



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

6.1.2 PROTECTIVE COATING SYSTEMS (PAINTS) - ORGANIC MATERIALS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of the suitability of containment coatings and organic materials.

Secondary - None.

I. AREAS OF REVIEW

The specific areas of review are as follows:

1. The protective coating systems (paints) used inside the containment are evaluated as to suitability for design basis accident (DBA) conditions.
2. The stability of materials including protective coatings and organics are examined to determine the potential formation of decomposition products under DBA conditions. Radiation and chemical effects are considered.

Review Interfaces

The review organization as part of its primary review responsibility for SRP Section 6.5.2 also reviews the fission product removal effectiveness of the containment spray system as well as the deposition of fission products on containment protective coating systems.

Rev. 3 - [Month] 2007

USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," until the SRP itself is updated.

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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In addition, the primary branch will coordinate other branches' evaluations that interface with the overall review of organic materials - protective coating systems as follows:

1. Review of the radiation and chemical environments of equipment under DBA conditions as part of review responsibility for SRP Section 3.11.
2. Review of the control of combustible gases that can potentially be generated from the coating systems and organic materials and review the consequences of solid debris that can reach the containment recirculation sump as part of review responsibility for SRP Sections 6.2.5 and 6.2.2, respectively.
3. Review of the effects of solid debris on operations of fluid systems during post-accident conditions as part of review responsibilities for SRP Sections 5.4.7 and 6.3.

For those areas of review identified above as part of other SRP Sections reviews, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP Sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. Appendix B to 10 CFR Part 50 (Reference 1) as it relates to the quality assurance requirements for the design, fabrication and construction of safety-related structures, systems and components (SSCs).
2. A coating system to be applied inside a containment is acceptable if it meets the regulatory positions of Regulatory Guide 1.54 Rev. 1 (Reference 2) and the standards of ASTM D5144-00 and ASTM D3911-03 (References 3 and 4).

As discussed in Regulatory Guide 1.54 Rev. 1, to the extent that failure of protective coatings could prevent safety related SSCs from fulfilling their safety related function, the maintenance rule, 10 CFR 50.65, requires that licensees monitor the effectiveness of maintenance for protective coatings, or demonstrate that their performance or condition is being effectively controlled through the performance of appropriate preventative maintenance. Acceptance criteria include verification that coating monitoring and maintenance procedures are capable of ensuring that the coatings will not fail (delaminate from the substrate) and therefore become a debris source that could prevent the Emergency Core Cooling System (ECCS) from performing its safety related function.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for each review described in Subsection I of this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Technical Rationale

The technical rationale for application of these requirements to reviewing this SRP section is discussed in the following paragraph:

1. Appendix B to 10 CFR Part 50 requires a quality assurance program which comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. It is important to prevent the deterioration of protective coatings by 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. The protective coatings must be resistant to causing generation of combustible gases like hydrogen and methane and gaseous formation of radioactive organic iodides. If the protective coatings deteriorate by flaking, peeling, etc., they may form solid debris which can reach the containment recirculation sump and have a negative impact on the performance of post-accident cooling safety systems. Regulatory Guide 1.54, Rev. 1, describes an acceptable method of complying with the quality assurance requirements in regard to protective coatings applied to ferritic steels, aluminum, stainless steel, zinc-coated (galvanized) steel, concrete, or masonry surfaces of nuclear facilities. Compliance with Appendix B to 10 CFR Part 50 is important to ensure the overall quality and safety performance of protective coatings under normal and accident conditions.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case. The judgment on the areas to be given attention and emphasis in the review is based on an inspection of the material presented to see whether or not it is similar to that recently reviewed on other plants and whether items of special safety significance are involved.

For each area of review specified in subsection I of this SRP section, the review procedure is identified below. These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in subsection II.

At the construction permit review stage, the reviewer verifies that the applicant has committed to using protective coating systems which meet the acceptance criteria.

At the operating license review stage, the reviewer determines the types and quantities of radiation and chemical decomposition products that can be produced from all the paints and organic materials which are exposed to the containment atmosphere. The paints and organic materials to be considered include those paints that are specified in the Safety Analysis Report (SAR), unspecified protective coatings on small machinery and equipment, and organic materials such as cable insulation. The determination is based on documented test data provided by the applicant. If test data are unavailable, a conservative analysis is required. The environmental conditions for the test and analysis must be comparable to those specified in Section 3.11 of the SAR. In the absence of test data on specific coating systems and organic materials, the data in Reference 5 may be used to estimate the rates of hydrogen formation from zinc primers and from zinc primers plus topcoats. Cable insulation is assumed to generate hydrogen by radiolysis with a yield comparable to that of polyethylene (Reference 6). Unqualified paints (organic or inorganic), those that do not meet the acceptance criteria of this

Standard Review Plan section, are assumed to form solid debris under DBA conditions. Unqualified paints that contain only organic materials and that do not meet the acceptance criteria of this Standard Review Plan section, are assumed to generate hydrogen by radiolytic decomposition with a yield comparable to that of organic polymers (Reference 6).

If combustible gases such as hydrogen and methane can be generated, the reviewer notifies the appropriate reviewer if this source is not included in Section 6.2.5 of the SAR. If a system to control combustible vapors is not provided, then the release of volatile alkanes to form organic iodides is of additional concern. The yield of organic iodides relative to the total iodine released after a DBA is estimated using the data of Reference 7 and any applicable experimental results submitted by the applicant. The appropriate interfacing reviewer should be notified of the estimated organic iodide formation.

If solid debris can be produced, the interfacing reviewer responsible for solid debris should be notified of the quantity of debris that can result from decomposition of unqualified materials. The interfacing reviews should determine the effects of the debris on operation of post accident fluid systems.

Any exception to Regulatory Guide 1.54 involving quality assurance and quality control requirements should be referred to the appropriate interfacing reviewer for review and resolution.

Adverse interactions, if any, under DBA conditions, between the potential decomposition products, namely hydrogen and solid debris, and the engineered safety features are evaluated under SRP Sections 6.2.5 and 6.2.2, respectively.

For reviews of design certification and COL applications under 10 CFR Part 52, the reviewer should follow the above procedures to verify that the design set forth in the safety analysis report and, if applicable, site interface requirements meet the acceptance criteria. For design certification applications, the reviewer should identify necessary COL action items. With respect to COL applications, the scope of the review is dependent on whether the COL applicant references a design certification, an ESP or other NRC-approved material, applications, and/or reports.

After this review, SRP Section 14.3 should be followed for the review of Tier I information for the design, including the postulated site parameters, interface criteria, and ITAAC.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations support conclusions of the following type to be included in the staff's safety evaluation report:

1. The staff concludes that the protective coating systems and their applications are acceptable and meet the requirements of Appendix B to 10 CFR Part 50. This conclusion is based on the applicant having met the quality assurance requirements of Appendix B to 10 CFR Part 50 since the coating systems and their applications meet the positions of Regulatory Guide 1.54, Rev. 1, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," and the quality assurance standards of ASTM D5144-00, "Standard Guide for Use of protective Coating Standards in Nuclear Power Plants," and ASTM D3911-03, "Standard Test Method for Evaluating Coatings Used in Light Water Nuclear Power Plants at Simulated Design Basis Accident (DBA)

Conditions.” Also, the containment coating systems have been evaluated as to their suitability to withstand a postulated design basis accident (DBA) environment. The coating systems chosen by the applicant have been qualified under conditions which take into account the postulated DBA conditions.

For DC and COL reviews, the findings will also summarize (to the extent that the review is not discussed in other SER sections) the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable, and interface requirements and combined license action items relevant to this SRP section.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of design certifications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section, unless superceded by a later revision.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guide.

VI. REFERENCES

1. 10 CFR Part 50, Appendix B, Quality Assurance Criteria For Nuclear Power Plants and Fuel Reprocessing Plants.
2. Regulatory Guide 1.54, Revision 1, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants."
3. ASTM D5144-00, "Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants."
4. ASTM D3911-03, "Standard Test Method for Evaluating Coatings Used in Light Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions."
5. H. E. Zittel, "Post-Accident Hydrogen Generation from Protective Coatings in Power Reactors," Nuclear Technology, Volume 17, pp. 143-146 (1973).
6. R. O. Bolt and J. G. Carroll, "Radiation Effects on Organic Materials," Academic Press, New York (1963).
7. A. K. Postma and R. W. Zavadoski, "Review of Organic Iodide Formation Under Accident Conditions in Water-Cooled Reactors," WASH-1233 (1972).

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the draft Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

SRP Section 6.1.2

Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in (Draft) Revision 3, dated April 1996 of this SRP. See ADAMS accession number ML052070455.

In addition this SRP section was administratively updated in accordance with NRR Office Instruction, LIC-200, Revision 1, "Standard Review Plan (SRP) Process." The revision also adds standard paragraphs to extend application of the updated SRP section to prospective submittals by applicants pursuant to 10 CFR Part 52.

The technical changes are incorporated in Revision 3, dated [Month] 2007:

Review Responsibilities - Reflects changes in review branches resulting from reorganization and branch consolidation. Change is reflected throughout the SRP.

- I. AREAS OF REVIEW - Change made to clarify the intent of the staff review. As currently stated, this section implies that the coatings are absorbing fission products, as opposed to the actual phenomena which is deposition of the products on the coating surface.
- II. ACCEPTANCE CRITERIA - Changes made to reflect most current ASTM Standards. Replaced ASTM D3842 with ASTM D5144. Standard D3842 was replaced with D5144 by ASTM in 1995, and subsequently updated in 2000. Changed ASTM D3911-89 to D3911-03 to reflect current revision.

Add a discussion of periodic coating assessment to the technical rationale. Regulatory Guide 1.54, Rev. 1 and the ASTM standards it endorses provide guidance for proper inspection and maintenance of qualified protective coatings. Because of experience obtained as a result of Generic Safety Issue (GSI-191), the staff feels it is necessary to reinforce the value of coating assessment in a licensee's coating program. Note that Regulatory Guide 1.54 may be revised as a result of GSI-191, however this change will not take place in time for the current SRP update.

- III. REVIEW PROCEDURES - Removed references to specific organizations.
- IV. EVALUATION FINDINGS - Replaced ASTM D3842 with ASTM D5144. Standard D3842 was replaced with D5144 by ASTM in 1995, and subsequently updated in 2000. Changed ASTM D3911-89 to D3911-03 to reflect current revision.
- V. IMPLEMENTATION - No changes.
- VI. REFERENCES - Replaced reference 4 (ASTM D3842) with ASTM D5144-00. Change reference 5 from D3911-89 to D3911-03. Changes reflect most current versions of ASTM standards. Renumbered references for consistency with text.