DOCKET NOS. 50-213
50-245
50-336

ATTACHMENT (1)

HADDAM NECK PLANT

MILLSTONE NUCLEAR POWER STATION, UNIT NOS. 1 AND 2

GENERIC PROGRAM DESCRIPTION

845 292

JULY, 1979

A. Finite Element Model

Responses to I&E Bulletin #79-02, Questions 1 and 2, require an analytical model to verify that base plate flexibility is accounted for in the calculation of anchor bolt loads.

Using the commercially available ANSYS program, Teledyne Engineering Services (TES) developed a general finite element model of the base plate and anchor bolts to calculate bolt loads. The model provides for plate flexibility, gaps between the base plate and concrete, and variable bolt stiffness. The model includes the base plate, concrete subgrade, anchor bolts, and the attachment.

Tests of two prototype base plates are being performed to provide a comparison of experimental and analytical results. The test of the four-bolt base plate has been completed and the results compare favorably with the analytical results. The test of the eight-bolt base plate is not yet complete.

B. Shear-Tension Interaction Tests

Question 2 of I&E Bulletin #79-02 requires consideration of the effects of shear-tension interaction in the determination of the minimum factor of safety for the anchor bolts.

A program of destructive tests is being performed to determined ultimate tension and shear loads for expansion anchors. The objective is to develop shear-tension interaction diagrams which are more realistic and less conservative than the linear interaction equation for shear and tension. Several size anchors from seven different manufacturers are being tested. The total number of tests is about 700. Sixty-six, unreinforced slabs, measuring 3.5 feet by 7 feet by 1 foot, were poured with 3,000 psi concrete for the tests.

The test fixture has been constructed using two hydraulic jacks which are simultaneously controlled with an electronic feedback system. The desired ratio of shear and tension forces is carefully controlled. Load versus deflection and tension versus shear force diagrams are plotted automatically during each test.

C. Cyclic Load Tests

Questions 3 and 4(a) of I&E Bulletin #79-02 concern the effect of cyclic loads on anchor bolts. TES is performing cyclic load tests on various types of anchor bolts to develop data to address these concerns.

The bolts to be tested are installed in concrete blocks in accordance with the manufacturer's recommended installation procedures. The bolts are tested at a low frequency with one load range for approximately 1,000 cycles and at a higher frequency with a smaller load range for approximately one million cycles. After each cyclic test, the bolt is examined for damage and axial deflection, and then tested statically to its ultimate load.

The tests are expected to provide important information regarding the effect of cyclic loads on static capacity.