

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

August 11, 1988

NRC INFORMATION NOTICE NO. 88-60: INADEQUATE DESIGN AND INSTALLATION OF
WATERTIGHT PENETRATION SEALS

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to potential problems resulting from inadequate design and installation of penetration seals whereby the seals may not provide watertight barriers between redundant safe shutdown trains. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On June 3, 1988, with Vogtle Unit 1 at 100 percent power, an inadvertent pressurization of the fire protection system caused 1/4 to 1/2 inch of water to accumulate around cable penetrations on the B train cable spreading room floor. The water then seeped through the floor into the control room below. The water entered various process panel cabinets causing a spurious pressurizer high level signal and alarm. The spurious signal also resulted in a pressurizer level deviation signal that caused the pressurizer backup heaters to cycle on and off. In addition, the water caused a pressurizer power-operated relief valve to open.

Discussion:

During the review of this event, the licensee identified an unanalyzed condition in which a postulated fire in the B train cable spreading room, with either actuation of the sprinkler system and/or manual fire suppression activities, could result in a loss of functions required for safe shutdown as follows: loss of control room train B and auxiliary shutdown panel via

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the fire, and loss of control room train A via water leaking into control room panels. A second auxiliary shutdown panel (not required by the NRC) would still be available; however, no indication would be available since the indication circuits on that panel are not isolated from the control room.

Testing showed that the water seeped between the concrete floor and the penetration embedded steel angle (see Figure 1, attached). The licensee applied a silicone sealant around the perimeter of all the floor penetrations where the concrete and the angle iron meet. Testing showed that the sealant was watertight.

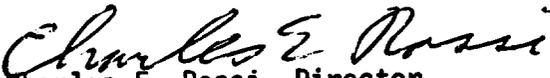
The licensee found through additional testing that there was a second leak path within the cable bundles penetrating the foam sealant material. If a large number of cables are so tightly massed that foam does not completely surround the individual cables, leakage can occur along the cables. The licensee applied sealant around and between individual cables and at the interface of the foam and the steel angle where foam shrinkage can cause a gap.

Through testing, the licensee showed that a penetration seal with limited conductors penetrating the silicone seal material is watertight. As an additional precaution, an elastomer cap was placed over the seal to protect the foam and sealant from damage by water impingement in the event of fire suppression activity (see Figure 2, attached).

The licensee began a review to determine whether there were other seals that, because of leakage, could cause an unanalyzed event. The review located all instances in which a room containing one train of safe shutdown equipment was located above another room containing the redundant train of safe shutdown equipment. The licensee broadened the scope of review to include other conditions in which leakage could affect safety-related equipment.

General Design Criterion 3 in Appendix A to 10 CFR 50 states, in part: "Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components." The NRC has identified numerous occurrences of system interaction between fire suppression systems and systems important to safety. "Actuation of Fire Suppression System Causing Inoperability of Safety-Related Equipment" was the subject of Information Notice 83-41. The scenario at Vogtle Unit 1 is of particular significance in that it could involve the potential loss of redundant and auxiliary safe shutdown trains.

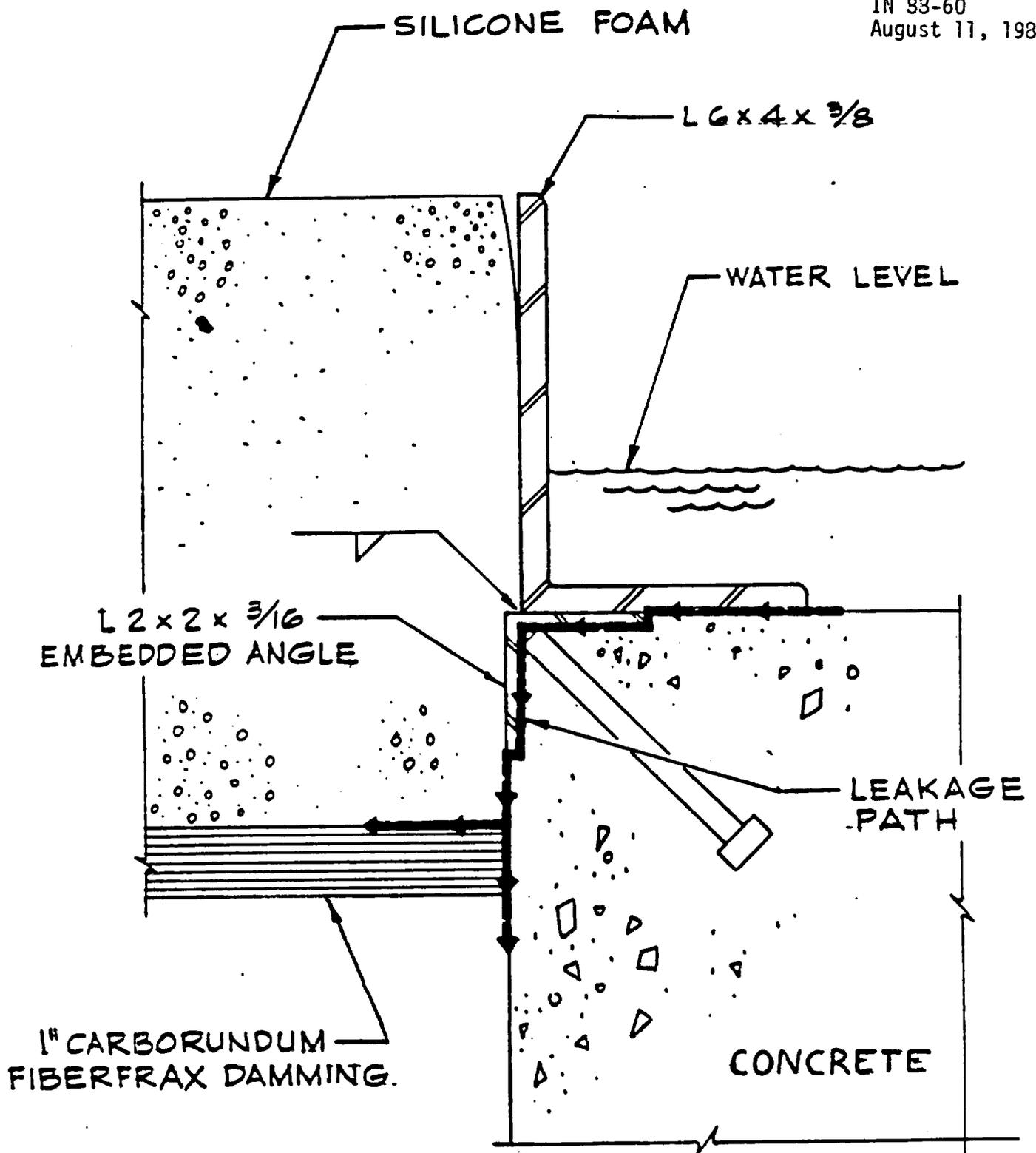
No specific action or written response is required by this information notice. If you have questions about this matter, please contact the technical contact listed below or the Regional Administrator of the appropriate NRC regional office.


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

Technical Contact: D. Oudinot, NRR
(301) 492-1174

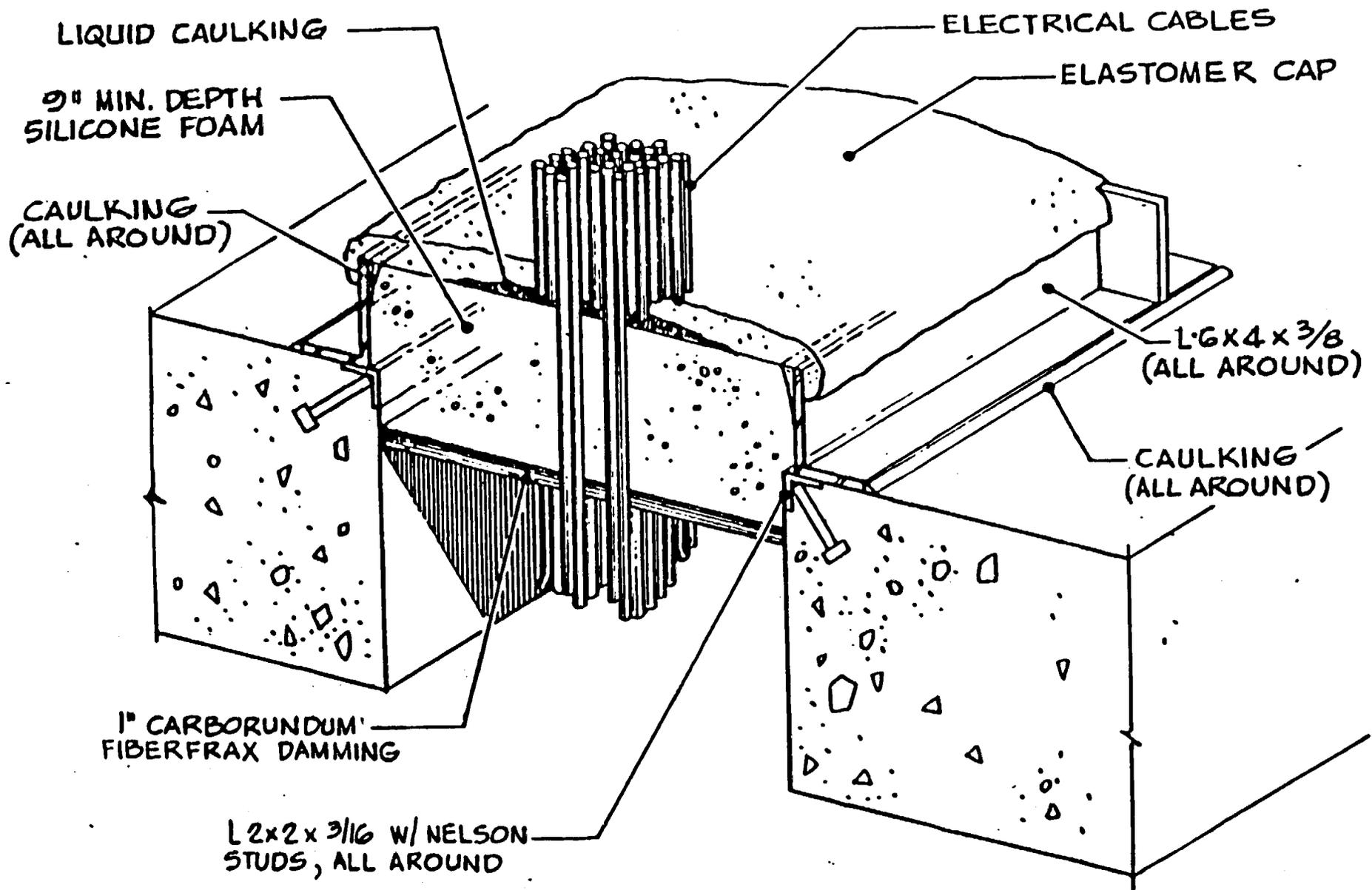
Attachments:

1. Figure 1, Penetration Seal Leakage Path
2. Figure 2, Proposed Typical Seal Repair
(Upper Cable Spreading Room)
3. List of Recently Issued NRC Information Notices



PENETRATION SEAL LEAKAGE PATH

FIGURE 1



PROPOSED TYPICAL SEAL REPAIR
 (UPPER CABLE SPREADING ROOM)

FIGURE 2

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-04, Supplement 1	Inadequate Qualification and Documentation of Fire Barrier Penetration Seals	8/9/88	All holders of OLs or CPs for nuclear power reactors.
88-59	Main Steam Isolation Valve Guide Rail Failure at Waterford Unit 3	8/9/88	All holders of OLs or CPs for nuclear power reactors.
88-58	Potential Problems with ASEA Brown Boveri ITE-51L Time-Overcurrent Relays	8/8/88	All holders of OLs or CPs for nuclear power reactors.
88-57	Potential Loss of Safe Shutdown Equipment Due to Premature Silicon Controlled Rectifier Failure	8/8/88	All holders of OLs or CPs for nuclear power reactors.
88-56	Potential Problems with Silicone Foam Fire Barrier Penetration Seals	8/4/88	All holders of OLs or CPs for nuclear power reactors.
88-55	Potential Problems Caused by Single Failure of an Engineered Safety Feature Swing Bus	8/3/88	All holders of OLs or CPs for nuclear power reactors.
88-54	Failure of Circuit Breaker Following Installation of Amprector Direct Trip Attachment	7/28/88	All holders of OLs or CPs for nuclear power reactors.
88-53	Licensee Violations of NRC Regulations, Which Led to Medical Diagnostic Misadministrations	7/28/88	All manufacturers and distributors of radio-pharmaceuticals for human use, nuclear pharmacies, and medical licensees.

OL = Operating License
CP = Construction Permit

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*EAB:NRR	*EAB:NRR	*TECH:ED	*C:EAB:NRR	*C:OGCB:NRR	<i>DOEA:NRR</i>
DOudinot:db	DFischer	BCalure	WLanning	CHBerlinger	CERossi
8/3/88	8/3/88	8/3/88	8/4/88	8/4/88	8/5/88

The licensee found through additional testing that there was a second leak path within the cable bundles penetrating the foam sealant material. If a large number of cables are so tightly massed that foam does not completely surround the individual cables, leakage can occur along the cables. The licensee applied sealant around and between individual cables and at the interface of the foam and the steel angle where foam shrinkage can cause a gap.

Through testing, the licensee showed that a penetration seal with limited conductors penetrating the silicone seal material is watertight. As an additional precaution, an elastomer cap was placed over the seal to protect the foam and sealant from damage by water impingement in the event of fire suppression activity (see Figure 2, attached).

The licensee began a review to determine whether there were other seals that, because of leakage, could cause an unanalyzed event. The review located all instances in which a room containing one train of safe shutdown equipment was located above another room containing the redundant train of safe shutdown equipment. The licensee broadened the scope of its review to include other conditions in which leakage could affect safety-related equipment.

General Design Criterion 3 in Appendix A to 10 CFR 50 states, in part: "Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components." NRC has identified numerous occurrences of system interaction between fire suppression systems and systems important to safety. "Actuation of Fire Suppression System Causing Inoperability of Safety-Related Equipment" was the subject of Information Notice 83-41. This scenario is of particular significance in that it could involve the potential loss of redundant and auxiliary safe shutdown trains.

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Testing showed that the water seeped between the concrete floor and the penetration embedded steel angle (see Figure 1, attached). The licensee applied a silicone sealant around the perimeter of all the floor penetrations where the concrete and the angle iron meet. Testing showed that the silicone caulk modification was watertight.

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