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

April 1, 1993

NRC INFORMATION NOTICE 93-25: ELECTRICAL PENETRATION ASSEMBLY DEGRADATION

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 problems that could result in degradation of electrical penetration assembly seals. This information notice focuses on the containment integrity function of these seals. 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

In July 1987 and in October 1989, the licensee for the Trojan Nuclear Plant, the Portland General Electric Company, reported problems with containment air leakage through its Bunker-Ramo electrical penetration assembly seals [licensee event reports (LERs) 50-344/87-11 and 50-344/89-23]. In July and August 1991, the NRC inspected the use of containment electrical penetration assembly seals at Trojan and concluded that the licensee had not established an effective program for trending and evaluating electrical penetration assembly seal leakage (Inspection Report 50-344/91-27). On October 28, 1991, while the plant was in a refueling outage, the licensee reported to the NRC that in the originally installed electrical penetration assemblies, the seal (polyurethane) and lubricant (Celvacene or Glycerin) materials were inappropriate for the application (LER 50-344/91-11-01). The licensee concluded that these materials may cause seal degradation and that the seals may become degraded if subjected to design basis accident conditions for moisture or temperature. The licensee replaced the electrical penetration assembly seal with an environmentally qualified ethylene propylene rubber seal and added a silicone rubber backup O-ring to the outer face of each electrical penetration assembly module. The licensee subsequently replaced all the Bunker-Ramo electrical penetration assemblies with Conax assemblies.

Discussion

Electrical penetration assemblies provide electrical continuity for field cables penetrating the containment and maintain containment integrity.

Degraded electrical penetration assemblies can adversely affect containment integrity by allowing excessive leakage from the containment under accident conditions.

The Bunker-Ramo electrical penetration assembly consists of a cylindrical structure with circular header plates at each end. One header plate is designed to be bolted to a flange on the containment liner plate penetration nozzle. Containment integrity is achieved by two C-cup seals between the flanges. In the Bunker-Ramo design, a helical spring-loaded polyurethane seal is mounted at each end of the electrical penetration assembly. Each electrical penetration assembly has two seals, an outer one, nominally of 8.9 cm [3.5 inch] diameter, and an inner one, of nominally 6.4 cm [2.5 inch] diameter. The outer seal functions as part of the containment boundary while the inner seal functions as an outer seal test pressure boundary. The electrical penetration assembly header plate is equipped with a connection to which a pressure indicating gauge can be attached to monitor seal leakage.

At the Trojan plant, the qualified life of the seal had not been accurately established. The simultaneous effects of corrosion and moisture at normal temperature had not been taken into account. The established longevity was not corrected after factoring in the actual degradation observed during periodic surveillance of the individual seals. Also, an administrative mechanism was not in place to replace the seals before their estimated qualified life expired. The original seal material in the Bunker-Ramo electrical penetration assembly has polyester urethane manufactured by Parker Packing Company (Parker) under the trade name of Parkerthane (Parker Compound No. P4611). Parker, which manufactures both polyester urethane and polyether urethane seals, indicated in its catalog that polyester urethane maintains critical characteristics up to 6 years while polyether urethane maintains critical characteristics up to 10 years.

The polyester urethane (the originally installed seal material) was determined inadequate for several reasons:

Short expected life (independently estimated at 2-5 years under some conditions)

Incompatibility with water (hydrolysis shortens life)

Incompatibility with high temperature (acceleration of hydrolysis)

Susceptibility to compression-set (a slowly acquired permanent deformation)

The licensee used different lubricants over the years. In 1987, the licensee determined that three seals had failed because they were erroneously lubricated with an incompatible (silicone) grease. After examination of seal failures that occurred in 1991, Parker determined that the failed seals had castor oil residue on the exterior, indicative of the use of Celvacene lubricant, which includes castor oil and cellulose acetate butyrate. Celvacene, specified for use by the original penetration supplier, can cause

degradation of polyurethane as follows. The cellulose acetate butyrate component breaks down in the presence of moisture, producing butyric acid, which in turn catalyses hydrolysis of the seal polymer. The hydrolysis slowly degrades the polyurethane material. Under accident conditions, the seal degradation may be accelerated.

The original penetration supplier, Bunker-Ramo, no longer supplies such assemblies. Similar electrical penetration assemblies have been supplied by Amphenol, but this company also no longer supplies such assemblies.

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment: Filed in jacket
List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-24	Distribution of Revision 7 of NUREG-1021, "Operator Licensing Examiner Standards"	03/31/93	All holders of operator and senior operator licenses at nuclear power reactors.
93-23	Weschler Instruments Model 252 Switchboard Meters	03/31/93	All holders of OLs or CPs for nuclear power reactors.
93-22	Tripping of Klockner-Moeller Molded-Case Circuit Breakers due to Support Level Failure	03/26/93	All holders of OLs or CPs for nuclear power reactors.
93-21	Summary of NRC Staff Observations Compiled during Engineering Audits or Inspections of Licensee Erosion/Corrosion Programs	03/25/93	All holders of OLs or CPs for light water nuclear power reactors.
93-20	Thermal Fatigue Cracking of Feedwater Piping to Steam Generators	03/24/93	All holders of OLs or CPs for PWRs supplied by Westinghouse or Combustion Engineering.
93-19	Slab Hopper Bulging	03/17/92	All nuclear fuel cycle licensees.
93-18	Portable Moisture-Density Gauge User Responsibilities during Field Operations	03/10/93	All U.S. Nuclear Regulatory Commission licensees that possess moisture-density gauges.
93-17	Safety Systems Response to Loss of Coolant and Loss of Offsite Power	03/08/93	All holders of OLs or CPs for nuclear power reactors.
93-16	Failures of Nut-Locking Devices in Check Valves	02/19/93	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

degradation of polyurethane as follows. The cellulose acetate butyrate component breaks down in the presence of moisture, producing butyric acid, which in turn catalyses hydrolysis of the seal polymer. The hydrolysis slowly degrades the polyurethane material. Under accident conditions, the seal degradation may be accelerated.

The original penetration supplier, Bunker-Ramo, no longer supplies such assemblies. Similar electrical penetration assemblies have been supplied by Amphenol, but this company also no longer supplies such assemblies.

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.

orig /s/'d by BKGrimes

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

Technical contacts: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment:
List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

D/DORS:NRR
BKGrimes
03/29/93

*C/OGCB:DORS:NRR	*RPB:ADM	*D/DRIL:NRR	*C/RVIB:DRIL:NRR
GHMarcus	TechEd	CERossi	LJNorrholm
03/05/93	04/13/92	03/03/93	02/27/93
*OGCB:DORS:NRR	*RESINSP/RV	*RVIB:DRIL:NRR	*SC/RVIB:DRIL:NRR
CVHodge	RBarr	KNaidu	GCwalina
06/03/92	06/03/92	01/11/93	02/27/93

DOCUMENT NAME: 93-25.IN

castor oil residue on the exterior, indicative of the use of Celvacene lubricant, which includes castor oil and cellulose acetate butyrate. Celvacene, specified for use by the original penetration supplier, can cause degradation of polyurethane as follows. The cellulose acetate butyrate component breaks down in the presence of moisture, producing butyric acid, which in turn catalyses hydrolysis of the seal polymer. The hydrolysis slowly degrades the polyurethane material. Under accident conditions, the seal degradation may be accelerated.

The original penetration supplier, Bunker-Ramo, no longer supplies such assemblies. Similar electrical penetration assemblies have been supplied by Amphenol, ~~but~~ this company also no longer supplies such assemblies.

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment:
List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES

D/DORS:NRR			
BKGrimes			
03/ /93			
*C/OGCB:DORS:NRR	*RPB:ADM	*D/DRIL:NRR	C/RVIB:DRIL:NRR
GHMarcus	TechEd	CERossi	LJNorrholm
03/05/93	04/13/92	03/03/93	02/27/93
*OGCB:DORS:NRR	*RESINSP/RV	*RVIB:DRIL:NRR	*SC/RVIB:DRIL:NRR
CVHodge	RBarr	KNaidu	GCwalina
06/03/92	06/03/92	01/11/93	02/27/93

degradation of polyurethane as follows. The cellulose acetate butyrate component breaks down in the presence of moisture, producing butyric acid, which in turn catalyses hydrolysis of the seal polymer. The hydrolysis slowly degrades the polyurethane material. Under accident conditions, the seal degradation may be accelerated.

The original penetration supplier, Bunker-Ramo, is no longer in the business. Similar electrical penetration assemblies have been supplied by Amphenol, but this company also is no longer in the business. The licensee at Trojan replaced its Bunker-Ramo electrical penetration assemblies with Conax electrical penetration assemblies.

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment:
List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES				
	D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM	*D/DRIL:NRR
	BKGrimes	GHMarcus GHM	TechEd	CERossi
	02/ /93	03/5 /93	04/13/92	03/03/93
*OGCB:DORS:NRR	*RESINSP/RV	*RVIB:DRIL:NRR	*SC/RVIB:DRIL:NRR	*C/RVIB:DRIL:NRR
CVHodge	RBarr	KNaidu	GCwalina	LJNorrholm
06/03/92	06/03/92	01/11/93	02/27/93	02/27/93

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment:
List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES

	D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM	D/DRIL:NRR
	BKGrimes	GHMarcus	TechEd	CERossi
	02/ /93	02/ /93	04/13/92	02/ /93
*OGCB:DORS:NRR	*RESINSP/RV	*RVIB:DRIL:NRR	SC/RVIB:DRIL:NRR	C/RVIB:DRIL:NRR
CVHodge	RBarr	KNaidu	GCwalina	LJNorrholm
06/03/92	06/03/92	01/11/93	02/ /93	02/ /93

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachment:
List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES

	D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM	D/DRIL:NRR
	BKGrimes	GHMarcus	TechEd	CERossi
	01/ /93	01/ /93	04/13/92	01/ /93
*OGCB:DORS:NRR	*RESINSP/RV	*RVIB:DRIL:NRR	SC/RVIB:DRIL:NRR	C/RVIB:DRIL:NRR
CVHodge	RBarr	KNaidu	GCwalina	LJNorrholm
06/03/92	06/03/92	01/11/93	01/27/93	01/ /93

DD:DRIL:NRR
RZimmerman
01/ /93

under loss of coolant accident (LOCA) conditions. Premature degradation of the insulation covering the electrical connections can expose the connections to an adverse environment during a LOCA. A brief survey of these LERs is included in Attachment 1.

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachments:
1. Survey of Licensee Event Reports (LERs)
2. List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES

		D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM
		BKGrimes	GHMarcus	TechEd
		01/ /93	01/ /93	04/13/92
*OGCB:DORS:NRR	*RESINSP/RV	RVIB:DRIL:NRR	C/RVIB:DRIL:NRR	D/DRIL:NRR
CVHodge VH	RBarr	KNaidu	LJNorrholm	CERossi
06/03/92 010893	06/03/92	01/11/93	01/ /93	01/ /93

identify excessive leakage of EPA seals indicating possible degradation from moisture intrusion. Degraded seals can cause breach of containment integrity under loss of coolant accident (LOCA) conditions. Premature degradation of the insulation covering the electrical connections can expose the connections to an adverse environment during a LOCA. A brief survey of these LERs is included in Attachment 1.

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: C. Vernon Hodge, NRR
(301) 504-1861

Robert C. Barr, Region V
(509) 377-2627

Kamal Naidu, NRR
(301) 504-2980

Attachments:
1. Survey of Licensee Event Reports (LERs)
2. List of Recently Issued NRC Information Notices

Document Name: PRESBOUN.IN

*SEE PREVIOUS CONCURRENCES

	D/DORS:NRR	C/OGCB:DORS:NRR	*RPB:ADM	D/DRIL:NRR
	BKGrimes	GHMarcus	TechEd	CERossi
	01/ /93	01/ /93	04/13/92	01/ /93
OGCB:DORS:NRR	RESINSP/RV	*RVIB:DRIL:NRR	SC/RVIB:DRIL:NRR	C/RVIB:DRIL:NRR
CVHodge vh	RBarr concurred by phone vh	KNaidu	GCwalina	LJNorrholm
06/03/92	06/03/92	01/11/93	01/ /93	01/ /93
01/14/93				

of EPA seals represent violations of containment integrity, and environmental qualification deficiencies in EPA components indicate ~~possible failure~~ that they could fail under loss of coolant accident (LOCA) conditions. A brief survey of these LERs ~~is included in Attachment 1.~~ Attachment 1 is

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.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contacts: Vern Hodge, NRR
(301) 504-1861

Rob Barr, RV
(503) 556-3751

Attachments:
1. Survey of Licensee Event Reports (LERs)
2. List of Recently Issued NRC Information Notices

Document Name: BUNK0403 REV 19

			D/DOEA:NRR	C/OGCB:DOEA:NRR
			CERossi	CHBerlinger
			04/ /92	04/ /92
OGCB:DOEA:NRR	RESINSP/RV	ROAB:DSP:NRR	RVIB:DRIS:NRR	RPB:ADM
CVHodge	RBarr	SMazumdar	KNaidu	TechEd JMain
04/ /92	04/ /92	04/ /92	04/ /92	04/13 /92