



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

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERN
ELEMENT REPORT 215.9 (B), STRUCTURAL STEEL CONNECTION DESIGN"

I. Subject

Category: Engineering (20000)
Subcategory: Civil/Structural Design (21500)
Element: Structural Steel Connection Design (21509)

The basis for Element Report 215.9 (B) Revision 1, dated January 13, 1987 is employee concern IN-85-297-003 which states:

"Structural steel connections (I-beam to embed plates) are both welded and bolted. One method is for vibration and the other is for dead loads. Both type connections are being used on the same I-beam and these are not supposed to be mixed'. Construction Dept. concern. CI declined to provide futher information."

This concern was evaluated by the licensee as potentially nuclear safety-related and potentially applicable to Sequoyah (generic). A similar concern was investigated under Sequoyah Element Report 222.5(B) entitled "Pipe Support Weld Design - Bolts Replaced by Weld."

II. Summary of Issues

One issue was defined by the licensee:

Bolted and welds are used in the same connection to transfer loads from structural steel members to concrete walls. These are not supposed to be mixed.

III. Evaluation

The employee's concern about mixed connections was evaluated as related to welding and bolting at the same connection. There is nothing unusual about a welded connection at one end of a beam and a bolted connection at the other end.

The FSAR and design criteria for the Sequoyah Nuclear Plant commit the licensee to design structural steel in accordance with the American Institute of Steel Construction (AISC) code. Section 1.15.10 of the 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 weld. Welds is used shall be provided to carry the entire stress in the connection."

The intent of this rule 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.

However, the licensee also creates the potential for using a weld of insufficient size with Note 2 on Drawing 47A050-2 Revision 5 which 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."

Significant Condition Report SQN CEB 8601 noted that this note had existed since 1978, but design calculations to justify this statement did not exist. Similar notes are found in the licensee's drawing series 47A051, 47A052, 47A054, 47A055 and 47A056 which cover general notes for all seismic category 1 support structures for piping, electrical conduits and trays, HVAC ducts, and instrument tubing. A licensee review found several structural steel supports with these mixed connections, e.g., supports for a large duct at elevation 710 that circles the reactor cavity wall.

The licensee submitted recent licensee calculations which concluded that all systems will be able to perform their intended functions and no failures would occur as a result of the drawing note. The licensee's evaluation team observed that the loads were shared by the welds and bolts contrary to AISC rules and there were several cases where the yield stress of the weld was exceeded based on allowable design stresses. In addition, the shear strength of the base metal was not considered in determining the load-carrying capacity of the weld. While this is a programmatic error, the NRC staff noted that it has a negligible effect for these welded base plates.

The licensee's evaluation team substantiated the employee concern that welds and bolts are used on the same connection. The team also found that the calculations do not demonstrate licensee conformance to FSAR commitments.

For corrective action, Sequoyah 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 based on actual loads. 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 licensee's investigation of the concern was adequate, and their resolution of the concern as described in TVA Employee Concerns Special Program Report Number 215.9 (B) Revision 1 dated January 13, 1987, entitled "Civil/Structural Design - Structural Steel Connection Design" is acceptable for Sequoyah. The licensee 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. The licensee issues a policy memorandum to provide instructions for designing these mixed connections and to prevent a recurrence of this type of problem.

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