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MIDLAND PROJECT
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We have reviewed IE Bulletin 79-02 on the subject of "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts" against the Midland Plant Unit 1 and 2 design. Attached are three (3) copies of the results of that review.

The attachment was prepared prior to the receipt of 79-02, Revision No 1. We are not aware of any piping supports for which leveling nuts are in use in conjunction with expansion anchors.

The reinspections necessary to accomplish the requirements of Item 4 of the bulletin will not be completed until the end of July. There is a preliminary indication that there is some problem with meeting the required embedment depths. Acquisition of additional UT instruments, review of design requirements for individual hanger installations and further inspections are required to quantify the extent that the embedment depth characteristic has not been met. A further response will be provided to the NRC on this matter by August 15, 1979.

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CC: Director, NRC Office of Inspection & Enforcement
Director, Nuclear Reactor Regulation

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This document is in response to the requirements of NRC IE Bulletin 79-02, dated March 8, 1979. Investigation includes pipe supports using concrete expansion anchors for Seismic Category I systems as defined by Regulatory Guide 1.29, Seismic Design Classification, Rev 1 dated August 1973. The FSAR response in Appendix 3A clarifies Regulatory Guide 1.29, Seismic Design Classification.

Question 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. If the base plate is determined to be flexible, then recalculate the bolt loads using an appropriate analysis which will account for the effects of shear-tension interaction, minimum edge distance, and proper bolt spacing. This is to be done prior to testing of anchor bolts. These calculated bolt loads are referred to hereafter as the bolt design loads.

Response

Prying action in the base plate-to-concrete connection using expansion anchor bolts is considerably less than the same phenomenon in steel-to-steel connections, mainly because of the much lower expansion anchor stiffness. If the bending stresses in the base plate are within the AISC allowables, the base plate is rigid enough for prying action to be negligible (refer to ITT Grinnell report, Attachment 1). For this project, the bending stresses in the base plate were kept within the AISC allowables.

When the base plate is subject to a moment, the moment arm (C) to determine the tension ($T = \frac{\text{Moment}}{C}$) in the expansion anchors was taken to be equal to C_1 as shown in Figure 1. In reality, the moment arm is greater than C_1, and will approach C_2 as the plate becomes infinitely rigid. For this project, the base plate and bolts were designed conservatively for bending loads.

Question 2

Verify that the concrete expansion anchor bolts have the following minimum factor of safety between the bolt design load and the bolt

(i.e., type of concrete and its strength

a. .Four - For wedge and sleeve type anchor bolts

b. Five - For shell type anchor bolts

Response

A minimum safety factor between the bolt design load and the bolt ultimate capacity, determined from static load tests simulating the actual conditions of installation, was taken to be equal to four for stud type anchor bolts, and five for the shell type. These minimum safety factors were increased by a factor of two when seismic loads were considered. The project specification (Attachment 2) was the basis of design for all pipe supports and hangers.

Question 3

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

Response

Expansion anchors are not used on the supports of pipes subject to high cyclic operating loads (continuous vibration from valves, pumps, and machinery or flow-induced vibrations). These lines are identified in the project specification (Attachment 2), and it will be verified by field inspection that no expansion anchors were used for these lines.

Question 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, ensure 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 ensure that minimum design requirements have been met with respect to 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 Items a and b

each seismic category.

Response

a. Installation of Expansion Anchors

Torque testing was performed at the jobsite (Attachment 3) to determine torque values and correlate these values with tension loads. These tests are the basis for the project specification (Attachment 2).

b. Testing Expansion Anchors for Pullout Capacity

Installed stud type expansion anchors were tested using a calibrated, manually operated torque wrench. Minimum torque values as given in the specification (Attachment 2) were obtained during testing. In lieu of torque testing, shell type expansion anchors were tested with a tensioner. Test load values equal to approximately 200% of the allowable tension load for 3,000-psi concrete were used.

c. Inspection of Expansion Anchors

The following procedure for stud and shell type bolts are applicable for inspection and testing during installation and reinspection of samples.

1. STUD TYPE

a) Bolt capacity will be checked by testing as specified in Item b, Testing of Anchors for Pullout Capacity.

b) Bolts are stamped with their length. For the bolts which were not stamped, a sample will be checked by using ultrasonic means. The person performing the ultrasonic test will be required to sign the data sheet.

c) Bolt diameter will be verified.

d) Verification that the nut is not bottomed out on the bolt will be accomplished by backing the nut off and visually inspecting the bolt for threads below the surface of the plate. In lieu of this, a comparison of the manufacturer's thread length with measured length will be an acceptable alternative.

e) Concrete surrounding the plate will be checked for signs of failure.

a) Bolt capacity will be checked by testing as specified in Item b, Testing of Anchors for Pullout Capacity.

b) The bolt thread engagement will be checked for a minimum of one bolt diameter.

c) The shell will be checked for contact with the support plate by making certain that the setting depth of the shell varies from flush with the concrete surface to approximately 1/8 inch below the surface.

d) Bolt diameter will be verified.

e) Concrete surrounding the plate will be checked for signs of failure.

d. Restore Original Torque Values After Testing

If the nut is loosened during inspection or reinspection, bolts will be tightened using the installation torque specified in the project specification (Attachment 2).

e. Test Sample Size and Acceptance Criterion

In order to improve and substantiate the degree of acceptability of the quality control documentation, random samples of 60 stud anchors and 60 shell anchors will be selected and tested. These tests will demonstrate, with a confidence level of 95%, that not more than 5% of the installed anchors are defective. The sequential sampling program shown in Table 1 will be followed if some bolts are found defective in the sample.

The random selection of the anchors will be performed by numbering the anchors and using random number tables. Stud and shell type anchor samples will be identified separately and tested as two different lots.

TABLE 1

SEQUENTIAL SAMPLING PROGRAM

Sample Size	Acceptable Number of Defects in the Sample
60	0
92	1
124	2
152	3
182	4
216	5

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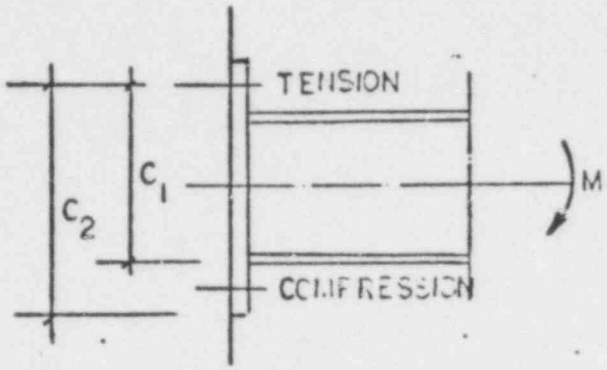

FIGURE 1