U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

6.1.2 PROTECTIVE COATING SYSTEMS (PAINTS) - ORGANIC MATERIALS

REVIEW RESPONSIBILITIES

Primary - Chemical Engineering Branch (CMEB)

Secondary - None

I. AREAS OF REVIEW

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.

CMEB will coordinate other branches evaluations that interface with the overall review of organic materials - protective coating systems as follows: The Equipment Qualification Branch reviews the radiation and chemical environments of equipment under DBA conditions as part of its primary review responsibility for SRP Section 3.11, the Accident Evaluation Branch (AEB) as part of its primary review responsibility for SRP Section 6.5.2 reviews the fission product removal effectiveness of the containment protective coating systems as well as the containment spray system, the Containment Systems Branch reviews the control of combustible gases that can potentially be generated from the coating systems and organic materials and reviews the consequences of solid debris that can reach the containment recirculation sump as part of its primary review responsibility for SRP Sections 6.2.5 and 6.2.2 respectively, the Reactor Systems Branch as part of its primary review responsibility for SRP Sections 5.4.7 and 6.3 reviews the effects of solid debris on operations of fluid systems during post-accident conditions.

For those areas of review identified above as being reviewed as part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section(s) of the corresponding primary branch.

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II. ACCEPTANCE CRITERIA

CMEB acceptance criteria are based on meeting the relevant requirements of Appendix B to 10 CFR Part 50 as it relates to the quality assurance requirements for the design, fabrication and construction of safety-related structures, systems and components.

A coating system to be applied inside a containment is acceptable if it meets the regulatory positions of Regulatory Guide 1.54 and the standards of ANSI N101.2.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes aspects of the areas covered by this review plan section 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.

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 3 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 4). 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 4).

If combustible gases such as hydrogen and methane can be generated, the reviewer notifies the Containment Systems Branch 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 5 and any applicable experimental results submitted by the applicant. The Accident Evaluation Branch should be notified of the estimated organic iodide formation.

If solid debris can be produced, the Containment Systems Branch and Reactor Systems Branch should be notified of the quantity of debris that can result from decomposition of unqualified materials. If the Containment Systems Branch determines that the solid debris can reach the containment recirculation sump, the Reactor Systems Branch determines the effects of the debris on the 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 Quality Assurance Branch 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.

IV. EVALUATION FINDINGS

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

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, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants" and the quality assurance standards of ANSI N101.2, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities". 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.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

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

VI. REFERENCES

1. Regulatory Guide 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants."

2. ANSI N101.2, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities," American National Standards Institute (1972).

3. H. E. Zittel, "Post-Accident Hydrogen Generation from Protective Coatings in Power Reactors," Nuclear Technology, Volume 17, pp. 143-146 (1973).

4. R. O. Bolt and J. G. Carroll, "Radiation Effects on Organic Materials," Academic Press, New York (1963).

5. A. K. Postma and R. W. Zavadoski, "Review of Organic Iodide Formation Under Accident Conditions in Water-Cooled Reactors," WASH-1233 (1972).

6. 10 CFR Part 50, Appendix B, Quality Assurance Criteria For Nuclear Power Plants and Fuel Reprocessing Plants.