Arizona Nuclear Power Project
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November 28, 1984
ANPP-31264-TDS/TRB

U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane - Suite 210
Walnut Creek, California 94596-5368

Attention: Mr. D. F. Kirsch, Acting Director
Division of Reactor Safety and Projects

Subject: Final Report - DER 84-44
A 50.55(e) Reportable Condition Relating To Fatigue Failure Of The Charging Pumps.
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between D. Hollenbach and A. Ramey on July 6, 1984
B) ANPP-30128, dated August 6, 1984 (Interim Report)
C) ANPP-30634, dated September 24, 1984 (Time Extension)
D) ANPP-30954, dated October 25, 1984 (Time Extension)
E) ANPP-31160, dated November 16, 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,

EE Van Brunt/BSK

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

EEVB/TRB/nj
Attachment

cc: See Page Two

IE-27

cc: Richard DeYoung, Director
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U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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FINAL REPORT - DER 84-44
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

Combustion Engineering (C-E) advised Bechtel (Reference 4) that North East Utilities has filed a 10CFR Part 21 report relative to fatigue cracking in Gaulin charging pump blocks. The 10CFR Part 21 report identifies cracks discovered in the blocks on or about August 8, 1982, February 27, 1984 and April 4, 1984 at the Millstone Nuclear Power Station, Unit No. 2.

PVNGS utilizes three charging pumps per unit of similar design as those at Millstone in the Chemical and Volume Control System (CH). They are Model No. NP-18, three cylinder, positive displacement pumps manufactured by Gaulin Corporation and supplied by C-E.

The charging pumps operate in conjunction with the rest of the Chemical and Volume Control System to perform the following functions:

(1) Provide normal make-up water to the Reactor Coolant System (RCS) to compensate for letdown and power changes.

(2) Maintain RCS chemistry and coolant activity.

(3) Provide filtered flow to reactor coolant pump seals.

(4) Provide normal means of boron addition to the RCS.

(5) Provide make-up for small leaks in RCS (instrument and sample lines).

(6) Provide auxiliary pressurizer spray flow during later stages of cooldown when the reactor coolant pumps are not running, and/or during a loss of on- and off-site power event.

Evaluation

The topic of cracked charging pump blocks has been a concern to many utilities.

° Omaha Public Power District reported three cracked blocks in their first ten years of operation. After discovering cracks in two blocks, pulsation dampeners and suction stabilizers were installed. Cracks were found in a third block a year and a half later, but was believed to have been damaged prior to the backfit. No additional problems have been experienced in four years. These Gaulin pumps were earlier models than those used at PVNGS.

- Florida Power and Light Co. has had four individual blocks cracked in their St. Lucie 1 plant; they have not isolated the causes although inadequate suction stabilizer pressure has been observed. These pumps are ARMCO pumps.

- Arkansas Power and Light Co. has experienced two cracked blocks in the last three years; one is attributed to a loss of level in the Volume Control Tank and the other is still under investigation.

- The Millstone 2 plant has had six cracked pump blocks since 1976 (three each on ARMCO and Gaulin pumps); they are getting approximately 6000-8000 hours of operation time from each pump before it cracks. A destructive analysis by a subcontractor of one cracked Gaulin pump block was performed, and it was ascertained that an initiating flaw smaller than detectable by Gaulin inspection methods (which were in accordance with the applicable ASME Code requirements) propagated due to overstressing of the pump block. The cracks are initiated within the pump blocks and propagate between one or more of the three cylinders and the outside surface. Although the cracks appear as hairlines during pump examination, they evidently propagate and enlarge during the pump cycle and permit reactor coolant leakage. This leakage is estimated at less than two gallans per hour. In no case did any of the pumps fail to operate while in service. It is noted here that Millstone 2 historically has had serious charging system vibration problems.

  The root cause of crack propogation of the charging pump blocks is attributed to overstressing of the blocks due to piping vibration loads. Based on information provided by other utilities, it is believed that the cracks in the blocks originated from material inclusions located at or very close to the surface at the intersection(s) of bores (high stress area), and propagated due to internal cyclic working pressures. It is also suspected that the very small radii at the intersections of the machined bores contributes to these being areas of high stress concentration. The mechanism for crack initiation is not known as of this date and is still under investigation.

It is believed that the cracks propagated due to piping vibration loads. These loads are decreased via the use of suction stabilizers and discharge pulsation dampeners, which are utilized in the PVNGS piping design in the CH system. This design should minimize cracking of the pump blocks. PVNGS has not experienced cracking of any charging pump blocks to this date.

The System 80 design has two normally running charging pumps to account both for seal injection to the reactor coolant pumps and for reactor coolant makeup, the third pump is normally on standby. The design is based on one pump operation as being acceptable during periods that require maintenance on two of the three pumps due to either packing failure or a cracked block. This one pump arrangement can be accomplished provided that component cooling water is available to the reactor coolant pump seals. The limiting condition for operation is not the lack of system capability, but the condition imposed by the technical specification, typical of all C-E plants, requiring two operating charging pumps. In addition, one charging pump is capable of delivering 26 gpm to the RCS for emergency boration per the technical specification and would be available for auxiliary spray for RCS depressurization. RCS makeup for small leaks is normally provided by the charging pumps. However, if the leak rate exceeds the capacity of the available charging pummps, then the HPSI, CS or LPSI Pumps can be used for makeup by adjusting plant pressure below the respective pump shutoff head to allow for makeup and boration. Although a pump is normally secured when packing leakage reaches specified levels or when indication of a creacked block is present, in most cases these pumps could be returned to service as is and still provide emergency assistance to the operable pump in carrying out their safety function. This conclusion is based on the fact that a cracked block has not caused a pump to fail to operate.

II. Analysis of Safety Implications

It is not probable that all three charging pump blocks will crack simultaneously. Furthermore, the propagation of cracks in a charging pump block does not mean that the pump will fail to deliver required flow. (As stated, leakage through a cracked block is estimated at less than two gallons per hour.) Therefore, this condition is evaluated as not reportable under 10CFR50.55(e).

Even though for PVNGS the cracking of the charging pump blocks is not a substantial safety hazard, this condition has already been reported as 10CFR Part 21 reportable by North East Utilities. Therefore, determination of 10CFR Part 21 reportability is not required.

III. Corrective Action

A maintenance and inspection program, which is in addition to the normal maintenance and inspection required, has been submitted by C-E in Reference 8 and will be implemented. This program includes observation of the pumps on a monthly basis for indications of leakage (weeping). Also, after 3,000 hours of operation, a pump should be monitored on a weekly basis. These inspection frequencies are based on information that those Gaulin pumps which have exxperienced fatigue cracking have had from a few thousand to several thousand hours of operating time prior to cracking. If leakage indications are discovered, it is recommended that the block then be dye penetrant (DP) inspected. For example, at San Onofre Unit 2 the front cap gaskets were throught to be leaking before the crack (in a location adjacent to the gasket) was found. It is not considered necessary to institute a regular DP inspection program.

IV. References

1. Letter V-CE-30739, August 10, 1984

2. Letter V-CE-30763, August 10, 1984

3. Letter V-CE-30937, September 13, 1984

4. Letter V-CE-30348, June 6, 1984

5. Letter V-CE-31229, October 24, 1984

6. Letter B/CE-E-4937, October 2, 1984

7. Letter V-CE-31343, November 9, 1984

8. Letter V-CE-31354, November 12, 1984