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

May 16, 1988

NRC INFORMATION NOTICE NO. 88-25: MINIMUM EDGE DISTANCE FOR EXPANSION  
ANCHOR BOLTS

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to test results indicating that the recommended minimum edge distance for the design and installation of expansion anchor bolts may be unconservative with respect to effectively resisting the shear forces imposed on anchor bolts during a design-basis event such as a safe-shutdown earthquake. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On March 18, 1988, Hilti, Inc., informed the Nuclear Regulatory Commission (NRC), in accordance with 10 CFR Part 21, of recent tests of Hilti Kwik-Bolts that indicate that the previously recommended minimum distance from an anchor bolt to an unsupported concrete edge may be insufficient to develop 100% of the recommended anchor capacity. In view of the foregoing, the NRC staff met with representatives of Hilti, Inc. (Hilti) to discuss the notification.

During the meeting, the NRC staff was informed that prior to November 1985, the edge-distance guidelines provided by Hilti for the installation of Hilti Kwik-Bolts were those of the Expansion Anchor Manufacturers Institute (EAMI). The EAMI guidelines are used throughout the United States and recommend an edge distance, the distance from the center of an expansion anchor bolt to an unsupported edge of a concrete support, of five anchor diameters to achieve 100% of the recommended anchor capacity. In November 1985, Hilti revised its design and installation guidelines and recommended a greater edge distance than the EAMI guidelines. These conservative guidelines were adopted based on information and broader technical knowledge and experience gained as a result of marketing Hilti bolts to foreign customers. Consequently, Hilti initiated a testing program in 1986 to support their revised edge-distance guidelines.

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The 10 CFR Part 21 notification documents the results of this testing program and indicates that Hilti Kwik-Bolts installed in accordance with the EAMI guidelines have only 30% of the recommended anchor shear capacity and 78% of the recommended tensile capacity. Hilti further indicated that the test results are believed to be applicable to other expansion anchor bolts that use the same type of anchor mechanism as Hilti Kwik-Bolts.

Discussion:

The NRC staff considers the test results indicating a 70% reduction in shear capacity to be significant and to indicate that there is a potential safety concern that will require further NRC review. However, the test results do not indicate an imminent safety concern for expansion anchor bolts installed in nuclear power facilities for the reasons given below.

- (1) The purpose of the Hilti edge-distance test program was to establish design recommendations for the resistance capacity of a single bolt as a function of edge distance. The test anchorage consisted of only one bolt anchored to a concrete block that was not reinforced. Equipment or system anchorage arrangements at nuclear power facilities usually use more than one anchor bolt and a steel bearing plate or base assembly. Installation pretensioning torque loads applied to the anchor bolt nuts create compressive loads and frictional resistance forces between the bearing plate and the concrete that tend to make the anchorage and concrete support act as a single unit and mitigate the severity of the single bolt edge-distance problem. If the frictional resistance forces between the concrete support and the bearing plate are reduced due to the creep of concrete and the relaxation of anchor bolts, the bearing plate can still redistribute the additional shear forces, which cannot be resisted by the edge bolts with reduced capacity, to other bolts that have no capacity reduction due to the edge-distance problems.
- (2) The test results are an acceptable basis for establishing design recommendations; however, they should be viewed as conservative for the installation of bolts. The presence of steel reinforcement between the bolt and an unsupported concrete edge should increase the bolt shear capacity, depending on the amount of reinforcement and the type of placement, and also mitigate the consequences of the edge-distance problem. This is particularly true for large diameter expansion bolts (greater than 3/4-inch bolts).

Based on the NRC staff assessment of the information that has been provided since the submittal of the 10 CFR Part 21 notification, it appears that 1) most anchor bolts in nuclear power facilities were installed using the EAMI recommended guidelines and 2) the potential failure of these bolts to perform their intended function during a design-basis event, such as a seismic event, could jeopardize the integrity of safety-related systems and equipment. Therefore, the NRC will continue to evaluate this issue and take appropriate regulatory action if it is determined that a significant safety hazard exists at nuclear power facilities. However, addressees may wish to review the information and consider appropriate actions if this information indicates that a significant safety hazard exists at their facility.

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

Technical Contacts: John Ma, NRR  
(301) 492-1376

Jaime Guillen, NRR  
(301) 492-1153

Attachment: List of Recently Issued NRC Information Notices

Attachment  
IN 88-25  
May 16, 1988  
Page 1 of 1

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-24	Failures of Air-Operated Valves Affecting Safety-Related Systems	5/13/88	All holders of OLS or CPs for nuclear power reactors.
88-23	Potential for Gas Binding of High-Pressure Safety Injection Pumps During a Loss-of-Coolant Accident	5/12/88	All holders of OLS or CPs for PWRs.
88-22	Disposal of Sludge from Onsite Sewage Treatment Facilities at Nuclear Power Stations	5/12/88	All holders of OLS or CPs for nuclear power reactors.
88-21	Inadvertent Criticality Events at Oskarshamn and at U.S. Nuclear Power Plants	5/9/88	All holders of OLS or CPs for nuclear power reactors.
88-20	Unauthorized Individuals Manipulating Controls and Performing Control Room Activities	5/5/88	All holders of OLS or CPs for nuclear power, test and research reactors, and all licensed operators.
88-19	Questionable Certification of Class 1E Components	4/26/88	All holders of OLS or CPs for nuclear power reactors.
88-18	Malfunction of Lockbox on Radiography Device	4/25/88	All NRC licensees authorized to manufacture, distribute, and/or operate radiographic exposure devices.

OL = Operating License  
CP = Construction Permit

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Attachment: List of Recently Issued NRC Information Notices

Transmitted by memorandum to Charles E. Rossi from Lawrence C. Shao  
dated 4/20/88

*Lawrence Shao  
renewed formal  
draft on  
5/10/88  
CER*

\*SEE PREVIOUS CONCURRENCES

*OGCB:DOEA:NRR	*ESGB:DEST:NRR	*SC/ESGB:DEST:NRR	*C/ESGB:DEST:NRR	*PPMB:ARM
JGuillen	JMa	DJeng	GBagchi	TechEd
05/03/88	05/03/88	05/03/88	05/03/88	04/28/88

D/DOEA:NRR  
CEROST  
05/10/88

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\*SEE PREVIOUS CONCURRENCES

			D/DOEA:NRR	<i>CHB</i> C/OGCB:DOEA:NRR
			CERossi	CHBerlinger
			05/ /88	05/9/88
*OGCB:DOEA:NRR*ESGB:DEST:NRR		*SC/ESGB:DEST:NRR	*C/ESGB:DEST:NRR	*PPMB:ARM
JGuillen	JMa	DJeng	GBagchi	TechEd
05/03/88	05/03/88	05/03/88	05/03/88	04/28/88

can still redistribute the extra shear force (which cannot be resisted by the edge bolts with reduced shear capacity) to other bolts that have no capacity reduction resulting from edge-distance problems.

- (2) Since the anchor bolts were tested in concrete that was not reinforced, the test results should be viewed as the most conservative value for design. Steel reinforcement is typically present in concrete supports in structures at nuclear power facilities. The presence of steel reinforcement between the bolt and unsupported concrete edge should increase the bolt shear capacity. This is particularly true for large diameter expansion bolts (greater than 3/4-inch bolts). The amount of increase depends on the amount of reinforcement and the type of placement.

The NRC is in the process of collecting more information that would constitute the basis for further action and provision of regulatory guidance. The NRC staff will issue appropriate guidelines and criteria to ensure that all supports installed in nuclear power facilities with expansion anchor bolts have acceptable margins of safety. However, addressees are expected to review the information and consider appropriate actions if this information indicates that a significant safety hazard exists at their facility.

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

Charles E. Rossi, Director  
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JGuillen JMa  
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CHBerlinger  
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