



Standard Guide for Management of Non-Conforming Coatings in Coating Service Level I Areas of Nuclear Power Plants¹

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1. Scope

1.1 This guide provides the user with guidance on developing a program for managing non-conforming coatings in Coating Service Level I areas of a nuclear power plant.

1.2 Non-conforming coatings include degraded previously DBA-qualified or acceptable coatings, unqualified coatings, unknown coatings, and unacceptable coatings.

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:*²

[D4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities](#)

2.2 *Other Documents:*

[Regulatory Guide 1.54 Service Level I, II, and III protective Coatings Applied to Nuclear Power Plants](#)³

[EPRI Report 1003102 Guideline on Nuclear Safety-Related Coatings, Revision 1 \(formerly TR-109937\)](#)⁴

3. Terminology

3.1 *Definitions*—Definitions for use with this guide are shown in Terminology [D4538](#) or other applicable standards.

3.2 *Definitions of Terms Specific to This Standard:*

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 [D33.10](#) on Protective Coatings Maintenance Work for Power Generation Facilities.

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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 U. S. Nuclear Regulatory Commission, Distribution Services Section, Washington, DC 20555-0001, <http://www.nrc.gov>.

⁴ Available from EPRI Customer Fulfillment, 1355 Willow Way, Suite 278, Concord, CA 94520.

3.2.1 *non-conforming coatings, n*—a coating or coating system in a Coating Service Level I application that lacks or has insufficient documentation to support or verify DBA qualification.

3.2.1.1 *Discussion*—This would include coatings referred to as unqualified, unacceptable, and degraded qualified coatings.

3.2.2 *unacceptable coating system, n*—A safety related coating system for which no suitability for application review which meets the plant licensing requirements has been completed.

3.2.2.1 *Discussion*—Therefore, no reasonable assurance exists that, when properly applied and maintained, the coating or lining will not detach under normal or accident conditions. This is applicable to “pre-ANSI” plants.

4. Summary of Practice

4.1 The process and use of this guide is summarized in [Fig. 1](#).

5. Significance and Use

5.1 There are several methods for managing non-conforming coatings in an operating nuclear power plant. This guide outlines methods that have been determined to be acceptable to the nuclear industry.

5.2 Managing the amount of non-conforming coatings is key to ensuring the amount assumed, in the licensing bases is not exceeded.

5.3 EPRI Report 1003102 Revision 1 (formerly TR-109937) provides additional information on the selection, application, inspection and maintenance of nuclear plant safety-related protective coatings. This reference offers a detailed discussion of important considerations related to protective coatings and can be used to supplement this guide as deemed necessary.

6. Establishing the Design Limit of Non-Conforming Coatings

6.1 Determine what coatings do not meet the licensing basis for the plant. For plants that have commitments to meet Regulatory Guide 1.54 (applicable revision) and/or related

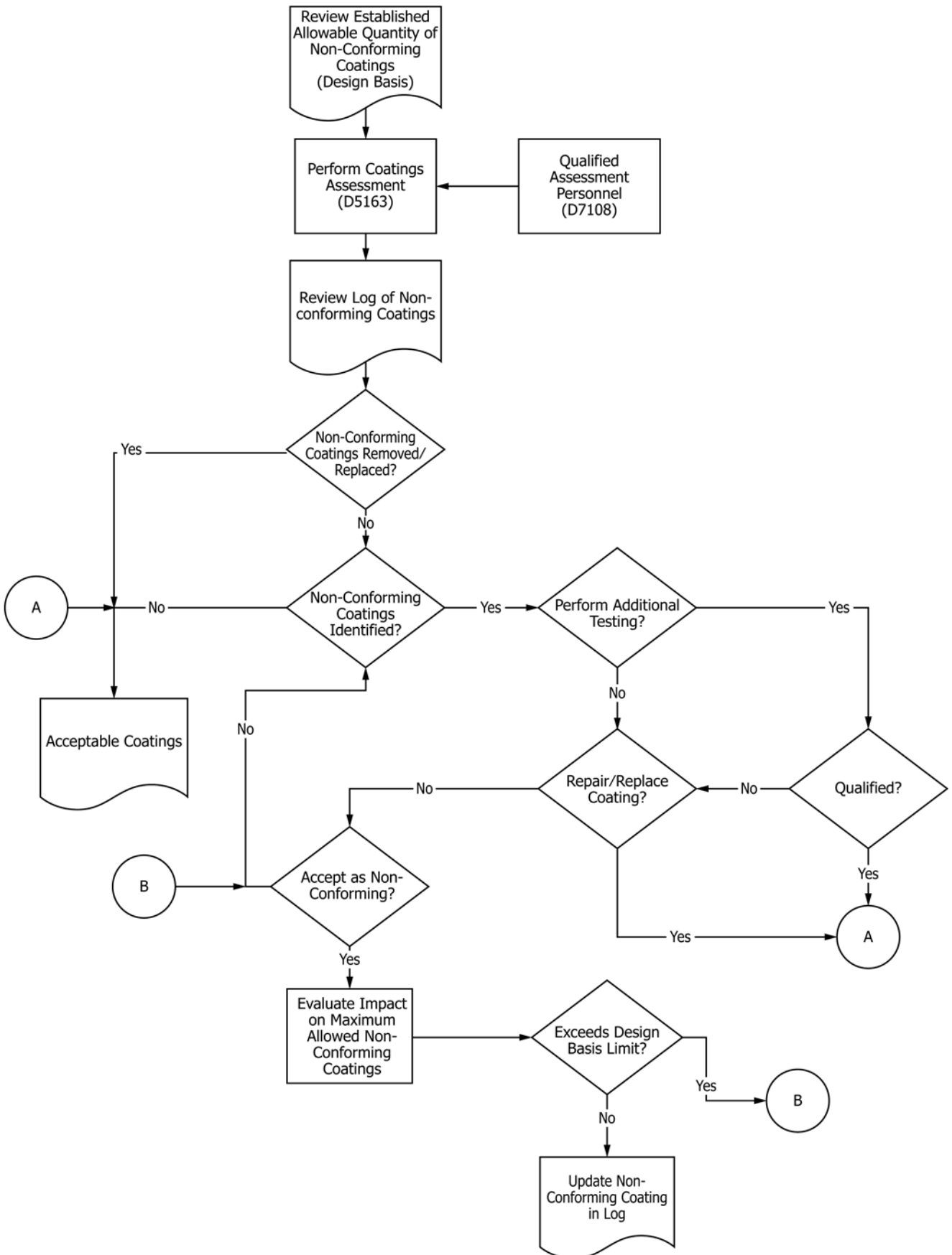


FIG. 1 Managing Non-Conforming Coatings

ANSI/ASTM standards typically require DBA testing of coatings and extensive documentation associated with the application of the qualified coatings. This may be a more significant requirement to satisfy than for an older plant which has not made commitments to these requirements.

6.2 The key to ensuring plant safety is to manage the amount of non-conforming coatings so that it does not exceed the amount assumed in calculations that support plant operation, such as sump suction strainer head loss.

6.3 Managing non-conforming coatings, must consider the capacity of the Emergency Core Cooling System (ECCS) suction strainer to accommodate debris expected to reach the ECCS suction strainer (including coating debris) without reducing the overall ECCS pump net positive suction head (NPSH) margin below an acceptable value. Those plants with significant operational NPSH margin for accommodating additional debris may require less precision when determining the amount of non-conforming coatings; simplified bounding techniques may be sufficient.

6.4 The non-conforming condition may also affect other plant design and licensing limits, such as coating thickness affects on the accident heat transfer and peak temperature calculations, and Fire Hazards Analysis.

7. Determining the Amount of Non-Conforming Coatings

7.1 Essentially every plant has some amount of non-conforming coatings inside of primary containment and this may be an acceptable condition. There are two considerations when identifying non-conforming coatings.

7.1.1 Does the coating meet the licensing basis commitments?

7.1.2 Is there reasonable assurance the coating will not detach during normal operation or a Design Basis Accident (DBA)?

7.2 The amount of coating that was applied inconsistent with licensing commitments and design requirements needs to be identified.

7.3 It may also be appropriate to review procurement documents (including records of work performed) for equipment installed in containment to determine if coating applications performed off site conforms to licensing bases and design requirements.

7.4 If records cannot be found that identify the types and quantities of coatings (for example, weight or volume) installed in containment, then some area, thickness, and density estimations need to be performed.

7.5 The results of the investigation should be tabulated according to the various containment surfaces, indicating the type, quantity, location, and qualification classification of the coating applied. Photographic documentation is also helpful for reference to the findings.

7.6 The tabulation should also consider identification of the complete coating system as applied.

7.7 Periodic reassessment or establishing a new baseline should be considered.

8. Guidance on Managing Non-Conforming Coatings

8.1 Once an accounting of the amount of non-conforming coatings is determined, a decision will need to be made as to how to manage the results. It is important to know the reason a particular area of coating is non-conforming.

8.1.1 Conditions that may cause a coating to be non-conforming:

(1) Lack of or incomplete documentation for the application process.

(2) Lack of or incomplete documentation regarding applicator qualification.

(3) Lack of or incomplete documentation regarding inspector qualification.

(4) Lack of incomplete design change documentation for the use of alternate coatings.

(5) Improper or inadequate specification of technical and quality procurement requirements for services and materials.

(6) Improper dedication of commercial grade coatings.

(7) Incomplete documentation for the testing used to establish conformance with the design bases.

(8) Incomplete/inadequate specifications and procedures.

(9) Undefined or vague personnel qualification criteria.

(10) Degraded coatings, both qualified and unqualified.

(11) Misapplication of a DBA qualified coating system.

8.2 *Remove, Repair, or Replace Non-Conforming Coatings:*

8.2.1 If a condition assessment reveals that the coating has physically degraded in service, the degraded coating should be removed or replaced in accordance with the coatings program as appropriate to restore that area to a qualified status.

8.2.2 Another option may be the replacement of a non-conforming coating with a qualified or an acceptable coating system.

8.3 *Mitigate the Consequences of Further Coating Degradation:*

8.3.1 To preclude the removal, repair, or replacement of non-conforming coatings, techniques may be used to mitigate the consequences of further degradation and detachment of coatings.

8.3.1.1 These measures may include construction of containment devices around the equipment coated with the non-conforming coating to prevent debris formation or transport.

8.3.1.2 The acceptable resolutions must be based on plant-specific conditions, and the impact such containment would have on the operation and maintenance of the equipment.

8.4 *Evaluate the Safety Impact of Non-Conforming Coatings:*

8.4.1 An evaluation that determines the impact of the non-conforming coating on the operation of the ECCS suction strainers following a Loss of Coolant Accident (LOCA) may need to be performed.

8.4.1.1 Typically, this will be required only when the total amount of non-conforming coating exceeds the amount considered in the ECCS suction strainer head loss calculation.

(a) Consideration of the failure characteristics of the coating, the time of failure, and the transport and strainer head loss characteristics of the detached coatings can all be used in the evaluation.

8.4.1.2 Use of the plant corrective action program will typically be required when the amount of non-conforming coatings exceeds that considered in the current ECCS suction strainer head loss calculations.

8.4.2 Non-conforming coating can also have a potential impact on other safety related SSC performance, such as the affect on the pressure/temperature curves during a LOCA or Main Stream Line Break (MSLB), Fire Hazards Analysis, etc., and should be evaluated accordingly.

8.5 *Managing the Addition of New Coatings:*

8.5.1 The coatings program should address the use of appropriate controls, such as procedural requirements and specifications, to ensure that the amount on non-conforming coatings does not increase in an uncontrolled manner.

8.5.2 The introduction of new equipment or structural components as a result of plant modifications or maintenance on existing equipment and structures could lead to an unwanted increase in the amount of non-conforming coatings. Therefore, the plant modification and maintenance programs should have a means to evaluate such potential impacts.

8.5.3 The Nuclear Coatings Specialist should ensure that technical requirements specified for replacement or repaired items, adequately addresses coatings program requirements.

8.5.4 Acceptance of their respective responsibilities, by other licensee organizations, for example, design engineering and procurement, who do not own the overall coatings program, is an important issue. The responsibilities of other disciplines should be clearly resolved early in the development of a safety-related coatings program.

8.5.5 Controls should be provided to address the use of paints and inks for labeling and stenciling. Some are organic materials and may not be included in the coatings program.

8.6 *Upgrading Non-Conforming Coatings:*

8.6.1 The upgrade of non-conforming coatings to an acceptable status can be accomplished by conducting those evaluations and/or tests that will compensate for the missing or incomplete documentation that supports the acceptability of the coating. The activities performed should result in reasonable assurance that the coatings were acceptable when applied.

8.6.2 It is important to recognize that the objective in moving particular coating work from a non-conforming status to an acceptable status is the achievement of reasonable assurance that is consistent with the licensing basis of the plant.

8.6.3 The requirements for the evaluation/test are not pre-defined because they should be tailored to address the specific weaknesses identified.

8.6.4 In some cases, it may be appropriate to supplement the documentation evaluation with limited testing to bolster the conclusions or address areas where the results of the documentation evaluation are inconclusive.

8.6.5 In lieu of performing extensive documentation reviews to upgrade the status of a coating, it may be more practicable and cost-effective to perform the necessary tests that would provide at least an equivalent level of assurance with regard to coating acceptability as would be achieved via a documentation review.

8.6.6 An acceptable method is to perform DBA qualification testing on representative samples of the non-conforming coatings. Acceptance of the test results will also require supporting documentation of the application of the original coating to ensure the samples are representative of the coating being tested. Alternately, actual samples from the facility may be removed and DBA tested, if practical.

9. Documentation

9.1 *Design Basis Limits for Non-Conforming Coatings:*

9.1.1 Each plant should have a documented basis for the amount on non-conforming coatings that currently exist within the containment structure and are part of the debris source term in the design of the ECCS suction strainer configuration.

9.1.2 This documentation should provide the maximum acceptable quantity of non-conforming coatings allowed within the containment structure.

9.2 *Documentation of Actual Total Non-Conforming Coatings:*

9.2.1 The Nuclear Coating Specialist should maintain a log or some other documentation that details the quantities of each type on non-conforming coating.


9.2.2 This documentation should include the type of non-conforming coating, the quantity of each, the location, why it is non-conforming, and the plan if any, to resolve the non-conformance.

9.2.3 This documentation should be updated or revised each refueling cycle with the removal, remediation, replacement, or addition of non-conforming coatings.

9.2.3.1 The effect on design margin of the ECCS system should also be assessed by this update.

10. Keywords

10.1 Design Basis Accident (DBA); Emergency Core Cooling System (ECCS) suction strainer; licensing basis; safety related

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