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September 14, 1984
ANPP-30519-TDS/TRB

REGION V T&E

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 83-42
A 50.55(e) Reportable Condition Relating To Thermowells In The
Reactor Coolant System.
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between P. Johnson and J. Roedel on
June 29, 1983
B) ANPP-27398, dated July 25, 1983 (Interim Report)
C) ANPP-27852, dated September 21, 1983 (Time Extension)
D) ANPP-28320, dated November 30, 1983 (Time Extension)
E) ANPP-28575, dated January 9, 1984 (Time Extension)
F) ANPP-28733, dated January 27, 1984 (Interim Report, Rev. 1)
G) ANPP-29714, dated June 11, 1984 (Time Extension)
H) ANPP-30191, dated August 13, 1984 (Time Extension)
I) Telephone conversation between P. Narbut and T. Bradish on
August 14, 1984

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 / TRB

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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PDR ADOCK 05000528
S PDR

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Mr. T. W. Bishop
DER 83-42
Page Two

CE Doc. No. CEN-265(V)-P
- Revision 1-P -
Proprietary Copies

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U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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File: DER 83-42 #38

* Non-Proprietary Copy Attached

FINAL REPORT - DER 83-42
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

While performing pre-core hot functional testing (HFT) of the RCS at Unit 1 in June 1983, it was reported that thermowells installed in the hot and cold legs of the RCS were not maintaining the pressure boundary and were emitting steam from their respective temperature elements. The thermowells were identified by tag numbers 1JRCA-TW-112CA, 1JRCC-TW-112CC, 1JRCA-TW-122CA, 1JRCD-TW-112CD, and 1JRCE-TW-111Y. The subject thermowells were supplied by Combustion Engineering (C-E).

Evaluation

The RCS pressure boundary must be maintained to ensure safe operation of the unit. Devices installed in the RCS piping that do not maintain pressure boundary integrity are unacceptable.

A review and analysis of the thermowell deficiencies by C-E (Ref. 1) determined that the principal failure mechanism was flow-induced vibration fatigue caused by vortex shedding. Relative motion between the thermowells and the nozzles as a result of flow-induced vibration and the close proximity of the thermowell's natural frequency to the vortex-shedding frequency caused wear on the nozzles and thermowells which contributed to the failures. In some cases shearing and/or bending of thermowells in the cold legs was also due to impact from heavy objects in the flow stream. C-E also indicated that the cold leg flows were greater than those postulated in their analysis of the RCS system, i.e., single pump operation at runout.

The C-E review concluded that the thermowells did not have adequate design strength to overcome the affects of the flow-induced vibration and that a modified nozzle/thermowell design is required to satisfy objectives as follows:

1. Increase the natural frequency of the thermowell to move it away from the potential vortex shedding frequency.
2. Eliminate the clearance and, thus, the motion at the support between the thermowell and nozzle.
3. Reduce stress levels.
4. Decrease the affects of vortex shedding.

II. Analysis of Safety Implications

Based on the fact that thermowell failures violated the RCS pressure boundary integrity, this condition is evaluated as reportable under the requirements of 10CFR50.55(e), since extensive repair is required; and, if the condition were to remain uncorrected, it would represent a significant safety condition. This condition is also evaluated as reportable under the requirements of 10CFR21.

In Reference (3), Discussion of Safety Implications, C-E points out that failure of several thermowells would not jeopardize safe operation since the leakage is controlled by the nozzle orifice and the charging pumps are capable of making up the loss of coolant. However, since the RCS pressure boundary was violated, C-E concurs that their reportability assessment (Reference 1) is still applicable.

III. Corrective Action

A. Reference (2) provides that C-E will replace the originally supplied thermowells and nozzles in Units 1, 2, and 3 (30 thermowells and nozzles per Unit) with redesigned thermowells and nozzles. Because of the clearance and fitup requirements, each thermowell is matched by serial number to a nozzle location and nozzle serial number for final installation.

Bechtel has issued DCPs 1SM-RC-101, 2SM-RC-101, and 3CM-RC-101 to replace the thermowells identified by tag numbers as follows and their respective nozzles.

<u>Unit 1</u>	<u>Unit 2</u>	<u>Unit 3</u>
1JRCA-TW-112CA	2JRCA-TW-112CA	3JRCA-TW-112CA
1JRCE-TW-112CB	2JRCE-TW-112CB	3JRCE-TW-112CB
1JRCC-TW-112CC	2JRCC-TW-112CC	3JRCC-TW-112CC
1JRCD-TW-112CD	2JRCD-TW-112CD	3JRCD-TW-112CD
1JRCE-TW-111X	2JRCE-TW-111X	3JRCE-TW-111X
1JRCE-TW-111Y	2JRCE-TW-111Y	3JRCE-TW-111Y
1JRCA-TW-112HA	2JRCA-TW-112HA	3JRCA-TW-112HA
1JRCE-TW-112HB	2JRCE-TW-112HB	3JRCE-TW-112HB
1JRCC-TW-112HC	2JRCC-TW-112HC	3JRCC-TW-112HC
1JRCD-TW-112HD	2JRCD-TW-112HD	3JRCD-TW-112HD
1JRCA-TW-115	2JRCA-TW-115	3JRCA-TW-115
1JRCE-TW-121X	2JRCE-TW-121X	3JRCE-TW-121X

<u>Unit 1</u>	<u>Unit 2</u>	<u>Unit 3</u>
1JRCE-TW-121Y	2JRCE-TW-121Y	3JRCE-TW-121Y
1JRCA-TW-122CA	2JRCA-TW-122CA	3JRCA-TW-122CA
1JRCB-TW-122CB	2JRCB-TW-122CB	3JRCB-TW-122CB
1JRCC-TW-122CC	2JRCC-TW-122CC	3JRCC-TW-122CC
1JRCD-TW-122CD	2JRCD-TW-122CD	3JRCD-TW-122CD
1JRCA-TW-122HA	2JRCA-TW-122HA	3JRCA-TW-122HA
1JRCB-TW-122HB	2JRCB-TW-122HB	3JRCB-TW-122HB
1JRCC-TW-122HC	2JRCC-TW-122HC	3JRCC-TW-122HC
1JRCD-TW-122HD	2JRCD-TW-122HD	3JRCD-TW-122HD
1JRCE-TW-125	2JRCE-TW-125	3JRCE-TW-125
*1JRCA-TW-111HA	*2JRCA-TW-111HA	*3JRCA-TW-111HA
*1JRCB-TW-111HB	*2JRCB-TW-111HB	*3JRCB-TW-111HB
*1JRCC-TW-111HC	*2JRCC-TW-111HC	*3JRCC-TW-111HC
*1JRCD-TW-111HD	*2JRCD-TW-111HD	*3JRCD-TW-111HD
*1JRCA-TW-121HA	*2JRCA-TW-121HA	*3JRCA-TW-121HA
*1JRCB-TW-121HB	*2JRCB-TW-121HB	*3JRCB-TW-121HB
*1JRCC-TW-121HC	*2JRCC-TW-121HC	*3JRCC-TW-121HC
*1JRCD-TW-121HD	*2JRCD-TW-121HD	*3JRCD-TW-121HD

*Hot leg anomaly thermowell and nozzle. No resistance temperature detector (RTD) instrument is installed.

These DCPs also provided for changing the RTDs for improved time-response characteristics, i.e., single element RTDs, from RdF part No. (P/N) 21233 to P/N 21458, and dual element RTDs from P/N 21252 to P/N 21459.

- B. NCRs SJ-2201, SM-2185, and SM-2249 have been dispositioned in accordance with the respective DCPs.
- C. A copy of this report will be sent to Combustion Engineering for their review and disposition under the requirements of 10CFR 21.
- D. Combustion Engineering will revise drawings, manuals, and qualification documents to incorporate the re-designed thermowells and nozzles and the upgraded RTDs.

- E. A demonstration test was performed on the Unit 1 RCS during July and August, 1984 to confirm that the redesigned nozzle/thermowell assemblies exhibited insitu responses consistent with results obtained during previous tests and by analysis. Various thermowells were equipped with internal accelerometers to determine tip deflections. Accelerometers were also mounted on the RCS pipe at the RTD locations to determine pipe motion and to verify input. The maximum allowable deflection of a thermowell tip for an infinite number of cycles was calculated to be 3.0 mils based on the endurance limit of the material. The results of the test showed the peak thermowell tip displacement to vary between .23 to .62 mils for runout flow conditions and .17 to .36 mils for normal operating conditions.

The test results have verified the redesigned thermowell/nozzle assembly to be satisfactory.

A detailed description of the investigative and testing program, the results, and the physical modifications performed, is included in Reference (3).

IV. References

- (1) Letter, V-CE-18813, August 16, 1983
- (2) Letter, V-CE-19093, October 6, 1983
- (3) Letter, V-CE-30902, September 6, 1984
C-E's Proprietary Final Report CEN-287(V)-P,
Rev. 1-P, Palo Verde Unit 1 Resistance Temperature
Detector Thermowell

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JLB

C-E Power Systems
Consultation Engineering
1000 Prospect Hill Road
Windsor, Connecticut 06095

Tel. 203/688-1911
Telex 99297

NSUC CENTER

84-001-419.1



September 6, 1984
V-CE-30902

Mr. E. E. Van Brunt, Jr.
Arizona Nuclear Power Project
P. O. Box 21666 - Sta. 3003
Phoenix, Arizona 85036

Subject: 10 CFR 50.55(e) Report on the Palo Verde RTD Thermowells

Dear Mr. Van Brunt:

Enclosed for your submittal to the Nuclear Regulatory Commission is the 10 CFR 50.55(e) report on the Palo Verde RTD Thermowells along with the proprietary affidavit. Copies 1 through 25 of the proprietary report are intended for submittal to the NRC. Copies 26 through 43 are provided for APS use. In addition, thirty-five copies of the non-proprietary version are also enclosed. This report is a final report and is considered complete.

If you have any questions feel free to call.

Very truly yours,

Steven R. McCoy

C. Ferguson
Project Manager

or

CF/TJC:jld
Enclosures

- cc: D. B. Amerine w/copy 45
- W. G. Bingham w/copy 44
- T. R. Bradish
- G. A. Butterworth
- J. R. Bynum
- J. W. Dilk
- R. H. Holm
- W. L. MacDonald
- W. H. Wilson
- W. F. Quinn

*To Assign		<i>WED</i>
ANPP Management Distribution	Resp. Mgr./Supv	
	ACG	
	GCA	
	<i>DBK</i>	<i>Vene</i>
	SCJ	<i>N. Pozly</i>
	BEK	
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	ACR	<input checked="" type="checkbox"/>
	WEI	
	BFG	
	ELL	
	<i>TRB</i>	<i>Vene</i>
	<i>WFO</i>	<input checked="" type="checkbox"/>
	<i>JDS</i>	<input checked="" type="checkbox"/>
*BEVB, Jr.	<input checked="" type="checkbox"/> enc.	
ROUTE		
F-U		
File		<i>84-001-419.1 enc.</i>

AFFIDAVIT PURSUANT

TO 10 CFR 2.790

Combustion Engineering, Inc.)
State of Connecticut)
County of Hartford) SS.:

I, A. E. Scherer, depose and say that I am the Director, Nuclear Licensing, of Combustion Engineering, Inc., duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations and in conjunction with the construction permit of Arizona Public Service Company, for withholding this information.

The information for which proprietary treatment is sought is contained in the following document:

CEN-265(V)-P Revision 1-P, Report on Palo Verde Unit 1 Resistance Temperature Detector Thermowell.

This document has been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by Combustion Engineering in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1. The information sought to be withheld from public disclosure are the design and test results pertaining to high response thermowells, which is owned and has been held in confidence by Combustion Engineering.

2. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a substantial competitive advantage to Combustion Engineering.

3. The information is of a type customarily held in confidence by Combustion Engineering and not customarily disclosed to the public. Combustion Engineering has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The details of the aforementioned system were provided to the Nuclear Regulatory Commission via letter DP-537 from F.M. Stern to Frank Schroeder dated December 2, 1974. This system was applied in determining that the subject document herein are proprietary.

4. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

5. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

6. Public disclosure of the information is likely to cause substantial harm to the competitive position of Combustion Engineering because:

a. A similar product is manufactured and sold by major pressurized water reactor competitors of Combustion Engineering.

b. Development of this information by C-E required thousands of man-hours of effort and hundreds of thousands of dollars. To the best of my knowledge and belief a competitor would have to undergo similar expense in generating equivalent information.

c. In order to acquire such information, a competitor would also require considerable time and inconvenience related to high response thermowells design and testing.

d. The information required significant effort and expense to obtain the licensing approvals necessary for application of the information. Avoidance of this expense would decrease a competitor's cost in applying the information and marketing the product to which the information is applicable.

e. The information consists of high response thermowell and test results, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with Combustion Engineering, take marketing or other actions to improve their product's position or impair the position of Combustion Engineering's product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

f. In pricing Combustion Engineering's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of Combustion Engineering's competitors to utilize such information

without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

g. Use of the information by competitors in the international marketplace would increase their ability to market nuclear steam supply systems by reducing the costs associated with their technology development. In addition, disclosure would have an adverse economic impact on Combustion Engineering's potential for obtaining or maintaining foreign licensees.

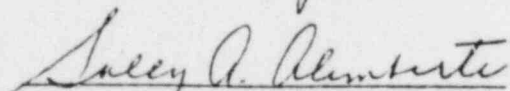
Further the deponent sayeth not.



A. E. Scherer
Director
Nuclear Licensing

Sworn to before me

this 6th day of September, 1984



Notary Public

my commission expires 3/31/86