

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

August 4, 1988

NRC INFORMATION NOTICE NO. 88-56: POTENTIAL PROBLEMS WITH SILICONE FOAM  
FIRE BARRIER 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 in their installed fire barrier penetration seals that could result in the reduction of fire-resistive capabilities for protection of safety-related redundant equipment and electrical power and control circuits. 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:

In May 1987, B&B Promatec submitted a 10 CFR Part 21 notification advising NRC that some silicone foam fire barrier penetration seals at Wolf Creek Nuclear Generating Station (WCNGS) did not meet minimum requirements. The nonconforming conditions reported by B&B Promatec were described as voids, shrinkage, and lack of fill. The conditions were not obviously visible because they were masked by fire-resistant boards that were typically installed on both sides of a wall penetration and the bottom side of a floor penetration. WCNGS licensee personnel found the problems during replacement of damaged fire-resistant boards. Thereafter, WCNGS adopted an inspection methodology in which the fire boards were removed, the silicone foam barriers were inspected and reworked as necessary, and the boards replaced.

Initial results from sample inspections indicated that over 25 percent of the inspected seals were nonconforming. Additional inspections performed before October 1987 revealed that 107 of 430 inspected seals required repair or rework and that 65 of the 107 contained voids. The licensee for WCNGS subsequently determined that the void problem was caused, at least in part, by underfill at the time of installation. As a result of the WCNGS report, NRC has been evaluating whether the silicone foam nonconforming conditions found at WCNGS have generic applicability for plants other than those notified by B&B Promatec. Part of this evaluation included a review of abstracts of licensee event reports.

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Information obtained from this review indicates that a number of licensees have reported various fire barrier penetration seal nonconforming conditions. Some of the previously reported nonconforming conditions appear to be similar to those reported for WCNGS but are not limited to any particular vendor or installer. Silicone foam was the only fire barrier penetration seal material that was specifically mentioned in the information reviewed, although some reports did not specifically identify the particular sealing material for the affected seals. On the basis of this information, NRC believes that if generic problems exist, they may be limited to only silicone foam fire barrier penetration seals but not to any particular vendor or installer.

#### Discussion:

This notice alerts addressees of the possibility that some installed fire barrier penetration seals may contain nonconforming conditions such as splits, gaps, voids, and lack of fill in the sealing material. These conditions may not be detected during routine inspection because the surface of the seal material is typically covered by a fire-resistant dam material. Information that is available suggests that the extent of the possible problem may be limited to fire barrier penetrations filled with silicone foam material.

Silicone foam has been used extensively as a fire barrier penetration sealing material in many nuclear power plants since the early 1970's. For silicone foam seals installed since the mid 1970's, the silicone sealing material has been formulated of a two-component RTV 3-6548 base product manufactured by Dow Corning. The silicone foam seals are produced by mixing the two components, which then chemically react ("snap") a short time after they are mixed. The resulting snap causes gas formation and material expansion, which produces a silicone foam cell structure. Experience with silicone foam indicates that any one of many factors could affect the adequacy of the final seal installation. These factors include the method of installation (e.g., damming technique), technical and quality control of material, material mixing process, pouring and curing process, method of final inspection, training and experience of installing personnel, and environmental factors, such as temperature and humidity. Loss of control for any one of these factors could result in seals that do not meet minimum requirements.

In many silicone foam fire barrier penetration seals, a permanent dam constructed from a fire-resistant material is used. These dams must be present if they were part of the qualified seal design. Normally, a permanent dam is located on the bottom of floor and ceiling penetrations and on both sides (although sometimes only on one side) of wall penetrations. One common installation method used in the past called for installing the permanent damming material first so that it would contain the liquid seal material during pouring and curing. Since the permanent dam was part of final installation and because removal and reinstallation of the dam could be difficult and time consuming, final inspection of many silicone foam seals was performed with the permanent dam in place. When this approach was used, final determination of whether a proper seal had been attained was made without direct visual inspection of the seal surface, which appears to be a questionable practice. Instead, indirect methods of checking,

such as tapping on the dam or inserting probe wires through the dam, were used. In addition to precluding direct visual inspection of a new seal, installed dams also hinder subsequent detection of nonconforming conditions that may have been present since initial installation or that may have developed after initial installation.

As mentioned earlier, licensees have reported various fire barrier penetration seal nonconforming conditions in the past. The reported conditions that suggest a generic problem are discussed below:

Voids - One nonconforming condition for silicone foam seals is the presence of voids. Voids can be created in a number of ways. First, proper preparation of the volume to be sealed is required before liquid fill. Proper preparation includes ensuring that the penetrating items (pipes and cables) have sufficient separation to permit the liquid to fill all the space in the volume. Second, the mixed sealing material requires a sufficiently long "snap" time to ensure that the expansion process does not prevent free flow of sealing liquid to all spaces in the volume. Third, the gas formed during the expansion process needs to diffuse from the material without creating large gas bubbles or pockets. Finally, a sufficient quantity of sealing material must be injected to ensure that all spaces within the volume will be filled.

Gaps - Another nonconforming condition is the presence of gaps or the pulling away of silicone foam material from the surface of penetrating items or inside surfaces of the fire barrier. In some cases, these gaps extend only a short distance into the seal thickness. In a few cases, gaps have been observed to extend completely through the entire thickness of the seal. Causes of the gaps have been variously given as failure to inject sufficient sealing material during filling, bulging of damming material, shrinkage of silicone foam, and contraction of silicone foam caused by a temperature change. The physical characteristics of the silicone foam are such that a 1 percent reduction in volume can be expected for a decrease of 20°F in temperature.

Splits - A third nonconforming condition is splitting (cracking of solidified material) of the silicone foam material. This condition was not reported at WCNGS but was reported by other licensees. In conversations with NRC, B&B Promatec stated that the reasons for silicone foam splitting are not completely understood and that splitting is a topic of discussion in the power sealer and insulation industry.

Some of the actions taken by licensees as a result of finding nonconforming silicone foam fire barrier penetration seals include (1) programs for inspection and periodic reinspection of installed seals, (2) repair of nonconforming seals, (3) evaluation of alternative materials for repairing old seals and installing new seals, and (4) development of alternative methods for installing and inspecting new silicone foam seals.

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

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

Technical Contacts: Joseph J. Petrosino, NRR  
(301) 492-0979

C. Vernon Hodge, NRR  
(301) 492-1169

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
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.
88-52	Failure of Intrauterine Tandem of Fletcher Applicator Brachytherapy Devices During Patient Treatment	7/27/88	Medical licensees.
88-46, Supplement 1	Licensee Report of Defective Refurbished Circuit Breakers	7/26/88	All holders of OLs or CPs for nuclear power reactors.
88-51	Failures of Main Steam Isolation Valves	7/21/88	All holders of OLs or CPs for nuclear power reactors.
88-50	Effect of Circuit Breaker Capacitance on Availability of Emergency Power	7/18/88	All holders of OLs or CPs for nuclear power reactors.

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OL = Operating License  
CP = Construction Permit

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Transmitted from DRIS on June 22, 1988

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\*OGCB:DOEA:NRR  
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07/22/88

\*RPB:ARM  
TechEd  
07/19/88

\*C/OGCB:DOEA:NRR  
CHBerlinger  
07/26/88

\*D:DRIS:NRR  
BKGrimes  
07/28/88

\*D:DEST:NRR  
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Attachments:

1. Partial List of Reports of Nonconforming Conditions in Fire Barrier Penetration Seals
2. List of Recently Issued NRC Information Notices

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*jh*  
OGCB:DOEA:NRR  
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Off for B.K. Grimes  
7/28/88

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Charles E. Rossi, Director  
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Office of Nuclear Reactor Regulation

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Attachments: *List of Reports conditions in Fire Barrier*  
1. ~~Partial Summary~~ of Nonconforming Penetration Seals  
2. List of Recently Issued NRC Information Notices

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