



Standard Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants¹

This standard is issued under the fixed designation D5163; 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.

1. Scope

1.1 This standard covers procedures for establishing a monitoring program for condition assessment of Coating Service Level (CSL) I coating systems in operating nuclear power plants. Monitoring is an ongoing process of evaluating the condition and performance of the in-service coating systems.

1.2 It is the intent of this standard to provide a recommended basis for establishing a coatings condition assessment program, not to mandate a singular basis for all programs. Variations or simplifications of the program described in this standard may be appropriate for each operating nuclear power plant depending on their licensing commitments.

1.3 This requirements of ASME Section XI, In-Service Inspection Subsections IWE and IWL are beyond the scope of this 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
- D714 Test Method for Evaluating Degree of Blistering of Paints
- D3359 Test Methods for Measuring Adhesion by Tape Test
- D4538 Terminology Relating to Protective Coating and

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.

Current edition approved Oct. 1, 2016. Published December 2016. Originally approved in 1991. Last previous edition approved in 2008 as D5163 – 08. DOI: 10.1520/D5163-16.

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.

- Lining Work for Power Generation Facilities
- D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D5498 Guide for Developing a Training Program for Personnel Performing Coating and Lining Work Inspection for Nuclear Facilities
- D6677 Test Method for Evaluating Adhesion by Knife
- D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
- D7108 Guide for Establishing Qualifications for a Nuclear Coatings Specialist
- D7234 Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
- 2.2 SSPC Standards:³
- SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements
- SSPC-PA 9 Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
- SSPC-VIS 2 Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces

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 *coating condition assessment, n*—overall evaluation of the coating condition based upon performance monitoring and visual inspection.

3.2.2 *coating maintenance work, n*—all-inclusive term associated with coating work that expressly relates to repair, refurbishment, or replacement of an existing coating. (See also *coating work*.)

3.2.3 *in-service coatings monitoring program, n*—systematic program established to assess and document the

³ Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

condition of an existing coating system with respect to prescribed performance attributes.

4. Significance and Use

4.1 Establishment of an in-service coatings monitoring program permits planning and prioritization of coatings maintenance work as needed to maintain coating integrity and performance in nuclear CSL I coating systems. For additional information on nuclear maintenance coating work, refer to ASTM MNL8.⁴

4.2 A coatings monitoring program enables early identification and detection of potential problems in coating systems. Some CSL I coating systems may be known in advance to be suspect, deficient, or unqualified. Monitoring coating performance will assist in developing follow-up procedures to resolve any significant deficiency relative to coating work.

4.3 Degraded coatings may generate debris under design basis accident conditions that could adversely affect the performance of the post-accident safety systems. A coatings monitoring program may be required to fulfill safety analysis report and generic letter commitments for CSL I coating work in a nuclear power plant facility.

5. Responsibility

5.1 The licensee or his designee should identify the department or group within the organization to be responsible for establishing the applicable requirements for activities or procedures covered by this standard and should document the scope of their responsibility. Delegation of this responsibility to other outside qualified organizations is permitted and should be documented.

5.2 The assigned department or group shall specify the detailed methods and procedures for meeting the applicable requirements of this standard.

5.3 The licensee's Nuclear Coating Specialist, or other individual assigned by the department or group should be responsible for:

5.3.1 Coordinating inspections, and any necessary testing, of existing coatings.

5.3.2 Evaluating the results and assessing the coating condition.

5.3.3 Establishing priorities for coating repair/replacement.

5.3.4 Performing a specific follow-up inspection as necessary to investigate and resolve anomalies or degradation identified during the initial walk down.

5.4 In the event of conflict, users of this guide must recognize that the licensee's plant-specific quality assurance program and licensing commitments shall prevail with respect to the coating performance monitoring process.

6. Frequency

6.1 Frequency of in-service coating inspection monitoring shall be determined by the licensee or his designee. In

operating nuclear power plants, certain monitoring activities may be restricted to major maintenance outages or refueling outages. It is a good practice to perform inspections during each refueling outage or during other major maintenance outages.

7. Records and Past History

7.1 Coating performance will depend on the operating conditions experienced by the coating systems. Records of these conditions shall be obtained for each operating unit. These may include, but not be limited to, ambient conditions, temperatures, humidity, immersion, splash and spillage, chemical exposures, radiation exposures, previous decontamination procedures, abrasion and physical abuse, and start-up/shutdown frequency. Any change in service criteria or modifications of the physical design shall be identified and dated.

7.2 The last two performance monitoring reports pertaining to the coating systems should be reviewed prior to the monitoring process. Other past coatings history data to be reviewed may include:

7.2.1 Copies of coating specifications, manufacturer's product data sheets, and application procedures for in-place coatings.

7.2.2 Quality control documentation for the existing in-place coating systems and their application.

7.2.3 Copies of previous inspection or monitoring reports.

7.2.4 Documentation pertaining to any maintenance work performed on existing coating systems.

8. Monitoring Procedure

8.1 Prior to conducting an inspection of the coating systems, the responsible organization shall ensure that the necessary services and equipment required for inspection are provided. Factors that must be considered while planning the inspection activities include, but are not limited to, lighting, access to coated surfaces, cleaning surfaces of any deposit or build up, ventilation and, where necessary, special underwater inspection requirements.

8.2 Station access procedures for CSL I coating systems monitoring shall be followed. While access procedures may vary from plant to plant, specific station access procedures may include:

8.2.1 Security clearance for protected, radiation controlled, and vital areas, and escorted or unescorted clearance as required,

8.2.2 Radiological history including prior radiation exposure for all personnel involved,

8.2.3 Health physics classroom training in the use of radiation detection and monitoring devices and procedures for wearing anti-contamination clothing,

8.2.4 A radiation work permit based on health physics' radiological survey of the work location,

8.2.5 Compliance with radiation work permit requirements and other special radiation controls unique to each work location, and

8.2.6 Issuance of dosimetry.

⁴ MNL8, Manual on Maintenance Coatings for Nuclear Power Plants. Available from ASTM International Headquarters, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

8.3 The safety requirements of the facility licensee or his designee must be met when performing all inspection operations.

9. Personnel Requirements, Qualifications, and Training

9.1 The Nuclear Coating Specialist shall meet the requirements of Guide [D7108](#).

9.2 Individuals other than the Nuclear Coating Specialist performing the functions of a Nuclear Coating Specialist shall be trained to the applicable referenced standards of Guide [D5498](#) and plant specific requirements of the licensee's Quality Assurance program.

10. Inspection Plan

10.1 The licensee or his designee should develop a plant specific inspection plan to accomplish the objectives of the monitoring program. A visual inspection shall be conducted on all accessible coated surfaces during a walk-through. After the walk-through, thorough visual inspections should be carried out on previously designated areas and on areas noted as deficient during the walk-through. The inspection plan shall address the following based on specific licensee or his designee requirements:

10.1.1 A pre-inspection briefing to familiarize all personnel performing inspection with objectives of the inspections, procedures to be followed, and precautions to be taken,

10.1.2 Monitoring team(s) assignments to specific areas for inspection(s), and

10.1.3 Location maps dividing the plant into identifiable areas for inspection activities to be issued to inspection teams. The maps should also identify items/areas requiring special testing, if any. The locations of all defects, tests performed, and photographs (analog, digital, and/or video) taken should be recorded on the maps so that additional testing, recoating, and further monitoring may be performed.

10.2 During walk-through, visually examine coated surfaces for any visible defects, such as blistering, cracking, flaking/peeling, rusting, and physical damage.

10.2.1 *Blistering*—Compare any blistering found to the blistering pictorial standards of coatings defects (refer to Test Method [D714](#)) and record size and frequency. If the blisters are larger than those on the comparison photographs, measure, record size and extent, and photograph. Report if blistered portions are intact.

10.2.2 *Cracking*—Cracking may be limited to the one layer of coating or extend through to the substrate. Measure the length of the crack or if extensive cracking has occurred, measure the size of the area affected. Determine if the cracking is isolated or is part of a pattern. Record measurements and describe crack depth and pattern on the inspection report. Photograph the area affected.

10.2.3 *Flaking/Peeling/Delamination*—Measure the approximate size of the degraded coating area and note the pattern formed. Carefully test to see if lifting can be easily achieved beyond the obvious peeled area. Note all observations including location of failure within the coating film, whether

the failure is cohesive or adhesive, etc., on the inspection report and photograph the area affected.

10.2.4 *Rusting*—Compare with the pictorial standards of Test Method [D610/SSPC-VIS 2](#) to determine the degree of rusting. Try to determine the source of rusting (that is, is it surface stain caused by rusting elsewhere, or is it a failure of the coating allowing the substrate to rust). Photograph the affected area and record observations on the inspection report.

10.2.5 If no defects are found, mark “Coating Intact, No Defects” on the inspection report.

10.2.6 If portions of the coating cannot be inspected, note the specific areas on the location map-inspection report, along with the reason why the inspection cannot be conducted.

10.3 Written or photographic documentation, or both, of coating inspection areas, failures, and defects shall be made and the process of documentation standardized by the licensee or his designee. Trend analysis of inspection results should be conducted to determine if previously identified defects have degraded further or defects are becoming more widespread.

10.4 For coating surfaces determined to be suspect, defective, or deficient, physical tests, such as dry film thickness (Test Methods [D7091](#), [SSPC-PA 2](#), and [SSPC-PA 9](#)), and adhesion (Test Methods [D3359](#), [D4541](#), [D6677](#), or [D7234](#)) may be performed when directed by the Nuclear Coating Specialist. Samples may be gathered, and the size and extent of defective patterns may be described.

10.5 Instruments and equipment needed for inspection may include, but not be limited to, bright white light source, marker pen, mirror, measuring tape, magnifier, binoculars, camera with or without wide angle lens, note pad, and self-sealing polyethylene sample bags.

11. Reporting, Evaluation, and Documentation

11.1 The coating condition assessment report shall be evaluated and approved by the Nuclear Coating Specialist or designee and should include at least the following information:

11.1.1 A list and location of all areas evidencing deterioration.

11.1.2 A prioritization of the repair areas into areas that must be repaired during the same outage and areas where repair can be postponed to future outages, keeping the coating under surveillance in the interim period.

11.1.3 *Inspection Data Sheets*—An example data sheet is given in [Fig. 1](#).

11.1.4 *Photographic Documentation*—An example location map for photographic identification is given in [Fig. 2](#). The location and direction of all photographs (analog, digital, and/or video) should be recorded on the maps for comparison with past and future photographs and to record existing conditions. Numbers 1 through 22 in [Fig. 2](#) depict the location of the photographer and the directions of the view.

12. Keywords

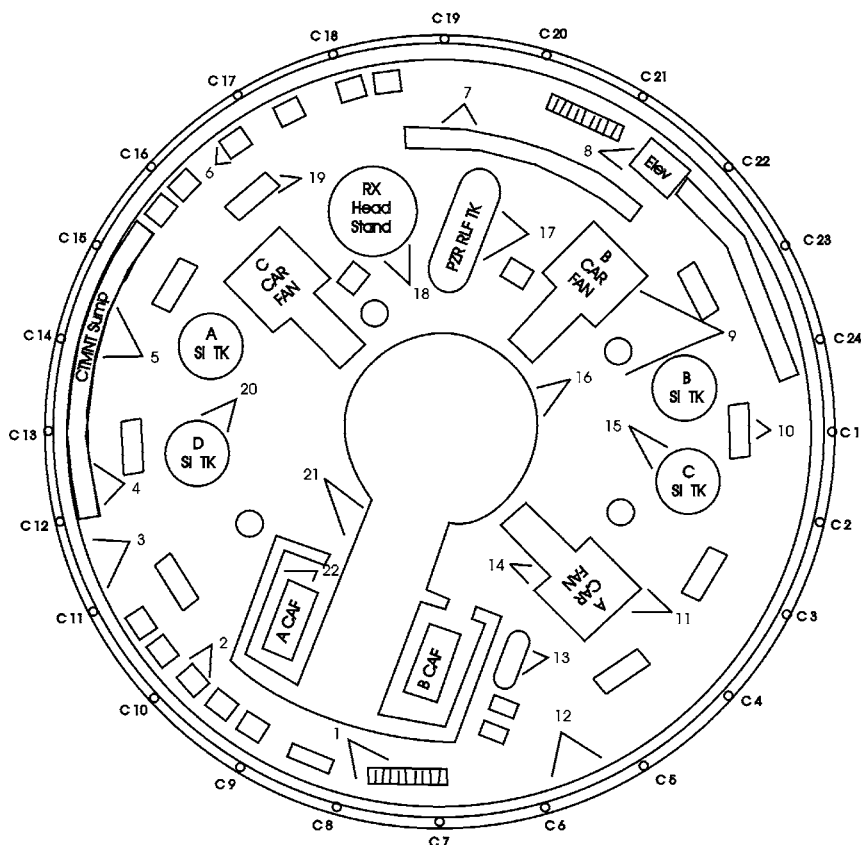
12.1 coating performance; Coating Service Level I coatings; coatings monitoring program; inspection; maintenance; nuclear power plant; surveillance

COATINGS PERFORMANCE MONITORING PROGRAM

Print Name: _____ Unit #: 1 2 Plant Location: _____
 Inspection Report #: _____ Survey Date: _____ Page ____ of ____
 Team #: _____ Work Package #: _____

PART 1: GENERAL VISUAL INSPECTION See Survey Map #: _____				
Item	General Coating Condition			
Description / Location (EI, AZ, nearest equipment)	Appearance		Photo / Video ID	Describe condition if unsatisfactory: (include blistering Cracking, dry film thickness, peeling, rusting, sample No.)
	Sat	Unsat		

FIG. 1 Inspection Data Sheet



NOTES

FIG. 2 Photographic Documentation Location Map

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>