclear Safety-Related Coatings[10]

10CFR50. 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[11]

10CFR50.65 Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants[11]

Guide 1.54 Regulatory/(1973) Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants[11]

USNRC Review Plan 6.1.2 Protective Coating Systems

[1] This guide is under the jurisdiction of ASTM Committee D-33 on Protective Coating and Lining Work for Power Generation Facilities and is the direct responsibility of Subcommittee D33.02 on Service and Material Parameters.

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[2] Certain ASTM standards are available in compilation form (which includes this guide), as *Compilation of ASTM Standards for Use of Protective Coating Standards in Nuclear Power Plants* for expedient reference and usage by personnel involved in nuclear coating work.

[3] *Annual Book of ASTM Standards*, Vol 04.06.

[4] *Annual Book of ASTM Standards*, Vol 06.02.

[5] *Annual Book of ASTM Standards*, Vol 06.01.

[6] *Annual Book of ASTM Standards*, Vol 04.07.

[7] *Annual Book of ASTM Standards*, Vol 14.02.

[8] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[9] Available from American Society of Mechanical Engineers, Three Park Ave., New York, NY 10016-5990.

[10] Available from EPRI Distribution Center, 207 Coggins Drive, P.O. Box 23205, Pleasant Hills, CA 94523 (510) 934-4212.

[11] Available from the U.S. Government Printing Office, Washington, DC 20402.