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U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF INSPECTION AND ENFORCEMENT

REGION IV

INTERIM REPORT ON PROTECTIVE COATINGS

PREPARED BY BROOKHAVEN NATIONAL LABORATORY

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I. INTRODUCTION

This is an interim report in response to an NRC Region IV request to itemize the information that is necessary to assess the adequacy of the Applied Protective Coatings Backfit Program at Comanche Peak Steam Electric Station (CPSES), Units 1 & 2. That information is contained in Section III of this report.

The remainder of the report is organized as follows:

Section II: Provides historical background related to CPSES and BNL's work to date

Section III: Outlined above

Section IV: Summary of findings to date

Section V: Conclusions

The major portion of BNL's effort to date has been in evaluating approximately 60 allegations. A report on this subject is due April 30, 1984.

.I. BACKGROUND

There are two major reasons for applying protective coatings inside the reactor containment building. The first reason is to protect exposed carbon steel surfaces from corrosion. The second reason is to provide for easier decontamination, which also reduces the level of occupational radiation exposure.

If coatings are not properly applied and subsequently fail, they can have an adverse safety impact by clogging pump strainers, spray nozzles, and fan filters which can degrade safety equipment operation.

This is more than a theoretical concern since a number of protective coatings failures have occurred at nuclear power stations. For example:

- Beaver Valley (1975) - During construction, the coatings failed on the containment dome.
- Brunswick 2 (1980) - During operation, coatings failure occurred below the torus water line.
- Dresden 2 (1971) - During operation, Torus coatings failure occurred.
- Peach Bottom 2 (1971, 1973) - During preoperational testing, torus coatings failure occurred.

In 1981, Region IV of the NRC conducted an inspection of protective coatings at Comanche Peak. As a result of this inspection, (Inspection Report #81-15), a Notice of Violation was issued regarding failure to follow quality assurance procedures for the inspection of protective coatings. From late September 1979 through October 1981, documentation for protective coatings was not maintained or was incomplete. As a result of this Notice of Violation, Comanche Peak instituted a Backfit Program to verify that the applied protective coatings were themselves adequate even though adequate documentation did not exist.

Starting in 1983, numerous individuals have made allegations concerning the adequacy of the applied protective coatings at Comanche Peak.

Brookhaven National Laboratory (BNL) was contracted to provide technical assistance in performing on-site inspections of the protective coatings program at Comanche Peak. The work, as stated in the contract, is to "Provide technical assistance in performing an inspection of the protective coatings program at the specified NTOL nuclear power plant. This inspection will include the examination of site procedures and verification of the adequacy of these procedures against standards and FSAR commitments, the adequacy of applied coatings, the adequacy of rework, and the procedures governing rework, the adequacy of verification testing, and the adequacy of completed quality records. Also included in the scope of this task will be the followup on specific technical questions contained in sworn testimony from persons making allegations of the adequacy of the protective coatings program."

The responsibility for reviewing the statistical adequacy of the licensee's Backfit Program, (i.e., sampling techniques, acceptance criteria, etc.) has been assigned to the NRC Auxiliary Systems Branch. With the concurrence of NRC Region IV, a meeting was held between ASB and BNL on April 2, 1984. The outcome of this meeting was that additional statistical information is required. This information has ben incorpurated into Section III of this report.

III. INFORMATION REQUIRED TO DETERMINE ADEQUACY OF APPLIED PROTECTIVE COATINGS THROUGH THE BACKFIT PROGRAM

Based on interviews with various personnel on the licensee's staff, it is BNL's understanding that the Backfit Program is limited to the primer coatings applied prior to the NRC's issuing Notice of Violation, Inspection Report No. 81-15. That is to say, no statistical analysis of Elcometer adhesion pull tests and Tooke Scratch tests was performed for coatings applied since the NRC issued its violation and for the top coat that has been applied since the coatings application first began. Therefore, if this understanding is accurate, BNL does not believe that the Backfit Program will be useful in determining the adequacy of applied coatings as far as total coating system is concerned. It is understood that in some if not all cases, the testing may have been performed for the total system. However, the licensee chose to perform a statistical analysis only in regard to the primer coat, and does not address the statistical significance of test results for the total coatings system. This will be resolved when the required information is supplied by the licensee.

Information Required

Note: The information requested in this section should be provided in reviewable form to BNL or made available at the site.

A. Programmatic

1. Provide the document or series of documents that explains the Backfit Program in its entirety.

2. What is the estimated total square footage of applied coatings in Unit 1 containment? What portion of the total applied coatings represents coatings applied to concrete surfaces, miscellaneous steel and containment liner plate?

3. Provide the location and boundaries and define all areas that have been exempted from the Backfit Program. Also provide the justification for the exemption.

4. Provide the percentage of the three major areas (see Question 2), that was included/exempted in the Backfit Program.

B. Training

5. Provide the operating procedure for instruments used during the Backfit Program.

6. Provide indoctrination and training records that demonstrate that those individuals performing testing for the Backfit Program were qualified.

7. Provide procedure reference for field checking of instruments during the Backfit Program.

C. Instrumentation and Testing

8. Provide instrument history/calibration records of each instrument used in the Backfit Program.

9. Provide the method used to evaluate and account for instruments found to be out of calibration during the Backfit Program. How was and is the deviation incorporated in reporting Elcometer Adhesion Test results?

   Additionally, for an instrument found out of calibration, provide documentation that shows that all tests done with that instrument since its last calibration were invalidated. Also, provide the procedure used to handle those inspection reports written after the instrument went out of calibration.

10. If not provided in the answers to Questions 7 and 8, provide the total number of instruments used in the Backfit Program. Provide the type and serial number of each instrument.

D. Statistical

11. Provide the total number of individual pull tests performed and the number of individual pull tests that failed for each of the three major areas (see Question 2).

12. Provide the final calculations for each of the three major areas (see Question 2) that demonstrate the estimated failure rate with its associated confidence limits, for each of the three major areas individually.

IV. FINDINGS RELATED TO THE ADEQUACY OF APPLIED PROTECTIVE COATINGS.

A. Testing

1. BNL has performed independent tests on the protective coatings at the site. On a random basis, 6 areas of approximately one hundred (100) square feet were chosen at various elevations and various azimuths. Two areas represented liner plate, two areas represented miscellaneous steel and two areas represented concrete surfaces. In each area, five (5) test dollies of approximately 1/2 square-inch were glued to the protective coatings and a pull of 250 psi was applied to the test dollies. If a dolly separated from the surface, the force that caused the separation was recorded. If the dolly did not pull off the surface at 250 psi, a reading of 250 psi was recorded and the dolly was knocked off of the surface after the instrument had been returned to a reading of zero and removed.

For the liner plate, a failure rate was exhibited of 4 out of 10, or 40%. Failures occurred in both test areas with corrected readings of 156, 186, 186, and 186. For miscellaneous steel, no failures were recorded in ten (10) tests, and for concrete surfaces, a failure of the concrete was experienced at a corrected reading of 156 psi for one test and no failures of the protective coatings in nine (9) tests.

In addition to Elcometer adhesion pull tests, 30 Tooke (scratch) tests were performed adjacent to the pull tests. No "out of specification" conditions were recorded in the dry fim thicknesses testing.

BNL's observed failure rate for the liner plate is unacceptable. Although it was limited in scope, it raises questions about the adequacy of the Backfit Program for the liner plate.

2. During the week of March 18, 1984, BNL observed an area at approximately elevation 860 and azimuth 175 of the liner plate that was being repaired because of recent unacceptable adhesion test readings and visible deterioration. This same area had acceptable adhesion test readings during initial backfit testing in December 1982. This again raises doubts about the adequacy of the Backfit Program for the liner plate.

B. Procedural

3. Contrary to good industry practice, solvent has been used excessively to wipe down primed surfaces prior to the top coat application. Excessive solvent retention will inhibit the curing of inorganic films and can lead to coatings failure under operating conditions. The licensee's procedures do not provide direction or caution on solvent use, nor is there evidence of proper training to this effect. In three areas of coating system failures on the containment liner plate, BNL observed a solvent odor that was far in excess of what would be considered normal.

4. Contrary to CPSES FSAR Section 1A(B), Regulatory Guide 1.58, and ANSI/ASME N45.2.6-1978, Section 4 and Table 1, Level 1 Coatings QC Inspectors have been making judgments and evaluations that they are not qualified to make.

Examples of this were evident in procedures where level I inspectors were: a) evaluating surface preparation without instruments or approved visual standards, b) evaluating the adequacy of coatings materials when its "pot life" had been exceeded, and c) evaluating the acceptable extent of overlapping dry spray beyond the specific areas to be coated.

5. Contrary to Gibbs & Hill, Inc., Protective Coatings Specification No. 2323-AS-31, Revision 1-March 15, 1978 for CPSES, Section 6.1 b and Brown and Root, Inc. letter BRV-12605, dated May 7, 198. to Tim Dolen, Carboline Company from D. C. Frankum, Project Manager, proper surface preparation was not achieved. Instruction Number QI-QP-11.4-5 allows 80 grit "flapper wheels" versus the 60 grit "flapper wheels" used to qualify surface preparation.

6. BNL has identified numerous procedural deficiencies. A summary of some of the more serious deficiencies follows:

a) Contrary to good industry practice and 10 CFR Part 50, Appendix B, Criterion V;

1) The procedures are not "stand-alone" documents, acceptance criteria are found in other referenced documents.

2) Procedures such as Instruction Number QI-QP-11.4-1, and QI-QP-11.4-5 requires a flashlight to be held perpendicular to the inspection surface only. Proper inspection technique would require a light to be positioned parallel to the surface to locate certain types of defects. Additionally, the minimum light required is not specified.

3) Procedure QI-QP-11.4-1, paragraph 3.1.2, states that for abrasives "... All grease, oil, and deleterious material is unacceptable", and yet provides no methods to determine if these materials are present. The procedure also does not define deleterious material.

b) Contrary to 10 CFR 50 Appendix B Criterion V and CPSES FSAR, paragraph 17.1.1.5, the final coatings walkdown procedure contained no acceptance criteria and did not contain appropriate instructions regarding hiding quality, cracking, delamination, peeling, excessive overspray, excessive roughness, flaking, blistering, or cracking. In conjunction with inadequate inspection procedures, this could allow acceptance of inadequate coatings.

c) Contrary to CPSES FSAR, page 1A(B)-22; R. G. 1.54, and ANSI N101.4-1972, paragraph 4.4.3, CPSES coatings procedures allow weld splatter to remain on metal surfaces. This could contribute to coatings failure.

d) Contrary to CPSES FSAR, page 1A(B)-22; R. G. 1.54, and ANSI N101.4-1972, paragraph 5.2.2, CPSES coatings procedures provide for the writing and approval of special coatings procedures, without the approval of the coating manufacturers.

e) Contrary to CPSES FSAR, paragraph 6.1B.2 and ANSI N.101.2, coatings applied over "drypack" concrete repairs were not DBA-qualified. Additionally, the "drypack" does not appear to meet paragraph 6.4.2 of ANSI N101.2-1972.

C. Documentation/Design Control

7) Based on a brief review of Design Change Authorizations (DCA's) written in the coatings area, it does not appear as though Quality Assurance is included in the review and approval chain, as would be required by 10 CFR 50 Appendix B, Criterion III. Also, there is no formal mechanism to ensure that users of controlled copies of the Coating Specification have received and are aware of all applicable DCAs. Finally, there is no requirement for specification revision after DCA's have been issued against it, either based on time or number of DCA's. Additional review in this area is needed to determine how quality is assured in the DCA program.

8) Contrary to FSAR Section 6.1B.2,ANSI N101.2, Section 4, a number of coatings systems have been specified and used that have not been DBA qualified. After identification of this by BNL, the licensee has committed to submitting these coatings systems to the appropriate DBA testing.

9) Contrary to FSAR Section 1A(B), Regulatory Guide 1.54 Section C.4, "STAF Hospital Spray Disinfectant", an aerosol containing chlorides, was used by painters inside containment where stainless steel is located.

10) A number of the 60 allegations against CPSES's protective coatings have been substantiated and additional allegations may be substantiated. The status of all 60 allegations will be stated in a follow up report due April 30, 1984.

V. SUMMARY AND CONCLUSIONS

1. An adequately conceived and properly implemented Backfit Program will permit an evaluation of the applied coatings at Comanche Peak. The information requested in Section III of this report will permit an assessment of the licensee's Backfit Program.

2. As demonstrated in Sections IV B and C, the coatings procedures and design control for coatings at CPSES appear to be inadequate to assure the specification of proper coatings systems and the application of coatings, once they are specified. As such, no determination can be made as to the adequacy of coating for the following applications: a) any repair work completed subsequent to the backfit testing, b) coating applications not included in the scope of the Backfit Program, and c) all coating work for Unit No. 2.

3. As stated in Section IV A, and further reinforced by conclusion number 2, the liner plate coating appears to be inadequate.