

Bechtel Associates Professional Corporation

SUBJECT: Broken Reactor Vessel Anchor Bolt in Unit 1 Status Report

PROJECT: Consumers Power Company
Midland Plant Units 1 & 2
Bechtel Job 7220

Introduction

This report summarizes the history of the failed reactor vessel anchor bolt and outlines the action taken to date to determine the failure mechanism.

Bolt Description

The anchor bolts are 7 feet 4 inches in length and 2-1/2 inches in diameter with 1-inch thick washers and heavy hex and jam nuts. There are 96 anchor bolts per reactor vessel with 48 on the inside of the reactor skirt and 48 on the outside (see Figure 1). The bolts are ASTM A 354 Grade BD, purchased under Bechtel Specification 7220-C-233(Q), Rev 3.

History of Failed Bolt

On July 26, 1979, anchor bolt 35 (the third stud clockwise from the X axis, on the inside with the "0" mark stamped on the anchor bolt; see Figure 1) in Unit 1 was tensioned to 75 ksi by B&W using the specified BIAC anchor bolt tensioner. On September 14, 1979, B&W personnel learned that this bolt and nut were missing when they attempted to install the jam nuts on the anchor bolts. On September 14, 1979, B&W issued NCR-1656 describing the situation. On the same day, Bechtel personnel initiated a search. The bolt was recovered on September 18, 1979. It was determined that the bolt broke 14 inches from the top end. The break occurred in the threaded portion approximately 1/2 inch from the last threads on the bolt, with separation occurring even with the bottom of the sole plate (see Figure 2). At the time of the break, the bolt apparently was ejected and may have caused several minute dimples on the surface of the reactor vessel itself (see Figure 3).

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CPCo reported this problem to the NRC on September 14, 1979.

Subsequent investigation determined that this bolt was supplied by Southern Bolt and Fastener Corp, heat treated by ~~MISSISSIPPI VALLEY~~ J. W. Rex Co., ~~SKIDWAYNIX SPOILTEX~~, and the material originated from Bethlehem Steel. The broken bolt is marked as belonging to Heat 654N136. Ninety-six bolts from three different heats are installed in Unit 1. Fifty-eight reactor anchor bolts from Heat 654N136 are installed in Unit 1, and no reactor anchor bolts from this heat are installed in Unit 2.

Investigation Plan*

An independent testing laboratory (Teledyne Engineering Services of Waltham, Massachusetts) has been contacted regarding performing a series of tests as the initial course of action to determine the cause of the failure. The tests discussed as appropriate for the present situation are:

1. Dye penetrant examination to detect cracks in the thread roots; with photographs included
2. Chemical analysis to determine conformance with ASTM A354 Grade BD and the existence of tramp elements
3. Mechanical tests for the following:
 - a. Rockwell C hardness at several locations on the bolt
 - b. Microhardness at several locations as close as practical to the fracture surface
 - c. Tensile strength (notched and unnotched specimens)
 - d. Yield strength
 - e. Impact testing to determine Charpy transition temperature.
4. Microscopy as follows:
 - a. Photomicrographs at failure initiation and away from failure to determine microstructural differences and/or heat treatment discrepancies

*This proposed Investigation Plan is presently being reviewed by Consumers Power and may be subject to modification.

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- b. Scanning electron micrographs of fracture surface
- 5. Plainstrain fracture toughness (K_{IC}) tests at room temperature
- 6. Ultrasonic test

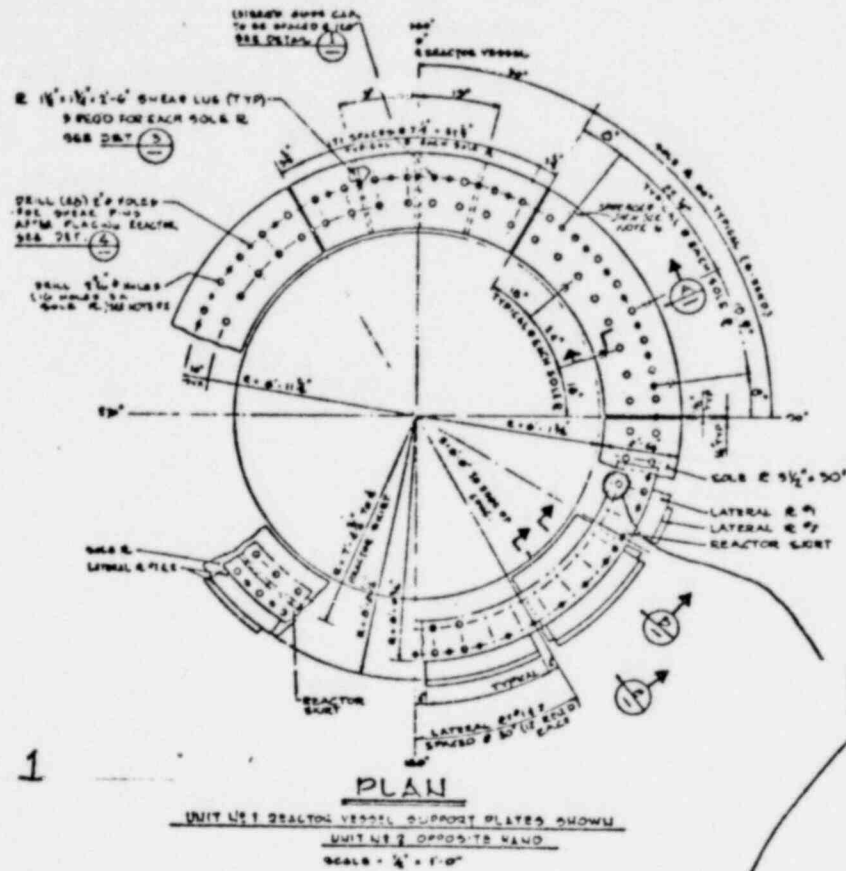
The test results can be available within 8 weeks after award of the contract. Upon review of the test results, further action, if required, will be proposed.

Teledyne has submitted to Bechtel Associates Professional Corporation a proposal to conduct the testing identified above. The proposal is being reviewed and, if satisfactory to the parties involved, contracting with Teledyne for its services will be expeditiously pursued. As part of the proposed review, the Teledyne QA program will be reviewed, especially as applied to subcontract work.

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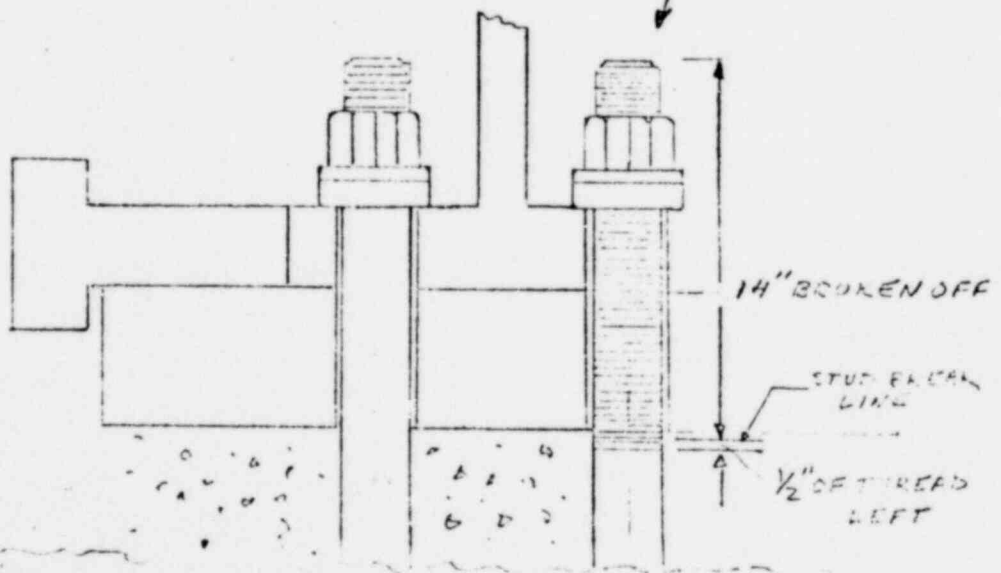
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POOR ORIGINAL



BOLT 35

FIGURE 2



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