Arizona Public Service Company
P.O. BOX 21666 • PHOENIX, ARIZONA 85036

January 30, 1984
ANPP-28747-BSK/TRB

U. S. Nuclear Regulatory Commission
Region V
Creekside Oaks Office Park
1450 Maria Lane - Suite 210
Walnut Creek, CA 94596-5368

Attention: Mr. T. W. Bishop, Director
Division of Resident
Reactor Projects and Engineering Programs

Subject: Final Report - DER 83-30
A 50.55(e) Reportable Condition Relating to A Marathon ASTM A354 Bolt Broke While Torquing the Bolt On The Unit 2 Feedwater Pump.
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between T. Young and R. Tucker on May 5, 1983.
B) ANPP-23952, dated, June 6, 1983 (Interim Report)
C) ANPP-27289, dated, July 21, 1983 (Time Extension)
D) ANPP-28142, dated October 31, 1983 (Time Extension)
E) ANPP-28391, dated December 8, 1983 (Time Extension)
F) ANPP-28581, dated January 9, 1984 (Time Extension)

Dear Sir:

Attached is our final written report of the deficiency referenced above, which has been determined to be Not Reportable under the requirements of 10CFR50.55(e).

Very truly yours,

E. E. Van Brunt, Jr.
APS Vice President, Nuclear
ANPP Project Director

EEVB/TRB:db
Attachment

cc: See Page Two

50-529

IE-27

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cc: Richard DeYoung, Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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FINAL REPORT - DER 83-30
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNIT 2

I. Description of Deficiency

While torquing the last anchor bolt for the installation of the Unit 2 turbine driven Auxiliary Feedwater pump, the nut was observed to be rotating excessively before reaching the required torque. Torquing was stopped at that time. Upon return to the pump the following day, the bolt was found to have failed. The bolt is a high strength A-354 BD 1-1/4" diameter anchor bolt with a specified installation torque of 2360 ft-lbs. As indicated in the referenced Nonconformance Report, thirteen bolts had already been successfully installed for the pump. Test records showed the failed bolt exhibited an Equotip hardness reading of L=632, which is within the acceptance criteria.

II. Analysis of Safety Implications

The equipment supplier has performed a seismic stress analysis (Bechtel Log Number 13-10407-M021-110-3) to determine if the remaining thirteen anchor bolts are sufficient to anchor the equipment.

Review of the analysis determined that the remaining thirteen anchor bolts were adequate to anchor the equipment. The analysis is based on generic seismic response curves for equipment located anywhere on the Palo Verde site. The response curves are included in specification 13-MM-021. Since the auxiliary feedwater pump is located on the basemat of the main steam support structure the response spectra curves have lower accelerations. Using the preceding curves for the as-built location for the pump, the anchor bolt stresses are well within the allowable limits.

Therefore, this condition is evaluated as not reportable under the requirements of 10CFR50.55(e) since if this condition were to remain uncorrected it would not represent a safety significant condition.

III Corrective Action

Since this is a second occurrence of embedded stud failure due to overtorquing (the first was a column anchor bolt), an investigation was made of the torque values used to preload the anchor bolts.

To prevent recurrence of inadvertent bolt failures, the methodology of determining torque values has been reviewed and evaluated. The torque values specified on drawing 13-C-00A-001 and in specification 13-MM-510 are based upon recommendations found in literature published by bolt manufacturers using an empirical formula:

$$T = C\text{-}D\text{-}P$$

where T = Installation Torque (ft-lbs)
C = Torque Coefficient = 0.20
D = Bolt Diameter (ft)
P = Bolt Tension (lbs)

Drawing 13-C-00A-001 is based upon P = 70% Pu is the minimum tensile strength of the bolt.

Subsequent to the failure of the ASTM A354 Gr. BD stud, a testing program was conducted at the jobsite to check the tension/torque relationship. A total of 48 specimens were used, comprised of A325, A490, A354 Bd, and A193 B7 bolts in 3/4", 7/8", 1" and 1-1/4" diameters. The results are as follows: The values of C, as calculated by the equation, ranged from 0.11 (one specimen) to 0.17 (one specimen) with a mean and median value of 0.14. The mode value was 0.15. Since the torque coefficient is actually lower than assumed, the torque in the drawing table results in a tension higher than expected: e.g. (if the actual bolt strength only meets the minimum specified tensile strength and the actual torque coefficient is 0.14, then the actual tension, P, would be

$$\frac{0.20}{0.14} \quad (70\%\ Pu) = 1.00\ Pu$$

and it becomes possible for the bolt to experience combined tensile and torsional shear overload during tightening).

The new torsion coefficient for determining the installation torque does not effect the status of the bolts that have already been torqued using the previous values. The following is the justification. Torque is applied to preload a bolt, resulting in a tensile stress in the bolt. Once a bolt is preloaded, this tensile stress will be the highest stress that the bolt will experience. Therefore, once a bolt is preloaded and it does not fail when torqued, it is considered a "good" bolt. Hence all thirteen bolts are adequate.

B. Change notices are being issued to revise Drawing 13-C-00A-001 and specification 13-MM-510. A torsion coefficient of 0.16 will assure proper tightening and to minimize the likelihood of recurrence by overtorquing failure. These changes do not impact the construction procedures.

C. NCR CC-4087 has been dispositioned "Use as Is."