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

September 10, 1993

NRC INFORMATION NOTICE 93-70: DEGRADATION OF BORAFLEX NEUTRON ABSORBER COUPONS

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 recipients to a potentially significant problem pertaining to degradation of Boraflex neutron absorber coupons. 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.

Background

Palisades has high-density fuel storage racks installed in the spent fuel pool that use Boraflex, a proprietary neutron absorbing material that was manufactured by Brand Industrial Services, Incorporated (BISCO). The storage racks are supplied by Westinghouse. The Boraflex is attached to the walls of each canister and is held in place by a stainless steel wrapper, which is spot welded to the walls.

The licensee has a surveillance program using Boraflex coupons to indicate the status of the Boraflex contained in the high density storage racks in the spent fuel pool. Recently observed degradation of several of these coupons, which may be due to exposure to high level gamma radiation in conjunction with interaction with pool water, raised questions about the integrity of the Boraflex contained in the storage racks. Significant loss of Boraflex in the high-density fuel racks could result in loss of the subcriticality margin in the spent fuel pool.

Through a commitment to the NRC, Palisades was required to test and inspect the Boraflex coupons after 5 years of use. The tests include opening the coupons for visual observation, neutron attenuation determination, and a Boraflex hardness test.

Description of Circumstances

During a period from August 17 through 19, 1993, 5 of the existing 10 Boraflex coupons were removed from the spent fuel pool, 4 being full-length coupons

and 1 a short-set coupon (see Figure 1). During removal of the full-length coupons a powdery substance and a grey debris cloud were observed emanating from the coupons. Further investigation of the full-length coupons revealed that one coupon had lost an estimated 90 percent of its Boraflex, two others 50 percent, and one 38 percent. Investigation of the short-set coupon showed that it had retained 100 percent of its Boraflex. The licensee has determined that the Boraflex in the 4 full-length coupons and the short-set coupon came from different lots of material.

A principal difference between the short-set and the full-length coupons is their geometrical design. The short-set coupon consists of eight compartments encapsulating the Boraflex with pool water accessing only the edges of the coupons. However, in the full-length coupon Boraflex is sandwiched axially over the entire length of coupon and bolted between two 0.51-mm [0.020-inch] stainless steel metal strips. The licensee postulated that a much larger area of the full-length coupon was exposed to the pool water environment and flow. In addition, the full-length coupon has a 12.7-mm [0.5-inch] hole through the metal strip on the top portion of the coupon, which contributes to the pool water flow around the Boraflex. The licensee has no immediate plans for removal or testing of the remaining five coupons in the spent fuel pool, but does intend to conduct neutron "blackness" testing in the spring of 1994.

The licensee also had initiated measurements of the silica content of the spent fuel pool water. No increase in silica above normal 1-4 ppm levels have been observed except in instances when the pool boron concentration was increased. Because silica filler material is a constituent of Boraflex, the presence of silica in the water may be an indication of degradation of the Boraflex in the fuel pool.

Discussion

Potential degradation mechanisms for Boraflex include (1) gamma flux, which changes the material characteristics of the base polymer, and (2) chemical environment, namely the accessibility of water to the Boraflex. The licensee has not drawn firm conclusions as to (1) the root cause of the observed degradation of Boraflex in the coupons, or (2) the correlation of the behavior of Boraflex in the coupons to that in the storage racks.

Degradation of the Boraflex in fuel storage racks could reduce the subcriticality margin in the spent fuel pool. The design basis assumes a 5 percent subcriticality margin on the basis of lowest pool temperature, no boron concentration in the pool water, and minimum spacing between fuel assemblies. In its preliminary analysis, the licensee assumed no boron in the pool water and a complete loss of Boraflex from the fuel storage racks. This reduced the subcriticality margin from greater than 5 percent to about 2 percent. However, the licensee used the burnup for the currently stored fuel in the criticality calculation. This is higher than the design burnup value, implying less reactive fuel in the fuel pool than assumed in the design calculation.

The licensee took several compensatory measures, including (1) making the operating staff aware not to dilute the spent fuel pool, (2) increasing the

spent fuel pool chemistry sampling frequency to daily, and (3) keeping the boron concentration in the spent fuel pool above 1800 ppm, which exceeds the technical specification requirement for boron concentration. With these precautions a subcriticality margin greater than 5 percent would be maintained.

Degradation of Boraflex has been previously addressed by NRC in Information Notice 87-43, "Gaps in Neutron-Absorbing Material in High-Density Spent Fuel Storage Racks," September 8, 1987. The Electric Power Research Institute, which has been studying this phenomenon for several years, has recently published an interim report, "Boraflex Test Results and Evaluation," TR-101986, February 1993.

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.

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Attachments:
1. Figure 1, Palisades Boraflex Coupon Types
2. List of Recently Issued NRC Information Notices

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*SEE PREVIOUS CONCURRENCE

OFFICE	OGCB:DORS:NRR	DRS:RIII	DD:DRS:RIII	SRXB:DSSA:NRR	C:SRXB:DSSA:NRR
NAME	*CVHodge	*KSalehi	*WLForney	*LIKopp	*RCJones
DATE	09/02/93	09/02/93	09/02/93	09/03/93	09/03/93

Tech Ed	D:DSSA	EMCB:DE:NRR	EMCB:DE:NRR	C:EMCB:DE:NRR	C:OEAB:DORS
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09/01/93	09/04/93	09/03/93	09/03/93	09/03/93	09/03/93

C:OGCB:DORS:NRR	D:DORS:NRR
*GHMarcus	BKGrimes
09/03/93	09/7/93

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NAME	CVHodge VH	KSalehi	WLForney VH	LIKopp	RCJones
DATE	09/02/93	09/02/93	09/02/93	9/3/93	9/3/93

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*Tech Ed	D:DSSA	EMCB:DE:NRR	EMCB:DE:NRR	C:EMCB:DE:NRR	C:OEAB:DORS
	ACThadani	JStrosnider	KIParczewski	RAHermann	AEChaffee
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GHMarcus GHM*	BKGrimes
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* with clarification of nature of industry notification to be added struck reference VH

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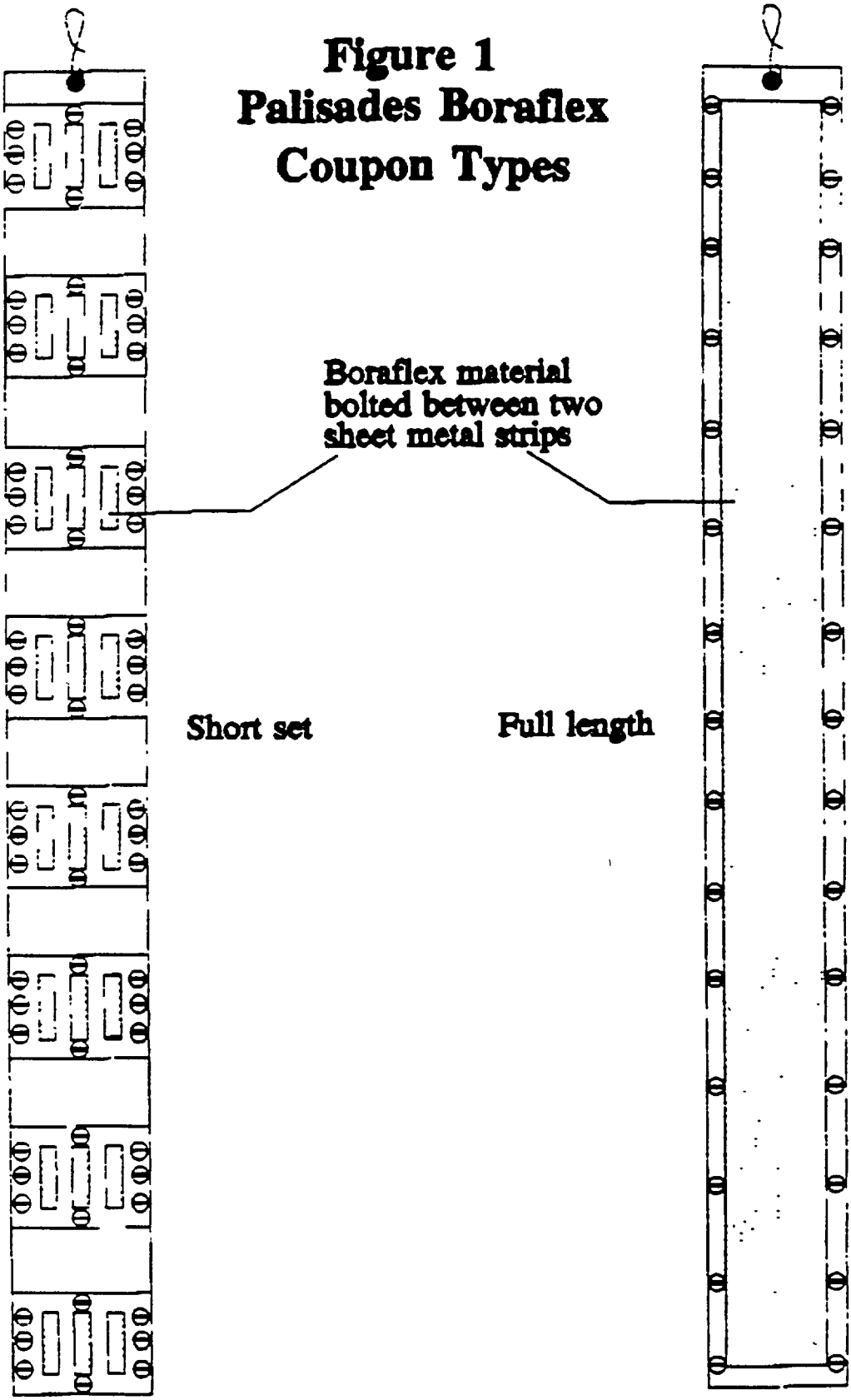
/ /93	/ /93

DOCUMENT NAME: PALNOFIG.CVH

Figure 1
Palisades Boraflex Coupon Types



LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-69	Radiography Events at Operating Power Reactors	09/02/93	All holders of OLs or CPs for nuclear power reactors and all radiography licensees.
93-68	Failure of Pump Shaft Coupling Caused by Temper Embrittlement during Manufacture	09/01/93	All holders of OLs or CPs for nuclear power reactors.
92-16, Supp. 2	Loss of Flow from the Residual Heat Removal Pump during Refueling Cavity Draindown	08/23/93	All holders of OLs or CPs for nuclear power reactors.
93-67	Bursting of High Pressure Coolant Injection Steam Line Rupture Discs Injures Plant Personnel	08/16/93	All holders of OLs or CPs for nuclear power reactors.
93-66	Switchover to Hot-Leg Injection Following A Loss-of-Coolant Accident in Pressurized Water Reactors	08/16/93	All holders of OLs or CPs for pressurized water reactors.
93-65	Reactor Trips Caused by Breaker Testing with Fault Protection Bypassed	08/13/93	All holders of OLs or CPs for nuclear power reactors.
93-64	Periodic Testing and Preventive Maintenance of Molded Case Circuit Breakers	08/12/93	All holders of OLs or CPs for nuclear power reactors.
93-63	Improper Use of Soluble Weld Purge Dam Material	08/11/93	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit