Central Files

50-331

Iowa Electric Light and Power Company

July 10, 1979
LDR-79-98

Mr. J. G. Keppler
Directorate of Regulatory Operations
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Dear Mr. Keppler:

This letter is in response to your Immediate Action Letter of July 6, 1979. The enclosed report has been developed by Bechtel and conforms to the mutually agreed upon guidance developed by Mr. E. J. Jordan, the NRC staff members, and Iowa Electric personnel present at the meeting conducted in Bethesda, Maryland on July 6, 1979.

The DAEC Operations Committee has reviewed the enclosed report and concludes that the safety-related systems required to be operable by the Technical Specifications are operational.

Very truly yours,

Larry D. Root

Larry D. Root
Assistant Vice President
Nuclear Generation

LDR/KAM/ms
Enc.
cc: All w/enc.
K. Meyer
D. Arnold
S. Tuthill
L. Liu
E. Hammond
H. Rehrauer
T. Ippolito (NRC)
E. Jordan (NRC)

MA 4

JUL 13 1979 60

7908140159

I. Introduction

Pursuant to a meeting with the NRC on July 6, 1979 in Bethesda, Maryland, and an Immediate Action Letter of the same date, the data contained herein should provide the information requested. The purpose of the meeting was to discuss test results-to-date as required by IE Bulletin 79-02. During that meeting the NRC voiced concerns relative to the capability of safety systems to perform their intended function in the event of a concrete expansion bolt (CEB) failure under earthquake induced loads. The NRC also requested that an evaluation of the adequacy of CEB's in concrete block walls be performed. The following sections contain the test and analytical results and the justification for continued operation of the DAEC plant.

II. Test Results

A total of 34 large pipe supports selected randomly from the DAEC safety systems were tested in the field verification program. The field verification program included large piping supports in wall, floor and ceiling configurations with 2, 4, 6 and 8 bolt base plate designs. The breakdown of the number of each type of base plate tested is as follows:

No. of Bolts in Base Plate	No. of Plates Tested	Total Bolts Tested
2	4	8
4	22	88
6	7	42
8	1	8
Totals	34	146

Each base plate in the program was inspected and tested to identify deficiencies in the installation of the bolts which would impair the load-carrying capacity of the bolts. The items which were inspected or tested for all the bolts in each base plate in the program are listed below. The impact of a deficiency in any of the items tested is also shown.

Inspection/Test Data	Impact of Deficiency
Bolt size less than specified	Derate
Bolt length less than specified	Derate
Thread engagement below minimum	Derate
Bolt bottomed out	Unacceptable
Test torque less than required	Unacceptable **
Concrete failure or excessive slippage	Unacceptable
Shell in contact with base plate	Acceptable *

* This deficiency was considered acceptable if, prior to the torque test, the plate was shimmed away from the shell and the bolt held torque.

** Bolts were tested to approximately 30-50% of their ultimate tensile loading using torque values which were derived using a conservative torque/tension correlation coefficient. The high test load was used even though the actual design loads in many cases are more than an order-of-magnitude lower. This introduces some conservatism in the defective rate indicated for bolts.

Out of the 146 bolts tested in the field program, 24 bolts were found to be unacceptable. The breakdown of the 24 unacceptable bolts by cause is as follows:

Cause	No.	% of Total Bolts Tested
Failed torque test	13	9
Excessive Slippage *	9	6
Bottomed Out	2	1
Total	24	16%

* During the torque test, the shell slipped more than the established 1/16" criterion, however, the bolts then held and passed the torque test. These were nonetheless considered failures in that bolt load-carrying capacity is indeterminate in the plate.

The supports which were found to have unacceptable bolts were evaluated to determine if the remaining bolts in the support would accommodate the actual design loads. Of the 34 supports tested, 15 were found to have one or more unacceptable bolts in the plate. Of the 15 supports, 11 were found to be acceptable after determining that the support would carry the design load. The 4 remaining supports would appear unable to carry the actual design load and were, therefore, considered unacceptable. From the test program and the subsequent pipe support design evaluation the indicated defective rate for large piping supports is approximately 12 percent.

From the field verification program, it appeared that, in general, when a support was determined to be unacceptable, there were multiple bolts in the support which were visably loose in the concrete or baseplate. Because of this observation and to aid in the assessment of the condition of the plant supports with CEB's a visual inspection program was initiated of all CEB supports in the RCIC, HPCI, RHR and Core Spray systems. To date, 123 supports out of a total of 134 have been visually inspected. From this inspection, 4 supports were observed to have multiple bolts which are visably defective. This would indicate a defect rate in the supports of approximately 3 percent which supports the 12 percent defect rate determined from the detailed field verification program.

Analytical Results

The test program discussed above, determined that 12% of the concrete expansion bolts (CEB) could not develop their rated load. In order to assess the effect these incapacities might have had on the piping systems during a seismic event, the piping system analysis was rerun using computer program ME 101, titled "Linear Elastic Analysis of Piping Systems", with a percentage of the restraints that utilized CEB assumed to have failed. While it is recognized that the restraint could have some structural capacity* remaining, for purposes of analysis, the restraint was not included.

The test cases included two piping runs in the core spray system and one in the HPCI system. A piping run was defined as piping, valves, fittings and other inline components between anchors. The anchor in some cases was a piece of equipment or a structural anchor.

A high pressure, a moderate pressure and a low pressure piping system was chosen for the study. Pipe diameters ranging from 4 inch to 12 inch O.D. were chosen. These three systems are representative of other safety related piping in the plant. A summary of the Core Spray Pump Suction piping analysis and a comparison with the previous analysis is attached to serve as an example.

A discussion on each of the systems follows.

* In some cases restraints employ both welded and CEB components.

Core Spray Pump Suction

1. Analysis

The Core Spray Pump Suction (SE) is a low pressure large diameter piping system. It is carbon steel and has a diameter of 10 and 12 inches. It is anchored at the torus and core spray pump. A structural anchor is also included on a branch line. There are a total of 11 supports and restraints, 6 of which have CEB. Based on the results of the testing program, one restraint (horizontal snubber) containing CEB's was deleted from the analysis.

2. Results

The results of the analysis showed loads on some restraints increasing and some decreasing. * The core spray pump nozzle loads (Forces) increased, however this should not be of concern since the SSE stress at the nozzle is 750 psi and the moment loads at the nozzles are decreased. A review of the hanger details indicates that restraints as designed can withstand the new seismic loads, where increased loading occurred. Increased deflection of the system is an expected result of a deletion of a restraint. The SSE deflection in this system increased to approximately 1 1/8 inches.

3. Conclusions

a) Some of the reactions on the core spray pump have increased but remain low. The SSE stress at the nozzle is less than 750 psi.

b) The loads on some hangers increased but are acceptable as designed.

c) With the one restraint removed, the system will perform its intended safety function.

HPCI Pump Discharge

1. Analysis

The HPCI pump discharge piping is a high pressure piping system. It has piping diameters ranging from 4 inch O.D. up thru 12 inch O.D. The piping run that was re-analyzed had a total of 10 supports and restraints, 2 of which utilized CEB. To evaluate the failure of one of these two CEB's we deleted one vertical

* The maximum system stress is below code allowable.

rigid near the center of the system. We believe this was a very conservative example since there are only 2 CEB restraints existing and one was deleted.

2. Results

   In some cases loads on supports and anchors increased and on some they decreased. The maximum system stress is low and well below code allowable. The forces and moments on the HPCI pump nozzle actually decreased as did the nozzle stress. The maximum deflection in the vertical has increased but remains small and should be of no concern.

Conclusions

Hanger and restraints are acceptable as designed.

Pump reactions decreased and are therefore acceptable.

The system should perform its intended safety function.

ADEQUACY OF CEB'S IN CONCRETE BLOCK

During the visual inspection of the safety systems it was determined that there are three large piping supports hung off the concrete block walls, one of the three is anchored with through-wall bolts with the steel base plate on the backside of the wall. The remaining two supports were evaluated to determine the load-carrying capability of the supports. In the evaluation, the initial step performed was to reduce the ultimate capacity of anchor bolts in concrete by a factor equal to the square root of the ratio of the average strengths of concrete block to concrete. This resulted in a factor of 0.725. From pull-out tests conducted at FFTF on CEB's in concrete block, typical minimum pull-out values were extracted. These minimum pull-out values were ratioed to the reduced ultimate capacity described above. This yielded a factor of 0.3. Combining the calculated reduction factor and the pull-out test reduction factor, a total reduction factor of 0.2375 was applied to the ultimate capacities of shell type anchors in normal concrete to yield the capacity of CEB's in concrete block.

Using the ultimate capacities as determined above, the safety factors were calculated using the design loads for the supports installed in concrete block walls. The safety factors in one were approximately 3.5 and 1.9 in the two supports. These appear acceptable for the interim (the replacement of these supports is scheduled for July 13, 1979) because of the conservatisms in the calculated and test reduction factors.

III. Conclusions

Design of piping systems in nuclear power plants to withstand the effects of seismic events include many conservatisms in every stage of design. Pipe supports and restraints often have capabilities that far exceed the actual design loads. Piping stress levels generally are low compared to the allowable stress.

There are many restraints in the DAEC systems that are of 100% welded construction as well as those that are a combination of welded and CEB's. If 12% of the restraints containing CEB's were to fail, it is anticipated that other adjacent restraints would share the additional load without a "domino effect".

The analytical evaluation assumes the loss of 12% of the CEB restraints. The results of the analysis indicate that the systems should be available to perform its intended safety function during and after an SSE.

COMPARISON BETWEEN OLD AND NEW LOADS ACTING ON ANCHOR AND SUPPORTS ISO. M-708

DATA POINT	MARK HANGER	TYPE	OLD SSE LBS	NEW SSE LBS	WEIGHT LOAD LBS	REMARKS
40	HBB-2-H6	VERT RIGID	546	552	1405	
60	HBB-2-SS7	Z-SNUBB	2762	2664	N/A	
85	HBB-2-H5	VERT RIGID	744	956	1135	
95	HBB-2-H4	VERT RIGID	816	826	1155	
105	HBB-2-H3	VERT RIGID	276	230	1325	

DATA POINT	TYPE OF ANCH	Fx Lbs	Fy Lbs	Fz Lbs	Mx Ft Lbs	My Ft Lbs	Mz Ft Lbs	SEISMIC STRESS	
								OBE	SSE
5 NEW SSE	STRUCT ANCH	346	724	280	2034	494	1984	1192	2384
5 OLD SSE	"	298	328	288	1140	456	1158	568	1136
55 NEW SSE	PUMP NOZZLE	1448	308	3009	1522	2310	406	392	744
55 OLD SSE	"	940	280	572	1532	2510	460	405	810
140 NEW SSE	TORUS NOZZLE	1412	802	1006	3842	9421	6056	308	616
140 OLD SSE	"	1822	740	1656	6166	9812	8724	428	856