CENTRAL FILES

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

Docket No. 50-220

Niagara Mohawk Power Corporation
ATTN: Mr. R. R. Schneider
Vice President
Electric Operations
300 Erie Boulevard West
Syracuse, New York 13202

NOV 0 8 1979

Gentlemen:

Enclosed is IE Bulletin No. 79-02, Revision 2, which requires action by you with regard to your power reactor facility(ies) with an operating license or a construction permit.

Should you have questions regarding this Bulletin or the actions required of you, please contact this office.

Sincerely,

Robert T. Carlson for Boyce H. Grier
Director

Enclosures:
1. IE Bulletin No. 79-02, Revision 2
2. List of IE Bulletins Issued in the Last Six Months

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

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IE Bulletin No. 79-02
(Revision 2)
Date: November 8, 1979

PIPE SUPPORT BASE PLATE DESIGNS USING CONCRETE EXPANSION ANCHOR BOLTS

Description of Circumstances:

Inspection experiences and the review of licensee response have identified several areas where the Bulletin intent has not been adequately addressed by licensees. Revision No. 2 of the Bulletin is intended to clarify the intent of the Bulletin and establish the NRC positions on minimum factors of safety, anchor bolt preload, and the expected date of completion for certain Bulletin actions. R2

Since the issuance of IE Bulletin No. 79-02 on March 8, 1979, IE inspection experience and many inquiries from licensees indicate that additional information and clarification is needed. This revision is intended to serve that purpose. None of the requirements of the original Bulletin have been deleted, and the due date for completion of the requested actions (July 6, 1979) has not been changed. The following text supersedes the text of Bulletin No. 79-02. Changes from the original text are identified by R1, R2 in the margin. The purpose of this revision is to identify acceptable ways of satisfying the Bulletin requirements. R1

While performing inservice inspections during a March-April 1978 refueling outage at Millstone Unit 1, structural failures of piping supports for safety equipment were observed by the licensee. Subsequent licensee inspections of undamaged supports showed a large percentage of the concrete anchor bolts were not tightened properly.

Deficiency reports, in accordance with 10 CFR 50.55(e), filed by Long Island Lighting Company on Shoreham Unit 1, indicate that design of base plates using rigid plate assumptions has resulted in underestimation of loads on some anchor bolts. Initial investigation indicated that nearly fifty percent of the base plates could not be assumed to behave as rigid plates. In addition, licensee inspection of anchor bolt installations at Shoreham has shown over fifty percent of the bolt installations to be deficient.

Vendor Inspection Audits by NRC at Architect Engineering firms have shown a wide range of design practices and installation procedures which have been employed for the use of concrete expansion anchors. The current trends in the industry are toward more rigorous controls and verification of the installation of the bolts.

The data available on dynamic testing of the concrete expansion anchors show fatigue failures can occur at loads substantially below the bolt static capa-

cities due to material imperfections or notch type stress risers. The data also show low cycle dynamic failures at loads below the bolt static capacities due to joint slippage.

In the review of anchor bolt installation practices, three facilities (Trojan, Duane Arnold, and Zimmer) have been identified which use expansion anchor bolts in concrete block walls to attach Seismic Category I piping supports. Testing results of anchor bolts in concrete block walls performed at FFTF indicate significantly lower ultimate capacities than for those in concrete. An Information Notice will be issued which provides additional details on the deficiencies identified at Trojan. R2

In the review of responses to the Bulletin, we have become aware that licensees may not have included review of piping supports with concrete expansion anchor bolts which did not use base plates. Such supports use structural steel members (angle or channel) attached directly to the concrete by expansion anchor bolts, with the piping attached to the structural steel member. The adequacy of the anchor bolt design and installation should be verified to satisfy the intent of the Bulletin. R2

Action to be Taken by Licensees and Permit Holders:

This Bulletin addresses those pipe support base plates that use concrete expansion anchor bolts in Seismic Category I systems as defined by Regulatory Guide 1.29, "Seismic Design Classification" Revision 1, dated August 1973 or as defined in the applicable FSAR. For older plants where Seismic Category I requirements did not exist at the time of licensing it must be shown that piping supports for safety related systems, as defined in the Final Safety Analysis Report, meet design requirements. R1

The revision is not intended to penalize licensees who have already completed some of the Bulletin requirements. In those instances in which a licensee has completed action on a specific item and the Bulletin revision provides more conservative guidance, the licensee should explain the adequacy of the action already performed. It should be reiterated that the purpose of the Bulletin actions are to assure operability of Seismic Category I piping systems in the event of a seismic event. R1

1. Verify that pipe support base plate flexibility was accounted for in the calculation of anchor bolt loads. In lieu of supporting analysis justifying the assumption of rigidity, the base plates should be considered flexible if the unstiffened distance between the member welded to the plate and the edge of the base plate is greater than twice the thickness of the plate. It is recognized that this criterion is conservative. Less conservative acceptance criteria must be justified and the justification submitted as part of the response to the Bulletin. If the base plate is determined to be flexible, then recalculate the bolt loads using an appropriate analysis. If possible, this is to be done prior to testing of anchor bolts. These calculated bolt loads are referred to hereafter as the bolt design loads. A description of the analytical model used to verify that pipe support base plate flexibility is accounted for in the calculation of anchor bolt loads is to be submitted with your response to the Bulletin. R1

It has been noted that the schedule for analytical work on base plate flexibility for some facilities extends beyond the Bulletin reporting time frame of July 6, 1979. For those facilities for which an anchor bolt testing program is required (i.e., sufficient QC documentation does not exist), the anchor bolt testing program should not be delayed. R1 R1 R1 R1 R1

2. Verify that the concrete expansion anchor bolts have the following minimum factor of safety between the bolt design load and the bolt ultimate capacity determined from static load tests (e.g. anchor bolt manufacturer's) whhich simulate the actual conditons of installation (i.e., type of concrete and its strength properties):

   a. Four - For wedge and sleeve type anchor bolts,
   b. Five - For shell type anchor bolts.

   The bolt ultimate capacity should account for the effects of shear-tension interaction, minimum edge distance and proper bolt spacing. R1 R1

   If the minimum factor of safety of four for wedge type anchor bolts and five for shell type anchors can not be shown then justification must be provided. The Bulletin factors of safety were intended for the maximum support load including the SSE. The NRC has not yet been provided adequate justification that lower factors of safety are acceptable on a long term basis. Lower factors of safety are allowed on an interim basis by the provisions of Supplement No. 1 to IE Bulletin No. 79-02. The use of reduced factors of safety in the factored load approach of ACI 349-76 has not yet been accepted by the NRC. R1 R1 R2 R2 R2 R2 R2 R2

3. Describe the design requirements if applicable for anchor bolts to withstand cyclic loads (e.g. seismic loads and high cycle operating loads).

4. Verify from existing QC documentation that design requirements have been met for each anchor bolt in the following areas:

   (a) Cyclic loads have been considered (e.g. anchor bolt preload is equal to or greater than bolt design load). In the case of the shell type, assure that it is not in contact with the back of the support plate prior to preload testing.

   (b) Specified design size and type is correctly installed (e.g. proper embedment depth).

   If sufficient documentation does not exist, then initiate a testing program that will assure that minimum design requirements have been met with respect to sub-items (a) and (b) above. A sampling technique is acceptable. One acceptable technique is to randomly select and test one anchor bolt in each base plate (i.e. some supports may have more than one base plate). The test should provide verification of sub-items (a) and (b) above. If the test fails, all other bolts on that base plate should be similarly tested. In any event, the test program should assure that each Seismic Category I system will perform its intended function.

The preferred test method to demonstrate the bolt preload has been accomplished is using a direct pull (tensile test) equal to or greater than design load. Recognizing this method may be difficult due to accessibility in some areas an alternative test method such as torque testing may be used. If torque testing is used it must be shown and substantiated that a correlation between torque and tension exists. If manufacturer's data for the specific bolt used is not available, or is not used, then site specific data must be developed by qualification tests. R1

Bolt test values of one-fourth (wedge type) or one-fifth (shell type) of bolt ultimate capacity may be used in lieu of individually calculated bolt design loads where the test value can be shown to be conservative. R1

The purpose of Bulletin No. 79-02 and this revision is to assure the operability of each seismic Category I piping system. In all cases an evaluation to confirm system operability must be performed. If a base plate or anchor bolt failure rate is identified at one unit of a multi-unit site which threatens operability of safety related piping systems of that unit, continued operation of the remaining units at that site must be immediately evaluated and reported to the NRC. The evaluation must consider the generic applicability of the identified failures. R1

Appendix A describes two sampling methods for testing that can be used. Other sampling methods may be used but must be justified. Those options may be selected on a system by system basis. R1

Justification for omitting certain bolts from sample testing which are in high radiation areas during an outage must be based on other testing or analysis which substantiates operability of the affected system. R1

Bolts which are found during the testing program not to be preloaded to a load equal to or greater than bolt design load must be properly preloaded or it must be shown that the lack of preloading is not detrimental to cyclic loading capability. Those licensees that have not verified anchor bolt preload are not required to go back and establish preload. However, additional information should be submitted which demonstrates the effects of preload on the anchor bolt ultimate capacity under dynamic loading. If it can be established that a tension load on any of the bolts does not exist for all loading cases then no preload or testing of the bolts is required. R1 R2

If anchor bolt testing is done prior to completion of the analytical work on base plate flexibility, the bolt testing must be performed to at least the original calculated bolt load. For testing purposes factors may be used to conservatively estimate the potential increase in the calculated bolt load due to base plate flexibility. After completion of the analytical work on the base plates the conservatism of these factors must be verified. R1

For base plate supports using expansion anchors, but raised from the supporting surface with grout placed under the base plate, for testing purposes it must be verified that leveling nuts were not used. If leveling nuts were used, then they must be backed off such that they are not in contact with the base plate before applying tension or torque testing. R1

Bulletin No. 79-02 requires verification by inspection that bolts are properly installed and are of the specified size and type. Parameters which should be included are embedment depth, thread engagement, plate bolt hole size, bolt spacing, edge distance to the side of a concrete member and full expansion of the shell for shell type anchor bolts. R1

If piping systems 2 1/2-inch in diameter or less were computer analyzed then they must be treated the same as the larger piping. If a chart analysis method was used and this method can be shown to be highly conservative, then the proper installation of the base plate and anchor bolts should be verified by a sampling inspection. The parameters inspected should include those described in the preceding paragraph. If small diameter piping is not inspected, then justification of system operability must be provided. R1

5. Determine the extent that expansion anchor bolts were used in concrete block (masonry) walls to attach piping supports in Seismic Category 1 systems (or safety related systems as defined by Revision 1 of IE Bulletin No. 79-02). If expansion anchor bolts were used in concrete block walls: R2

   a. Provide a list of the systems involved, with the number of supports, type of anchor bolt, line size, and whether these supports are accessible during normal plant operation. R2

   b. Describe in detail any design consideration used to account for this type of installation. R2

   c. Provide a detailed evaluation of the capability of the supports, including the anchor bolts, and block wall to meet the design loads. The evaluation must describe how the allowable loads on anchor bolts in concrete block walls were determined and also what analytical method was used to determine the integrity of the block walls under the imposed loads. Also describe the acceptance criteria, including the numerical values, used to perform this evaluation. Review the deficiencies identified in the Information Notice on the pipe supports and walls at Trojan to determine if a similar situation exists at your facility with regard to supports using anchor bolts in concrete block walls. R2

   d. Describe the results of testing of anchor bolts in concrete block walls and your plans and schedule for any further action. R2

6. Determine the extent that pipe supports with expansion anchor bolts used structural steel shapes instead of base plates. The systems and lines R2

reviewed must be consistent with the criteria of IE Bulletin No. 79-02, Revision 1. If expansion anchor bolts were used as described above, verify that the anchor bolt and structural steel shapes in these supports were included in the actions performed for the Bulletin. If these supports cannot be verified to have been included in the Bulletin actions: R2

a. Provide a list of the systems involved, with the number of supports, type of anchor bolt, line size, and whether the supports are accessible during normal plant operation. R2

b. Provide a detailed evaluation of the adequacy of the anchor bolt design and installation. The evaluation should address the assumed distribution of loads on the anchor bolts. The evaluation can be based on the results of previous anchor bolt testing and/or analysis which substantiates operability of the affected system. R2

c. Describe your plans and schedule for any further action necessary to assure the affected systems meet Technical Specifications operability requirements in the event of an SSE. R2

7. For those licensees that have had no extended outages to perform the testing of the inaccessible anchor bolts, the testing of anchor bolts in accessible areas is expected to be completed by November 15, 1979. The testing of the inaccessible anchor bolts should be completed by the next extended outage. For those licensees that have completed the anchor bolt testing in inaccessible areas, the testing in accessible areas should continue as rapidly as possible, but no longer than March 1, 1980. The analysis for the Bulletin items covering base plate flexibility and factors of safety should be completed by November 15, 1979. Provide a schedule that details the completion dates for IE Bulletin No. 79-02, Revision 2, items 1, 2, and 4. R2

8. Maintain documentation of any sampling inspection of anchor bolts required by item 4 on site and available for NRC inspection. All holders of operating licenses for power reactor facilities are requested to complete items 5, 6, and 7 within 30 days of the date of issuance of Revision No. 2. Also describe any instances not previously reported, in which you did not meet the revised (R2) sections of items 2 and 4 and, if necessary, your plans and schedule for resolution. Report in writing within 30 days of the date of this revision issuance, to the Director of the appropriate Regional Office, completion of your review. For action not yet complete, a final report is to be submitted upon completion of your action. A copy of your report(s) should be sent to the United States Nuclear Regulatory Commission, Office of Inspection and Enforcement, Division of Reactor Operations Inspection, Washington, D.C. 20555. These reporting requirements do not preclude nor substitute for the applicable requirements to report as set forth in the regulations and license. R2 R1

9. All holders of construction permits for power reactor facilities are requested to complete items 5 and 6 for installed pipe supports within 60 days of date of issuance of Revision No. 2. For pipe supports which have not yet R2

been installed, document your action to assure that items 1 through 6 will be satisified. Maintain documentation of these actions on site available for NRC inspection. Report in writing within 60 days of date of issuance of Revision No. 2, to the Director of the appropriate NRC Regional Office, completion of your review and describe any instances not previously reported, in which you did not meet the revised (R2) sections of items 2 and 4 and, if necessary, your plans and schedule for resolution. A copy of your report should be sent to the United States Nuclear Regulatory Commission, Office of Inspection and Enforcement, Division of Reactor Construction Inspection, Washington, D.C. 20555. R2

Approved by GAO (R0072); clearance expires 7/31/80. Approval was given under a blanket clearance specifically for identified generic problems.

APPENDIX A

SAMPLING METHODS

Item 4 of this Bulletin states that for anchor bolt testing purposes a sampling program is acceptable. Two sampling methods are discussed below, but other methods may be used if justified.

a. Test one bolt on each plate as originally recommended in Bulletin No. 79-02. If the test fails, all other bolts on that base plate should be similarly tested. A high failure rate should be the basis for increased testing.

b. Randomly select and test a statistical sample of the bolts to provide a 95 percent confidence level that less than 5 percent defective anchors are installed in any one seismic Category I system. The sampling program should be done on a system by system basis.

ENCLOSURE 2

LISTING OF IE BULLETINS
ISSUED IN LAST SIX MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-10	Requalification Training Program Statistics	5/11/79	All Power Reactor Facilities with an OL
79-11	Faulty Overcurrent Trip Device in Circuit Breakers for Engineered Safety Systems	5/22/79	All Power Reactor Facilities with an OL or CP
79-12	Short Period Scrams at BWR Facilities	5/31/79	All GE BWR Facilities with an OL
79-01A	Environmental Qualification of Class 1E Equipment (Deficiencies in the Environmental Qualification of ASCO Solenoid Valves)	6/6/79	All Power Reactor Facilities with an OL or CP
79-02 (Rev 1)	Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolts	6/21/79	All Power Reactor Facilities with an OL or CP
79-13	Cracking in Feedwater System Piping	6/25/79	All PWRs with an OL (for Action), All Other Power Reactor Facilities with an OL or CP (For Information)
79-14	Seismic Analysis for As-Built Safety Related Piping Systems	7/2/79	All Power Reactor Facilities with an OL or CP

LISTING OF IE BULLETINS
ISSUED IN LAST SIX MONTHS (CONTINUED)

Bulletin No.	Subject	Date Issued	Issued To
79-15	Deep Draft Pump Deficiencies	7/11/79	All Power Reactor Facilities with an OL or CP
79-14 (Revision 1)	Same Title as 79-14	7/18/79	Same as 79-14
79-16	Vital Area Access Controls	7/30/79	All Holders of and Applicants for Reactor Operating Licenses
79-17	Pipe Cracks in Stagnant Borated Water Systems at PWR Plants	7/26/79	All PWR Power Reactor Facilities with an OL
79-05C&06C	Nuclear Incident at Three Mile Island - Supplement	7/26/79	All PWR Power Reactor Facilities with an OL
79-18	Audibility Problems Encountered on Evacuation	8/7/79	All Power Reactor Facilities with an OL
79-19	Packaging Low-Level Radioactive Waste for Transport and Burial	8/10/79	All Power and Research Reactors with OL, all Fuel Facilities (except Uranium Mills), and certain Materials Licensees
79-20	Same Title as 79-19	8/13/79	Certain Materials Licensees
79-21	Temperature Effects on Level Measurements	8/13/79	All Power Reactor Facilities with an OL or CP

LISTING OF IE BULLETINS
ISSUED IN LAST SIX MONTHS (CONTINUED)

Bulletin No.	Subject	Date Issued	Issued To
79-14 (Supplement)	Same Title as 79-14	8/15/79	Same as 79-14
79-02 (Rev 1) (Supplement No. 1)	Same Title as 79-02	8/20/79	Same as 79-02 (Rev 1)
79-13 (Rev 1)	Cracking in Feedwater System Piping	8/30/79	All Designated Applicants for OLs
79-22	Possible Leakage of Tubes of Tritium Gas Used in Timepieces for Luminosity	9/5/79	Each Licensee who Receives Tubes of Tritium Gas in Timepieces for Luminosity
79-14 (Supplement No. 2)	Same as Title 79-14	9/7/79	Same as 79-14
79-23	Potential Failure of Emergency Diesel Generator Field Exciter Transformer	9/12/79	All Power Reactor Facilities with an OL or CP
79-24	Frozen Lines	9/27/79	All Power Reactor Facilities which have either OLs of CPs and are in late stage of construction
79-13 (Rev. 2)	Cracking in Feedwater System Piping	10/17/79	All PWRs with an OL and Designated Applicants (for Action), All Other Power Reactor Facilities with an OL or CP (for Information)

LISTING OF IE BULLETINS
ISSUED IN LAST SIX MONTHS (CONTINUED)

Bulletin No.	Subject	Date Issued	Issued to
79-17	Pipe Cracks in Stagnant Borated Water Systems at PWR Plants	10/29/79	All PWRs with an OL (for Action). All other Power Reactor Facilities with an OL or CP (for Information)
79-25	Failures of Westinghouse BFD Relays in Safety-Related Systems	11/2/79	All Power Reactor Facilities with an OL or CP (for Action)