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September 26, 1984 REGION V
ANPP-30663-TDS/TRB

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

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

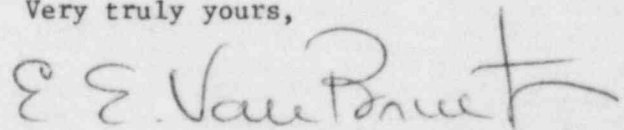
Subject: Final Report - DER 84-51
A 50.55(e) Reportable Condition Relating To Failure Of The
Turbine-Driven Auxiliary Feedwater Pump To Quick Start From
Ambient Conditions.
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between D. Hollenbach and T. Bradish
on July 24, 1984
B) ANPP-30309, dated August 23, 1984 (Interim Report)

Dear Sir:

Attached is our final written report of the Reportable Deficiency under
10CFR50.55(e), referenced above.

Very truly yours,



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

EEVB/TRB/nj
Attachment

cc: See Page Two

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Mr. T. W. Bishop
DER 84-51
Page Two

cc: Richard DeYoung, Director
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Washington, D. C. 20555

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FINAL REPORT - DER 84-51
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

The Terry Turbine which drives the Auxiliary Feedwater (AF) Pump AFA-P01 trips on overspeed when starting from a cold, ambient condition. This deficiency was identified during the performance of Unit 1 Startup testing and is documented in Nonconformance Report (NCR) SJ-4551. The turbine-driven pump is one of the two essential Q-Class pumps which are required to perform the following:

- a) To maintain water inventory in the steam generators during emergency operation when the main feedwater system is inoperable.
- b) To provide feedwater to the steam generators for the removal of decay heat from the reactor coolant system under accident conditions.

In addition, the turbine-driven AF pump has the unique safety design requirement that it shall be available in the event of a loss of AC power.

The C-E interface requirements specify that auxiliary feedwater be delivered to the steam generators within 20 seconds of receiving an Auxiliary Feedwater Actuation Signal (AFAS). The Terry Turbine Instruction Manual, Bechtel Log No. M021-158 specifies that care must be exercised on an emergency quick start so that the turbine is not "tripped out" on overspeed by too fast an acceleration rate (for governor control) from opening the turbine stop valve too quickly. In the Palo Verde design, the turbine stop valve (trip and throttle valve) is normally kept open. Steam is supplied by opening upstream steam supply and bypass valves as shown on the attached sketch.

Evaluation (refer to sketch, attached)

During an emergency shutdown condition, following the initiation of an AFAS, the steam supply valves receive a signal to open in order to start the steam turbine. Upon receipt of an AFAS signal, the solenoid-operated bypass valves open to bring the turbine up to idle speed prior to full steam admission. An adjustable Agastat relay provides a time delay prior to opening the supply valves. In the original design the idle speed was set at 1300 rpm and the steam supply valves opened five seconds after the solenoid bypass valves received a signal to open.

Evaluations have indicated that the five-second delay is not sufficient to allow for the warming up of the lines and pump casing and attain the turbine idle speed. Since the turbine speed control system maintains the governor valve in a full open position until the idle speed is reached, the start of main steam admission within five seconds after the initiation of a turbine startup command results in the entry of "ungoverned" steam flow to the turbine causing an overspeed condition and consequently the rapid closure of the trip and throttle valve.

The solution to this problem is to make the necessary design changes in order to establish the turbine idle speed and place the turbine on governor control prior to the admission of full steam flow. This objective is being accomplished by the implementation of the following modifications:

1. The 5-second delay time has been changed to 10 seconds.
2. The discharge piping from the two solenoid bypass valves has been routed to a single orifice with an injection point closer to the turbine. This modification allows the sizing of a single orifice rather than two parallel orifices, as well as reducing the mass of pipe requiring heating before the turbine reaches idle speed. One orifice assures the same bypass steam flow to the turbine with one AFAS signal or two AFAS signals which corresponds to one steam admission valve or both steam admission valves opening.
3. The idle speed was reduced from 1300 rpm to 800 rpm.
4. The governor ramp start has been delayed until the steam admission valves are full open. In the original design, the ramp began as soon as the admission valves came off their seat.
5. The condensate drains on both the turbine casing and the steam supply piping are being modified to increase the capacity of the low point drain system to eliminate the condensate generated during the warm-up period prior to a cold start.

The changes described in Items 1 through 4 above have been implemented and the turbine has undergone five successful cold starts. The average time required for the turbine to start from cold and reach rated speed has been 19 seconds. Combustion Engineering has performed an analysis and has accepted a 30-second interface requirement in lieu of the previously established 20 seconds for delivery of the rated feedwater flow to the steam generators following the generation of an AFAS (Ref. V-CE-30850, August 28, 1984).

II. Analysis of Safety Implications

The turbine-driven auxiliary feedwater pump is essential for plant safety. It is one of the two redundant pumps that delivers emergency feedwater to the steam generators following a main steam line break or a main feedwater line break inside the containment, or steam generator tube rupture.

Of the two redundant pumps, it is given operating priority.

Based on the above, this condition is evaluated as reportable under the requirements of 10CFR50.55(e); since, if this condition were to remain uncorrected, it would represent a significant safety condition.

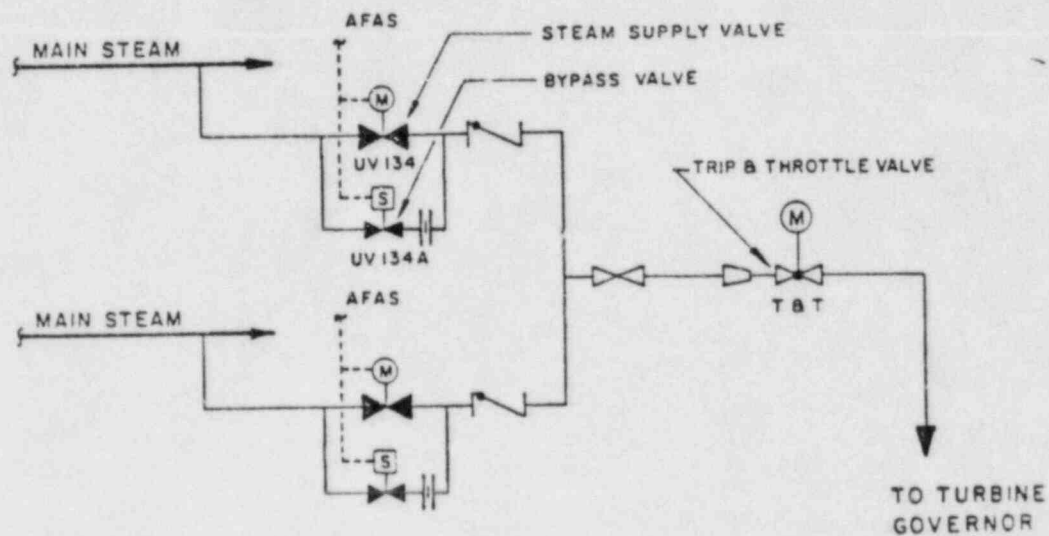
The project has evaluated this condition as not reportable under 10CFR21, since the subject system had not been turned over for use by operations.

III. Corrective Action

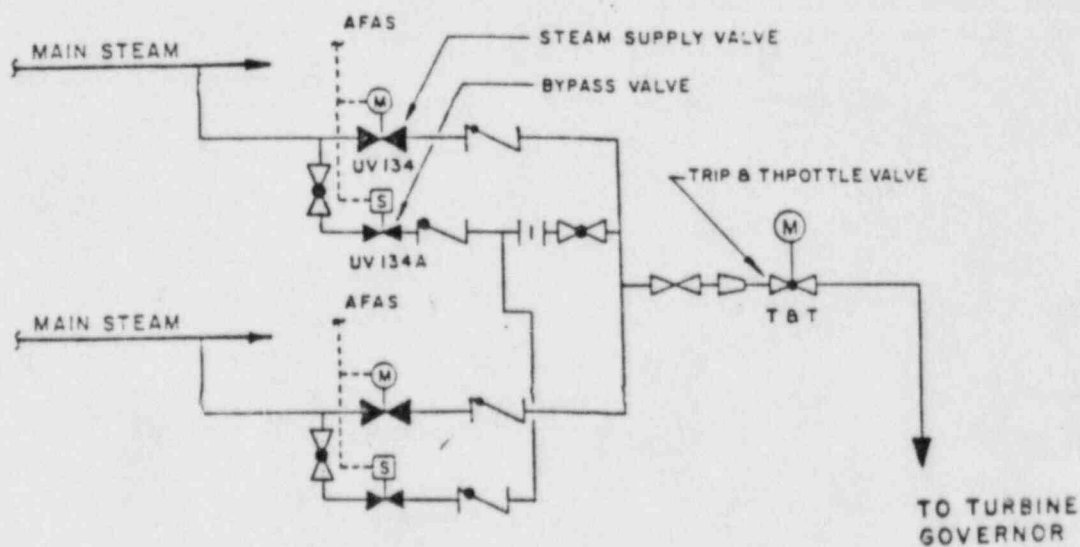
Design Change Package (DCP) No. 1SM-AF-077 has been issued and implemented on Unit 1 to make the changes listed under Section II, Items 1 through 4. Units 2 and 3 will be modified per DCP Nos. 2SM-AF-077 and 3CM-AF-077 respectively.

DCP No. 1SM-AF-078 will be issued to implement the modifications listed under Section II, Item 5, on Unit 1. These modifications will be complete prior to fuel load. DCP Nos. 2SM-AF-078 and 3CM-AF-078 will be issued to modify Units 2 and 3 respectively.

Bechtel Revision 3 to the C-E interface requirement (Bechtel Log Number N001-22.01-9) and SAR Change Notice 1239 have been initiated to reflect the feedwater delivery time change from 20 seconds to 30 seconds.



BEFORE MODIFICATION



AFTER MODIFICATION

SKETCH FOR DER 84-51