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Mr. Thomas E. Murley, Director
Office of Inspection and Enforcement Region I
United States Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

Subject: Limerick Generating Station, Units 1 & 2
Significant Deficiency Report No. 91
Diesel Oil Storage Tank Interior Coatings
NRC Construction Permit Nos. CPPR-106 & 107

File: QUAL 2-10-2 (SDR No. 91)

Dear Mr. Murley:

During final inspection of the Limerick diesel oil storage tanks, failures were observed in the epoxy phenolic coating applied to the lower portion of the interior surface. We have evaluated the safety impact of this failure and consider it a significant deficiency per 10CFR50.55(e), and are hereby notifying you as required.

The details of our evaluation are contained in the attached report. Please do not hesitate to contact us should you desire further discussion or clarification of any aspect of this item.

Very truly yours,

John S. Kemper

Copy to: Director of Inspection and Enforcement
United States Nuclear Regulatory Commission
Washington, DC 20555

S. K. Chaudhary, Resident NRC Inspector (Limerick)



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Limerick Generating Station, Units 1 and 2

Significant Deficiency Report - SDR No. 91

Diesel Oil Storage Tank

Interior Coating Peeling

NRC Construction Permit Nos. CPPR-106 and 107

## Introduction

This is the final report concerning a significant deficiency on the fuel oil storage tanks for the Limerick diesel generators. The affected tanks were fabricated by Buffalo Tank Division of Bethlehem Steel Corporation at their Baltimore, MD facility. A total of eight tanks were supplied to Limerick, four for each unit. Each tank is 12' in diameter, 49' long, and will hold a maximum of 41,500 gallons of fuel oil. All eight of the tanks have been installed at the site and are located underground in front of the radwaste building.

## Description of Deficiency

During final inspection of the Unit 1 and Unit 2 diesel oil storage tanks, the epoxy phenolic coating on portions of the interior surface of three of the four Unit 1 tanks was observed to have extensive peeling and flaking. If not repaired, these fragments could have entered the fuel oil transfer piping and filters, thus impeding fuel oil flow and potentially causing a diesel generator failure.

The protective coatings were applied at the manufacturer's facility before the tanks were delivered to the Limerick site, sometime in the latter half of 1980. The tanks were coated in accordance with the specified requirements of both PECo. and Bechtel Power Corporation, the Architect Engineer for the Limerick project. The specification required that the entire interior surface of the tanks be coated with an inorganic zinc primer (Carbozinc-11, manufactured by Carboline Corporation) to a thickness of between 2.0 mils and 4.0 mils. On top of the zinc primer, an epoxy phenolic coating (Plasite - 7122, manufactured by Wisconsic Protective Coatings, Inc.) was applied to a minimum of 12 mils and a maximum of 18 mils dry film thickness. The epoxy was applied only to the sump area and bottom one foot of the tank when measured in the vertical direction.

There are two factors which may have contributed to the coating failure: (1) chemical imcompatibility between the zinc primer and the epoxy coating, and (2) improper curing of the zinc primer. According to the epoxy coating manufacturer, both the inorganic zinc and the epoxy are formulated for application to white-metal blasted steel; the epoxy is not formulated for application over the inorganic zinc. In addition, field examination by Bechtel's coating specialists indicated that the inorganic zinc was not cured properly prior to the application of the epoxy topcoat. The zinc coating appears soft and chalky and does not provide an acceptable surface for the adhesion of a topcoat. As a result of these factors, failure of the epoxy occurred in flakes of approximately 1 $in^2$ mean cross sectional area.

Subsequent investigation by Philadelphia Electric Company has revealed an additional concern regarding this coating system. The zinc in the primer coat may react adversely with diesel fuel when exposed over a long period of time. Products of this reaction are often soluble when the fuel is at room temperature, but may degrade into insoluble gums as the fuel passes through the hot injectors and intake manifolds of a diesel engine. This may result in degraded performance as the engine is operated over a period of time.

The above problems are limited to the eight underground fuel oil storage tanks. The diesel generator day tanks are not within the scope of this concern, since the interiors of these tanks are not coated. The type of coating system described above has not been used on any other oil storage tanks at the Limerick plant.

Corrective Action

The existing coatings will be removed from all eight of the diesel generator fuel oil storage tanks.

The entire interior surface of the tanks will be sandblasted to white metal. The sump area and bottom vertical foot of the tanks will then be recoated with a substitute epoxy phenolic coating (Amercoat 90, manufactured by Ameron Protective Coatings, Inc.) applied directly to the white metal. The coating will be certified by the manufacturer for compatibility with diesel fuel, and will be applied in conformance with the manufacturer's instructions. In light of the zinc/diesel fuel compatibility concerns discussed above, the remainder of the interior surfaces will not be recoated.

Appropriate inspection points will be established during the sandblasting and recoating operation. These inspections

shall consist of visual observations, surface profile comparisons, and measurements of dry film thickness. No surface will be accepted for coating unless it meets the acceptance criteria of SSPC-VIS-1, and no coating will be accepted unless it meets the thickness requirements discussed above, when measured in accordance with SSPC-PA-2 inspection procedures. In addition, no runs, sags, voids, overspray, loss of adhesion, inadequate curing, or rusting of the substrate shall be permitted.

This work will be completed within the next few weeks for the Unit 1 fuel oil tanks only, since initial loading of diesel fuel is scheduled before the end of October, 1983. Work on the remaining Unit 2 fuel oil tanks will be deferred until a few weeks prior to loading of the Unit 2 diesel fuel, in order to preclude rusting of the tank substrate.

Safety Implications

If left unrepaired, the epoxy flakes could have entered the transfer pump suction and clogged one of the several filters in the piping between the pump discharge and the diesel engine fuel injectors. This could have impeded fuel oil flow and potentially caused a diesel generator failure. Should this have occurred during a loss of offsite power, the safe shutdown capability of the plant would have been compromised. We believe that the revised coating system described above resolves any safety implications for the following reasons:

1. Corrosion Allowance - The tanks are provided with 1/8" corrosion allowance from the low liquid level to the top of the tanks, and a 1/4" corrosion allowance from the maximum water level to the bottom of the tank. This is sufficient for the 40 year service life of the tanks.

2. Condensate Removal - The tanks are designed to permit easy removal of any condensation which may collect at the bottom of the tank. This will be removed at three month intervals in accordance with the plant Technical Specifications. The presence of any particulates from rust formation or coating failure would therefore be detected.

3. Fuel Oil Quality - The fuel oil purchased for the Limerick diesel generators will be No. 2 diesel fuel and will meet the requirements of Federal Fuel Oil Specification VV-F800b (Grade 2P). The Limerick fuel oil storage and transfer system has been designed to maintain this fuel at the highest level of quality as is practical. Factors which

are known to degrade fuel oil quality (e.g., exposure to high temperatures, temperature fluctuations, presence of water bottoms, and contact of the fuel with either copper or zinc) have been specifically addressed in the design of the system and are discussed in the Limerick FSAR.

In addition, the surveillance testing program and the plant technical specifications will require that the fuel be tested upon arrival on site and at three month intervals thereafter. This will ensure that adequate fuel oil quality is maintained to enable diesel generator operation.

4. Particulate Contamination - Any particles that may accumulate in the fuel oil - whether from rust, from peeling of the epoxy coating, or from external sources - will be prevented from entering the diesel generator fuel oil injectors by a series of duplex filters and strainers located between the fuel oil transfer pump discharge and the engine. Each of these filters and strainers is provided with differential pressure alarms which are set low enough to provide sufficient warning that an element will require cleaning. Upon receipt of an alarm, the operators will manually switch to the parallel element to enable continued diesel generator operation.

We believe that this program will provide sufficient protection against internal corrosion of the tanks due to condensation, while also ensuring that long term storage of the fuel oil will not result in degraded quality.