U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Update to Regulatory Documents on Protective Coatings at Nuclear Facilities

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Outline

- Regulatory Guide 1.54 Revision 2
- License Renewal
- Applying lessons learned from GSI-191 to BWRs
- Summary

Safety Function of Protective Coatings:

- NRC regulation 10CFR Part 50.46 b(5) requires the Emergency Core Cooling System (ECCS) have the capability to provide long term cooling of the reactor core following a LOCA
- Debris is generated by LOCA or Main Steam Line Break (MSLB) - Detached containment coatings are one potential debris source
- The accumulation of debris on the sump strainer, fuel or in downstream components could adversely impact the performance of the ECCS
- Generic Letter 2004-02 was issued to require re-analysis of debris effects, including coatings, for PWRs

Regulatory Guidance

- Standard Review Plan (NUREG 800)
  - Provides guidance for NRC staff for review of license amendments and new reactor applications
  - Section 6.1.2, ‘Protective Coatings Systems’ was revised in 2007. ASTM D5144-00 and D3911-03 were accepted for qualification of protective coatings.
- Regulatory Guide
  - Provide guidance to licensees and applicants on implementing specific parts of the NRC's regulations.
  - RG 1.54 provides guidance for the use of protective coatings in nuclear power plants.
- Generic Aging Lesson Learned Report (GALL) (NUREG 1801)
  - Identifies plant aging management programs necessary for license renewal.

Regulatory Guide 1.54

- RG 1.54 Rev 2 “Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants” was issued October 2010. It endorses 19 ASTM standards with some conditions and limitations.

- RG 1.54 and the cited ASTM standards provide guidance for the selection, qualification, application, and maintenance of protective coatings in Nuclear Power Plants.

Changes in R G 1.54 Rev 2

- ASTM D 3911-08, for DBA testing, does not specify minimum acceptance criteria. For Service Level I coatings the NRC staff position is that licensees or applicants shall meet the following minimum acceptance criteria:
  a. Peeling and delamination shall not be permitted.
  b. Cracking is not considered a failure unless it is accompanied by delamination or loss of adhesion.
  c. Blisters shall be limited to intact blisters that are completely surrounded by sound coating bonded to the surface.
- The licensee may establish more stringent acceptance criteria; the above criteria are meant to establish minimum standards only.

Changes in R G 1.54 Rev 2

- ASTM D6677-07, Knife Adhesion Testing, replaces ASTM D3359-95, Measuring Adhesion by Tape
  - Knife adhesion test is more a common screening test than tape adhesion test, based on industry input.

- ASTM D7108-05, Qualifications for Nuclear Coating Specialists, was added to endorse minimum standards of qualification for a coating specialist

- ASTM D7491-08, Management of Non-Conforming Coatings, replaces ASTM D5962-96, Maintaining Unqualified Coatings, which was withdrawn.

Changes in R G 1.54 Rev 2

- ASTM D7167 Monitoring Performance of Service Level III Coatings was added to cover SL III coatings, which was not addressed in prior revisions.

- EPRI-1019157 “Guideline on Nuclear Safety-Related Coatings, Revision 2” was published in Dec 2009. It is accepted with the exception that specialized coatings should not be used for restoring structural integrity (Section 3.4.2).

Changes in R G 1.54 Rev 2

- ASTM D 5163-08, “Standard Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants” provides guidelines that the NRC staff finds acceptable for establishing an in-service coating monitoring program for Service Level I coating systems in operating NPPs and for Service Level II and other areas outside containment (as applicable) with the following 4 conditions:
  1. Licensees should establish an acceptable condition assessment program using qualified personnel and should perform condition assessments at a periodicity that would allow them to detect potential coating degradation and to implement repairs before such degradation would adversely impact post-accident safety systems.
  2. Licensees should perform condition assessments under the direction of a nuclear coating specialist, as defined in ASTM D 7108-05.

Changes in R G 1.54 Rev 2

3. Licensees should evaluate degraded coatings identified during condition assessments for their impact on the ECCS post-accident function consistent with the guidance in RG 1.82 “Water Sources for Long-Term Recirculation Cooling Following a Loss-Of-Coolant Accident,” and in accordance with applicable licensing-basis documents.
4. Although the ASTM D 5163-08 standard provides reasonable assurance that qualified coatings left in service after a visual inspection will remain adhered to their substrates under accident conditions, it does not guarantee that visual inspection will detect all degraded coatings.

   Therefore, the NRC recommends that licensees account for the potential that visual inspections may not identify some degraded coatings by using margin in debris-generation calculations for ECCS strainer performance or by using a debris transport analysis to show that the debris will not reach the strainer.

License Renewal

- NUREG-1800 Rev 2 “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” and NUREG-1801 Rev 2 “Generic Aging Lessons Learned (GALL) Report” were both published in December 2010

- Aging Management Program XI.S8 for Protective Coating Monitoring was updated
  - Updates reference to RG 1.54 Revision 2
  - Accepts ASTM D5163-08 and Electric Power Research Institute (EPRI) Report 1019157 for protective coating condition monitoring programs.
  - Protective Coatings on concrete surfaces was added to scope of this AMP for completeness.

Protective Coatings: BWRs

- Coatings in BWRs were handled differently for resolution of Bulletin 96-03
  - Projected surface area of conical jet vs. volume of sphere
  - Generic dry film thicknesses used for quantity of debris
  - Less rigorous treatment of unqualified coatings
- BWROG is evaluating differences in resolution between BWRs and PWRs

Protective Coatings: BWRs

- NRC staff position is that BWR coatings should be treated the same as is being done for PWRs.
  - Periodic condition assessments
  - Failure and transport characteristics
  - Treatment of unqualified coatings
  - Maintenance of degraded coatings
  - Qualification of personnel

Protective Coatings: BWRs

- Other specific areas of interest:
  - Any unique characteristics of the submerged coatings in suppression pools were ignored in the URG
  - GL 98-04 responses often did not contain details of the coatings program

Regulatory Perspectives: Going Forward

- Maintaining the design basis of coatings is the crucial issue from this point forward.
  - Managing unqualified coatings
    - ASTM D7491 Management of Non-Conforming Coatings in Coating Service Level 1 Areas of Nuclear Power Plants
  - Periodic condition assessments
    - ASTM D 5163 Condition Assessment of Coating Service Level I Coating System in Nuclear Power Plants
- Inspection & Maintenance
  - ASME B&PV Code Section IX Subsections IWE/IWL is not enough. It only covers containment pressure boundary items

Related Regulatory Action

- RG 1.82 “Water Sources for Long-Term Recirculation Cooling Following a Loss-of Coolant Accident” is being revised
  - Provide guidelines for evaluating the availability of water sources for long-term cooling, including failed coatings
  - Incorporate lessons learned from GSI-191
  - Schedule is to have this RG published in 2011.

New Reactors

- RG 1.54 Rev 2 has a statement that “new reactor designs may employ design features that are different from the operating reactors that formed the basis for this RG. For example a plant with passive post-LOCA containment cooling may have different requirements for protective coatings on containment surfaces. (The coatings have different safety functions) Applicants for new reactors may need to adjust some sections of their DCDs.”
- Protective Coatings classification varies for some new reactors:
  - SL I and II inside containment
  - SL III on exterior surfaces of class MC containment vessel (AP-1000)
- Effects of coating debris on sump performance are being addressed similar to operating PWRs.

New Reactors

AP 1000

- The exterior of the containment vessel will be coated with inorganic zinc, as is the interior of the containment vessel.

- Inside containment, Service level II epoxy coatings are postulated to fail due and not affect ECCS strainer performance because they will not transport readily due to their density.

- The exterior coating is classified as "Safety - Service Level III." with four functions that are listed as safety-related in the DCD (e.g., Table 6.1-2): "Promote wetability, heat conduction, non-detachable, and inhibit corrosion.“

New Reactors

US EPR is planning on SL II inside containment where there is no direct path for failed coating material to transport to the IRWST (e.g., isolated compartments within the containment) or other ESFs.

Questions

- What questions do you have?