Central Files

WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 1200, Green Bay, Wisconsin 54305

July 9, 1979

Mr. J. G. Keppler, Regional Director
Office of Inspection & Enforcement
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Dear Mr. Keppler:

Docket 50-305
Operating License DPR-43
IE Bulletin 79-02 Revision 1

The above referenced IE Bulletin is concerned with pipe support base plate designs using concrete expansion anchor bolts.

The specifics of this bulletin have been reviewed. A testing program and a program of engineering analysis and laboratory experimentation has been initiated to address these specifics. The testing program addresses the "as built" condition of the hangers including such factors as bolt spacing and plate thickness and their effect on bolt loading. In order to verify the integrity of the hangers each bolt on accessible engineered hangers on safety related systems in the containment building was tested either by a direct tension test or by a torque-tension test. In no case was the function on a hanger lost due to failure of the anchor bolts.

The engineering analysis portion of this program will use the "as built" data and the results of laboratory experimentation performed by Teledyne Engineering Services to calculate appropriate safety factors.

Presently, the program is progressing to areas other than those in containment. It is expected that the program will be completed in six months.

Details and responses to items addressed in the referenced IE Bulletin are addressed in attachment 1.

Very truly yours,

E R Mathews

E. R. Mathews
Vice President
Power Supply & Engineering

snf

Attach.

IE Bulletin 79-02 Revision 1

Item 1

Base plate flexability was not taken into account during the initial design of seismic class I pipe restraints on safety related systems. In addition, the majority of restraints at the Kewaunee Nuclear Power Plant are considered flexable under the NRC "2T" criterion. For these reasons a testing program has been initiated to address the concerns of the above referenced IE Bulletin. The results of the testing program will be used as input for the analytical phase of the program.

Items addressed in the testing program include base plate length, width and thickness, bolt hole size and spacing, distance from the stiffening member to the plate edges, lever arm length(s), bolt size(s) and engagement, anchor size, and proper anchor installation.

These parameters will be used as input for a pre and post processor developed by Teledyne Engineering Services (TES) which is used in conjunction with the ANSYS finite element structural analysis computer code. The description of these programs will be transmitted generically by TES.

The pre and post processor has been verified analytically using standard ANSYS analysis. Also, experimental baseplates have been constructed and instrumented to compare results with the pre and post processor. The four bolt plate experiment has been completed and the results compare favorably with the computer program.

Wisconsin Public Service Corporation or its representatives will use these computer programs to form upper bounds on acceptable loading taking baseplate flexability into account and maintaining safety factors greater than or equal to those suggested in IE Bulletin 79-02 Revision I.

The testing program as well as the analytical work is expected to be completed within six months.

Preliminary results show that the 2T criterion proposed by the NRC is overly conservative, as indicated in the IE Bulletin 79-02 Revision 1, and that in fact a 5T or 6T criterion would be more representative of the transition from ridgity to flexability.

Data collection is proceeding in a timely manner and is available for NRC inspection.

Item 2

The minimum safety factor of 5 obtained by taking the ratio of ultimate capacity to bolt design loads is a value which should be easily met in the Kewaunee Plant even when taking into account the effects of shear tension interaction, minimum edge distance and bolt spacing. We have performed a number of calculations to date and have verified safety factors of at least 5 because of such factors as concrete strength, design practices and quality of installation.

The design of these hangers are based on manufacturers data for pullout and shear failure. The capacities are based on Independent Testing Laboratory tests in 3500 psi concrete. The plant averaged concrete strength at the Kewaunee Nuclear Power Plant is 6200 psi, as determined

from standard destructive testing techniques. Thus an additional factor of safety is introduced due to the quality of concrete.

The design practice introduces a factor of safety by using one fourth of the capacities stated by the manufacturer. Also, by spacing hangers at intervals such that the amplitude of periodic motion is reduced, bolt stress is also reduced.

The quality of installation is exemplified by the extremely low failure rate when anchors are subject to a direct pull test or a torque-tension test.

The direct pull test is accomplished by shimming the base plate from the Phillips self drilling snap-off type anchors (the only type of anchor used), placing a threaded rod into the anchor and tensioning the rod with a hydraulic loading device. The value to which the anchors are loaded is the pull-out value (Pu) devided by four. This value is even more conservative than Pu/5 suggested by the NRC.

The direct pull test is the preferred method to verify anchor operability. When a direct tension test is impracticable to perform because of time limitations due to radiation concerns or space limitations, a torque test is preformed in much the same manner as the pull test. The plate is shimmed away from the anchors and a torque is applied to the bolt. Using the known relation between torque and tension the anchors are loaded to a value of Pu/2. This higher loading value was chosen such that the net torque resulting in a tension on the anchor should be at lease Pu/4, conservatively considering possible friction between the base plate and bolt.

The relationship between torque and tension has been reviewed by representatives of the NRC Office of Inspection and Enforcement, and is available for further inspection.

The inspection of hangers in the containment building has been completed and results are as follows:

a. CVCS 27 hangers total: No failures

b. RHR 28 hangers total: No failures

c. ACS 77 hangers total: No failures

d. RCS 42 hangers total: One failure

e. SI 93 hangers total: Five failures

A failure is recorded when the anchor is pulled free from parent concrete. In no case did the hanger as a whole fail.

Item 3

There were no design requirements for anchor bolts to withstand cyclic loads at the time of design. TES has been commissioned to preform testing to study the effect of cyclic loading on the ultimate capacity of anchors used in the Kewaunee Plant and this effect will be taken into account when calculating safety factors. The investigation of this effect is expected to be completed by July 15 of this year.

Item 4

Existing QC documentation does not address cyclic loading, proper type and installation of anchor bolts. The testing program outlined in the above text does. The program completed covers a 100% sample of the accessable engineered hangers on safety related systems in the containment building. At the present time we are continuing this approach on safety related systems in areas other than containment.

Based on the above results, which address approximately 1/3 of the engineered hangers on safety related systems, continued operation of the Kewaunee Nuclear Power Plant is justified and desirable pending completion of inspection and analytical evaluation.