



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERN
ELEMENT REPORT 222.5(B), "BOLTS REPLACED BY WELDING"

I. Subject

Category: Engineering (20000)
Subcategory: Pipe Support Weld Design (22200)
Element: Bolts Replaced by Welds (22205)

The basis for Element Report 222.5(B) Revision 2, dated January 23, 1987 is employee concern IN-85-109-002 which states:

"Bolts replaced by welding to embedded plates. The CI is of the opinion that the weld should be analyzed for carrying the entire load. (Auxiliary Building, Elevation 737 ft or 757 ft, Units 1 & 2) Two internal memos (correspondence known) describe this condition. Time frame was July 1983."

This concern was evaluated by TVA as potentially nuclear safety-related and potentially applicable to Sequoyah (generic). A similar concern is being investigated under Sequoyah Element Report 215.9(B) entitled "Civil/Structural Design - Structural Connection Design."

II. Summary of Issues

One issue was defined by TVA:

1. When a mixed bolt and weld design is made, the weld should be designed to carry the entire shear load.

III. Evaluation

The internal correspondence mentioned by the concerned individual (CI) was never identified, however note 3 on Drawing 47A050-1Q Revision 7 for Watts Bar permits the substitution of welds for bolts when an embedded plate is present. Note 2 on Drawing 47A050-2 Revision 5 for Sequoyah is similar and states:

"Mechanical Hangar Drawings - General Notes - Note 2 where a bolt anchored plate overlaps an existing embedded plate, bolt anchors may be replaced by a minimum of 2 in. of 5/16 in. weld for each bolt eliminated due to some portion of the bolt hole being obstructed by the embedded plate. Engineering design approval is required. This note is not applicable to 1-1/4 in. wedge bolts or to any size of grouted anchors."

In addition, Sequoyah drawing 47A053-1 Revision 3 states:

"Mechanical Heating, Ventilation and Air Conditioning Duct Supports - Note 20 Field may weld member supports to embedded plates where possible in lieu of bolt anchor plates shown on drawing. Weld size should be identical to that shown between member and bolt anchor plate."

Section 7.15.1.1 of the TVA Pipe Support Design Manual requires that the design calculations be performed in accordance with the American Institute of Steel Construction (AISC) code. Section 1.15.10 of AISC code contains the design criteria for the use of bolts in combination with welds:

"A-307 bolts, or high strength bolts used in bearing-type connections shall not be considered as sharing the stress in combination with welds. Welds if used shall be provided to carry the entire stress in the connection."

The intent of this code is that the relatively rigid weld will carry the shear load when connections have a combination of bolts and welds. According to this rule, replacing one bolt in a four bolt connection with a weld means that the weld must accommodate the shear stress formerly taken by all four bolts.

WBNP found that these welds were not designed to carry the entire shear load for large bolts and scheduled the following corrective actions:

1. Survey the plant to determine the worst in-place condition.
2. Evaluate this worst condition by analysis or testing.
3. Evaluate all applicable surface-mounted plates if the worst condition is unacceptable.
4. Revise notes on drawing 47A050-1Q for future installations. Engineering approval will be required before substituting welds for bolts.
5. Complete related design work.

This safety evaluation report covers the Sequoyah plant and Watts Bar will require a separate review. The as-built configurations identified by the CI at Watts Bar were evaluated by analysis and TVA found it to be adequate.

As a result of the WBNP review, SQNP performed a separate evaluation. A review of engineered supports did not reveal the use of 2 in. long, 5/16 in. fillet welds. According to TVA, the Sequoyah loads on the supports were not high enough to cause a welded connection to fail under the assumption that the weld carries the entire load. TVA admitted that one weld is not the equivalent of several bolts for shear loading, but engineering approval is needed before the mixed connection could be used. In addition, the prohibitions about 1-1/4 in. wedge bolts and grouted anchors were added to drawing 47A050-2 two months prior to the time frame of the employee concern.

The TVA evaluation team noted several shortcomings with the generic calculation that substituted a weld for a bolt:

1. The expansion anchors shared shear loads with welds which was contrary to the AISC code requirements. The weld or welds is required to carry the shear load of all of the bolts.
2. The calculation performed to qualify a mixed bolt connection for SCR SQN CEB 3601 did not satisfactorily address the instructions of pipe support design criteria.
3. The base metal strength should not be ignored in the calculations. While this is a programmatic error, the NRC noted that it has a negligible effect for these welded base plates.
4. Even if one fillet weld could substitute for only one bolt, the 2 in. x 5/16 in. fillet weld is not equal to the strength of a 1 in. diameter bolt.

TVA concluded that the employee concern is valid in that the weld must be designed to carry the entire shear load for a mixed bolt and weld connection.

For corrective action, TVA randomly selected 60 baseplates with mixed connections that represent the structures throughout the plant. These baseplates were analyzed by considering all of the shear forces applied to the baseplate as acting on the weld or welds. Policy memorandum PM-86-17 was issued to provide instructions for designing these mixed connections and to prevent a reoccurrence of this type of problem. The plan was to strengthen deficient welds, but none were found. Since no welds were deficient, TVA claimed a 95% confidence level in the integrity of these types of connections at Sequoyah.

IV. Conclusions

The NRC staff believes that the TVA investigation of the concern was adequate, and their resolution of the concern as described in TVA Employee Concerns Special Program Report Number 222.5(B) Revision 2 dated January 23, 1987, entitled "Pipe Support Weld Design - Bolts Replaced by Weld" is acceptable for Sequoyah. TVA admitted that the expansion anchors are designed to carry shear loads with welds contrary to AISC code requirements. Sequoyah performed a random sampling program of 60 baseplates and performed a stress analysis based on the as-measured dimensions of the connections. No connections required weld strengthening and the sample gave a 95% probability that less than 5% of all of these connections at Sequoyah may need strengthening.

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