UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

November 23, 1994

NRC INFORMATION NOTICE 94-79: MICROBIOLOGICALLY INFLUENCED CORROSION OF EMERGENCY DIESEL GENERATOR SERVICE WATER PIPING

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 to degradation resulting from microbiologically influenced corrosion in carbon steel piping systems that supply service water to emergency diesel generators. It is expected that recipients will review the 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.

Description of Circumstances

Haddam Neck Plant

On February 12, 1994, a through-wall leak developed in the service water system supply piping to the "A" emergency diesel generator. The leak occurred in a weld in an area of low flow, where the licensee was doing light surface grinding to prepare for ultrasonic test (UT) inspection. Previously, in March 1993, the licensee had found a similar leak associated with the "B" emergency diesel generator. After removing the leaking section and examining the pipe, the licensee determined that the leak was caused by poor initial weld quality and microbiologically influenced corrosion. Lack of penetration of some welds created a crevice condition. Radiographic tests (RT) of additional emergency diesel generator service water system piping revealed three additional welds that could form similar leaks. It was during preparation of one of these welds for UT examination that the through-wall leak associated with the "A" emergency diesel generator was found.

The licensee had previously performed a structural integrity determination in 1993 by radiography. Though based on a uniform wall loss instead of a sharp disruption, the licensee had at that time concluded that the worst-case degraded cross-section of the as-found pipe welds, located in the unisolable portions of the emergency diesel generator supply piping, met the Generic Letter 90-05 acceptance criteria for structural integrity and that the degraded piping would have sufficient mechanical and structural integrity to remain operable.

Beaver Valley Power Station, Unit 1

On May 6, 1994, the licensee found a through-wall leak (an 8 mm [5/16 inch] diameter hole) on the "A" train reactor plant river water system header to the emergency diesel generators. The leak developed on the below-grade portion of the 15-cm [6-inch] diameter A106 Grade B carbon steel piping. The licensee excavated the "A" and "B" train headers, ultrasonically examined them using the "autoscan" area mapping technique, and found localized pitting to less than minimum required wall thickness in three additional locations along the "A" train piping. The pits were not clustered or closely spaced, but were located along the pipe length between the five and seven o'clock positions. For reference, the nominal pipe wall thickness is 6.4 mm [0.25 inch] and minimum code wall thickness is 1.5 mm [0.06 inch].

The licensee evaluated the pitting in accordance with the American Society of Mechanical Engineers (ASME) Code of record. The basis for the localized thinning evaluation was conducted in accordance with industry guidance, EPRI NP-5911SP, "Acceptance Criteria for Structural Evaluation of Erosion-Corrosion Thinning in Carbon Steel Piping." This evaluation was reviewed by personnel in NRR and deemed as an acceptable conservative means of demonstrating ASME Code conformance. The licensee determined microbiologically influenced corrosion to be the cause of the pitting and through-wall leak. The licensee removed a 0.61 m [24 inch] long section of piping to culture and characterize the microbial activity and perform additional ultrasonic testing.

The general inside surface of the piping was moderately corroded, with localized pits and tubercles. Cultures from the pits contained sulfur-reducing bacteria and the anaerobic bacteria *Clostridium*. The tubercle formation was the result of the growth of the iron-oxidizing bacteria *Gallionella*. Ultrasonic examinations of a heat-affected zone indicated that the weld examined was not subject to preferential microbiologically influenced corrosion attack.

Discussion

Stagnant or intermittent-flow conditions, as in the case of emergency diesel service water supply headers, are conducive to the growth of microorganisms that can accelerate corrosion rates. Service water supply lines to emergency diesel generators are stagnant because motor-operated isolation valves are normally maintained shut (except during monthly surveillance testing). Crevices such as those in piping welds that lack penetration can enhance microbiologically influenced corrosion attack by giving a place for deposits and, therefore, for the bacteria to collect. Microbial films form when aerobic species, such as iron-oxidizing bacteria, create anaerobic conditions underneath them for microorganisms, such as sulfate-reducing bacteria, to accumulate at the metal surface. Sulfate-reducing bacteria attack the metal surface, produce corrosive chemicals, and cause deep pitting.

Microbiologically influenced corrosion on carbon steel will increase general corrosion, through-wall pitting, and the formation of tubercles. Tubercles consist of corrosion products, microbes, and debris. Tubercle growth could restrict cooling water flow to equipment.

Stainless steel piping is not immune to microbiologically influenced corrosion because microbes can attack at the weld heat affected zone (HAZ) in stainless steels when this zone becomes sensitized. Microbiologically influenced corrosion can also damage metals lined with polymeric materials, typically at coating imperfections.

Once microbial films are established on metal surfaces, they are extremely difficult to eliminate because of the resiliency of the individual microorganisms. Biocides are applied by some licensees in areas where continuous flow conditions cannot be maintained. However, biocide treatments are not always effective against established microorganism colonies because the biocide cannot penetrate through the tubercles or aerobic biofilms. Treatment against established colonies involves a combination of mechanical or chemical pipe cleaning, continued water treatment and regular maintenance. Continuous flow conditions have been found to prevent the attachment and growth of microbial films.

It may be necessary to replace materials if microbiologically influenced corrosion severely damages them or where mitigation measures cannot bring the system condition under control. Possible alternatives include replacing carbon steel with stainless steel or replacing stainless steel with more resistant materials, such as 6-percent molybdenum stainless steels, nickel base alloys, titanium, or nonmetallic materials.

The licensee did not regularly treat the Beaver Valley River water supply lines to the diesel with biocide or corrosion inhibitors. The chlorination injection point for the main river water headers is downstream of the branch lines to the emergency diesel generators. It also appears that the existing program at Haddam Neck of hypochlorite injection was not successful in mitigating the microbiologically influenced corrosion problems in stagnant dead-end lines at such locations as the emergency diesel generator supply.

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.

For Brian K. ~~Grimes, Director~~
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts:	Michael Modes, RI (215) 337-5198	James A. Davis, NRR (301) 504-2713
	Peter P. Sena, RI (412) 643-2000	Vern Hodge, NRR (301) 504-1861

Attachment:
List of Recently Issued NRC Information Notices

Attachments filed in Jacket

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-78	Electrical Component Failure due to Degradation of Polyvinyl Chloride Wire Insulation	11/21/94	All holders of OLs or CPs for nuclear power reactors.
94-77	Malfunction in Main Generator Voltage Regulator Causing Overvoltage at Safety-Related Electrical Equipment	11/17/94	All holders of OLs or CPs for nuclear power reactors.
94-76	Recent Failures of Charging/ Safety Injection Pump Shafts	10/26/94	All holders of OLs or CPs for pressurized water reactors.
93-60, Supp. 1	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	10/20/94	All 10 CFR Part 70 fuel cycle licensees.
94-75	Minimum Temperature for Criticality	10/14/94	All holders of OLs or CPs pressurized-water reactors (PWRs).
94-74	Facility Management Responsibilities for Purchased or Contracted Services for Radiation Therapy Programs	10/13/94	All U.S. Nuclear Regulatory Commission Medical Licensees.
94-73	Clarification of Criticality Reporting Criteria	10/12/94	All fuel fabrication facilities.
94-72	Increased Control Rod Drop Time from Crud Buildup	10/05/94	All holders of OLs or CPs for pressurized water reactors.
94-71	Degradation of Scram Solenoid Pilot Valve Pressure and Exhaust Diaphragms	10/04/94	All holders of OLs or CPs for boiling water reactors (BWRs).

OL = Operating License
CP = Construction Permit

The licensee did not regularly treat the Beaver Valley River water supply lines to the diesel with biocide or corrosion inhibitors. The chlorination injection point for the main river water headers is downstream of the branch lines to the emergency diesel generators. It also appears that the existing program at Haddam Neck of hypochlorite injection was not successful in mitigating the microbiologically influenced corrosion problems in stagnant dead-end lines at such locations as the emergency diesel generator supply.

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.

Original signed by B.D. Liaw for
Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: Michael Modes, RI
(215) 337-5198

James A. Davis, NRR
(301) 504-2713

Peter P. Sena, RI
(412) 643-2000

Vern Hodge, NRR
(301) 504-1861

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE

OFFICE	*OGCB/DORS	*TECH ED	*REGION I	*REGION I
NAME	CVHodge	JDMain	MCModes	PPSena
DATE	09/08/94	09/09/94	09/01/94	10/03/94

*ADD:DRS/REGION I	*EMCB/DE	*S:EMCB/DE	*C:EMCB/DE
ARBlough	JADavis	RAHermann	JRStrosnider
10/03/94	09/20/94	09/20/94	09/30/94

*D:DE	*OECBB/DOPS	*C:OECB/DOPS	D:DOPS/NRR
BWSheron	RLDennig	AEChaffee	BKGrimes
10/06/94	10/20/94	10/25/94	11/[illegible]/94

DOCUMENT NAME: 94-79.IN

inhibitors. The chlorination injection point for the main river water headers is downstream of the branch lines to the emergency diesel generators. It also appears that the existing program at Haddam Neck of hypochlorite injection was not successful in mitigating the microbiologically influenced corrosion problems in stagnant dead-end lines to such locations as the emergency diesel generator supply.

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.

Brian K. Grimes, Director
Division of Operating Reactor
Support
Office of Nuclear Reactor
Regulation

Technical contacts: Michael Modes, Region I
(215) 337-5198

Peter P. Sena, Region I
(412) 643-2000

James A.Davis, NRR
(301) 504-2713

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE

OFFICE	*OGCB/DORS	*TECH ED	*REGION I	*REGION I
NAME	CVHodge	JDMain	MCModes	PPSena
DATE	09/08/94	09/09/94	09/01/94	10/03/94

*ADD:DRS/REGION I	*EMCB/DE	*S:EMCB/DE	*C:EMCB/DE
ARBlough	JADavis	RAHermann	JRStrosnider
10/03/94	09/20/94	09/20/94	09/30/94

*D:DE	OECB/DOPS	C:OGCB/DOPS	D:DOPS/NRR
BWSheron	RLDennig	AEChaffee	BKGrimes
10/06/94	10/20/94	10/[illegible]/94	10/[illegible]/94

DOCUMENT NAME: NECK-MIC.INF

stagnant dead-end lines to such locations as the emergency diesel generator supply.

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.

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: Michael Modes, Region I
(215) 337-5198

Peter P. Sena, Region I
(412) 643-2000

James A. Davis, NRR
(301) 504-2713

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE

concurred by email vh

OFFICE	*OGCB/DORS	*TECH ED	*REGION I	REGION I
NAME	CVHodge	JDMain	MCModes	PPSena
DATE	09/08/94	09/09/94	09/01/94	~~09~~ 10/03/94

concurred by email vh

ADD:DRS/REGION I	*EMCB/DE	*S:EMCB/DE	C:EMCB/DE
ARBlough	JADavis	RAHermann	for JRStrosnider
~~09~~ 10/03/94	09/20/94	09/20/94	09/30/94

D:DE	AC:OGCB/DORS	D:DORS/NRR
BWSheron	ELDoolittle	BKGrimes
10/6/94	09/ /94	09/ /94

DOCUMENT NAME: NECK-MIC.INF

#6-10/3 cop

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.

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: Michael Modes, Region I
(215) 337-5198

Peter P. Sena, Region I
(412) 643-2000

James A. Davis, NRR
(301) 504-2713

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCE concurred by email concurred by email

OFFICE	OGCB/DORS	TECH ED	REGION I	REGION I
NAME	CVHodge	JDMain	MCModes	PPSena
DATE	09/08/94	09/09/94	09/01/94	09/ /94

ADD:DRS/REGION I	EMCB/DE	S:EMCB/DE	C:EMCB/DE
ARBlough	JADavis	RAHermann	JRStrosnider
09/ /94	09/20/94	09/20/94	09/ /94

D:DE	AC:OGCB/DORS	D:DORS/NRR
BWSheron	ELDoolittle	BKGrimes
09/ /94	09/ /94	09/ /94

DOCUMENT NAME: NECK-MIC.INF