UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

March 24, 1997

NRC INFORMATION NOTICE 97-13: DEFICIENT CONDITIONS ASSOCIATED WITH PROTECTIVE COATINGS AT NUCLEAR POWER PLANTS

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees about several instances in which protective coatings have not been properly applied, maintained, or qualified for their intended use and have jeopardized the operability of safety-related equipment. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

Protective coatings are used in many applications at nuclear power plants. For example, coatings may be used to protect the inside surfaces of storage tanks and containment liners from corrosion, to protect the inside surfaces of piping systems from erosion and corrosion, or to seal exposed concrete surfaces. Additionally, coatings may be applied to provide a skid-resistant surface to walk on or to control contamination.

Description of Circumstances

Several instances have been reported to the NRC recently in which protective coatings have either not been properly applied and maintained or have not been adequately qualified for their intended use. The following are examples:

1. Pipe Coating Material Found in the A-Train Recirculation Spray Heat Exchangers at Millstone Unit 3

   On July 25, 1996, Northeast Nuclear Energy Company reported in Licensee Event Report (LER) 96-025 (Accession Number 9608270262) that about 20 pieces of Arcor were found in the "A" train recirculation spray heat exchangers at Millstone Unit 3. Arcor is a coating material that was applied to the inside surfaces of the service water system piping at Millstone Unit 3. The licensee stated that Arcor chips were swept into the recirculation spray heat exchanger channel heads during engineered safety features/loss of power testing that had been conducted. The licensee also found 40 to 50 mussel shell fragments in the heat exchangers. Although the Arcor chips and mussel fragments were relatively small (on the order of 1 inch by 1 inch), the licensee determined that the number and size of Arcor chips and mussel fragments could have prevented the "A" train recirculation spray heat exchangers from performing their specified safety function.

The licensee determined that the Arcor chips were from a second coat of Arcor that was applied in the field (as opposed to being applied in the shop) to the internal diameter of the "A" train service water system piping. The licensee concluded that the plant's procedures for field application of the Arcor coating were not adequate to ensure proper bonding of the second coat. As corrective actions, the licensee planned to revise the procedure for the application of the Arcor to more adequately ensure proper bonding between the first and second coatings, and to visually inspect the "A" train service water system to determine the location and extent of Arcor delamination. Repairs to any affected areas of the "A" train service water system piping would use the revised procedure for Arcor application. A flushing and inspection of the "B" train recirculation spray heat exchangers did not disclose additional Arcor chips or mussel fragments.

2. Degradation of Protective Coatings Used Inside Containment

Zion Unit 2

In November 1996, Commonwealth Edison Company found that 40 percent to 50 percent of the concrete floor coatings at Zion Unit 2 showed extensive failure as a result of mechanical damage and wear and that about 5 percent of the coating associated with the concrete wall and liner plate was degraded. Although adhesion tests showed acceptable adhesion strength in most of the locations tested, one test that was made on an unqualified coating system did not satisfy the acceptance criteria. Unqualified coatings had been applied to various surfaces, including instrument racks, struts, charcoal filter housings, valve bodies, and piping. Also, documentation was not found for overcoating (i.e., touch-up work) that had been applied to many of the liner plates and concrete wall surfaces.

To resolve the coating discrepancies that were identified in the Zion Unit 2 containment, all of the loosely adherent coatings were removed and material transport calculations were performed for the coated surfaces inside containment. These calculations were used to define a "zone of influence" relative to the containment sump, and the licensee has removed all of the unqualified coatings that existed within this zone, except for small amounts that might be present on items such as identification tags, signs, and lighting fixtures. The licensee estimated that about 110m^2 [1200 ft^2] of unqualified coatings existed in the Unit 2 containment. In addition to these immediate actions, the licensee was establishing a long-term corrective action plan and a coating maintenance program to fully resolve the coating discrepancies at the Zion station.

Indian Point Unit 2

On March 10, 1995, the Consolidated Edison Company reported in LER 95-005 (Accession Number 9503210115) that paint was peeling from a floor in the Indian Point Unit 2 containment. The licensee found that the following factors contributed to the delamination of the paint: (1) the paint thickness exceeded the manufacturer's specifications by up to twice the allowed thickness; (2) there was excessive paint shrinkage caused by using too much paint thinner; (3) the surface had not been properly cleaned and prepared before the paint was applied; and (4) inspection and documentation requirements conforming to American National Standards Institute (ANSI) N101.4, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," which was invoked by the existing specification for the activity, were not implemented. The licensee concluded that the root cause of the observed condition resulted from the failure of personnel to follow approved procedures for painting applications.

Sequoyah Units 1 and 2

On October 18, 1993, the Tennessee Valley Authority reported in LER 93-026 (Accession Number 9310260116) that unidentified coatings were used on the exterior surfaces of reactor coolant pump motor support structures at Sequoyah Units 1 and 2. These support structures are located completely within the containment sump "zone of influence" at both of the Sequoyah units. The surface area of unqualified coating found on each of these support structures involved about 13m^2 [143 ft^2] of material, whereas the maximum amount of uncontrolled coatings allowed to exist in the zone of influence at the Sequoyah units without affecting the operability of the emergency core cooling and spray systems was set at 5m^2 [56.5 ft^2]. As corrective action, the licensee modified the motor support structures to include "catch" screens to prevent coatings on the motor support structures from reaching the strainers in the containment sumps.

Discussion

The failure of coatings to adhere to exposed surfaces inside containment and to the internal surfaces of fluid systems can result in clogged strainers, filters, and nozzles and can compromise the ability of safety-related equipment to function (e.g., the service water system, the containment spray system, and the emergency core cooling systems). It is important that coating systems remain adherent and intact during normal operating and transient conditions, as well as during the most extreme environmental conditions that can exist during design-basis accident conditions, especially if coating system failure can jeopardize the operability of safety-related equipment. Industry standards provide certification and qualification requirements for coatings that are used in these applications. Additionally, industry standards for coatings as well as vendor instructions and recommendations provide guidance pertaining

to such things as surface preparation and cleanliness requirements, temperature control, humidity control, timing requirements for multiple coat applications, application methods, and personnel qualification and training requirements. Depending on the specific application, a combination of in situ testing and periodic inspection of coatings may be necessary to ensure that the coating has been adequately applied and remains intact over time.

Coating activities that can affect safety-related equipment are governed in general by Title 10 of the *Code of Federal Regulations*, Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." Criterion IX of Appendix B, "Control of Special Processes," is especially relevant and requires that "Measures shall be established to assure that special processes...are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements." Regulatory Guide 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants," provides guidance on a way to comply with these quality assurance requirements as they relate to protective coating systems that are applied to ferritic steel, aluminum, stainless steel, zinc-coated (galvanized) steel, and masonry surfaces.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Wayne M Lloyd for

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
97-12	Potential Armature Binding in General Electric Type HGA Relays	03/24/97	All holders of OLs or CPs for nuclear power reactors
92-27, Supp. 1	Thermally Induced Accelerated Aging and Failure of ITE/ Gould A.C. Relays Used in Safety-Related Applications	03/21/97	All holders of OLs or CPs for nuclear power reactors
97-11	Cement Erosion from Containment Subfounda- tions at Nuclear Power Plants	03/21/97	All holders of OLs or CPs for nuclear power reactors
97-10	Liner Plate Corrosion in Concrete Containments	03/13/97	All holders of OLs or CPs for power reactors
97-09	Inadequate Main Steam Safety Valve (MSSV) Setpoints and Perform- ance Issues Associated with Long MSSV Inlet Piping	03/12/97	All holders of OLs or CPs for nuclear power reactors
97-08	Potential Failures for General Electric Magne-Blast Circuit Breaker Subcomponents	03/12/97	All holders of OLs or CPs for nuclear power reactors

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original signed by M.M. Slosson

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adherent and intact during normal operating and transient conditions, as well as during the most extreme environmental conditions that could occur during design-basis accident conditions. Qualification testing of coatings that are used in these applications normally conforms to applicable industry standards. In addition, vendor recommendations and instructions should be followed where applicable. Vendor guidance and industry standards for coating applications can provide important insights regarding proper surface preparation and cleanliness, temperature control, humidity control, timing requirements for multiple coat applications, application methods, and qualification and training of personnel. A combination of in situ testing and periodic inspection of coatings may be necessary to ensure that the coating has been adequately applied and remains intact over time.

Title 10 of the *Code of Federal Regulations*, Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," provides quality assurance requirements for performing activities associated with safety-related structures, systems, and components at nuclear power plants. Coating activities that can affect safety-related equipment are to be governed in general by the quality assurance criteria of Appendix B; Criterion IX of Appendix B, "Control of Special Processes," is especially relevant. Regulatory Guide 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants," provides guidance on a way to comply with these quality assurance requirements as they relate to protective coating systems that are applied to ferritic steel, aluminum, stainless steel, zinc-coated (galvanized) steel, and masonry surfaces.

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