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Arizona Public Service Company

1984 JUL 23 PM 2:28

July 18, 1984 REGION VICE  
ANPP-29987-TDS/TRB

U. S. Nuclear Regulatory Commission  
Region V  
Creskide 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

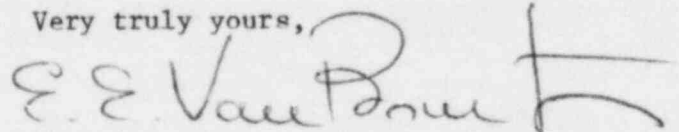
Subject: Final Report, Revision 1 - DER 82-37  
A 50.55(e) Reportable Condition Relating To Class 1E Wiring  
Terminations Crimped With Less Pressure Than Specified, Due To  
Lack Of Maintenance Program And Traceability For AMP Hydraulic  
Crimp Tools.  
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between T. Bishop and G. Duckworth  
on July 13, 1982  
B) ANPP-21591, dated August 10, 1982 (Interim Report)  
C) ANPP-22139, dated October 28, 1982 (Time Extension)  
D) ANPP-22278, dated November 15, 1982 (Final Report)

Dear Sir:

Enclosed is revision one of the subject Deficiency Evaluation Report  
under the requirements of 10CFR50.55(e). This revision restates the  
Corrective Action taken for this condition.

Very truly yours,



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

EFVB/TRB:db  
Attachment

cc: See Page Two

8408010346 840718  
PDR ADOCK 05000529  
S PDR

11  
IE-27

Mr. T. W. Bishop  
DER 82-37  
Page Two

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

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FINAL REPORT - REVISION 1 - DER 82-37  
DEFICIENCY EVALUATION 50.55(e)  
ARIZONA PUBLIC SERVICE COMPANY (APS)  
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

As requested by an NRC inquiry, the operating pressure to hydraulic crimping tools used for electrical terminations were checked in accordance with the vendor's instructions.

MP Hydraulic Pump Crimping Tools catalog no. 69120 were found to be operating at 4500 psi which is less than 8000 psi as specified by AMP in their Customer Manual CM1950. This condition was considered questionable because of the uncertainty as to whether the electrical terminations were adequately crimped to assure safety related functions.

No program has been initiated to assure correct tool usage, assure periodic maintenance for these hydraulic crimp units (22), or provide traceability of specific tool applications used in conjunction with the log termination on wire sizes 2/0 through 750 MCM.

AMP Special Industries has reviewed this condition and has conducted conclusive testing (see attachments A, B, C & D) on samples taken from the ANPP jobsite. Sample wire sizes 2/0, 4/0, 250 MCM, 350 MCM and 700 MCM were terminated by Bechtel site people at (1) 4500 psi and (2) 3200 psi and forwarded to vendor for tensile strength tests. The vendor also performed Mil-volt drop testing on additional wire samples of the same sizes but which were terminated by the vendor at 4500 psi and 8200 psi crimp pressures.

The results of the tensile strength tests (summarized in Table I attached) demonstrates that ANPP samples crimped at 4500 psi well exceeded UL-486A and Military specification MIL-T-7928G requirements.

The Mil-volt drop tests show that little volt drop difference occurs when injecting amperes through termination lugs crimped at pressures ranging from 8200 - 4500 psi. The results of these tests are summarized in Table II attached.

Although the tests were not performed at ampere loads provided in the MIL-T 7928G Standard the corresponding voltage drops for the maximum allowed wire ampacity figures, per Project Design Criteria (slightly higher than the tested values) are not expected to exceed the Maximum allowed by the MIL-T 7928G Standard. It is therefore concluded that the wire sizes 2/0 - 750 MCM that were crimped with lugs by AMP Tool crimp pressures of 4500 - 8200 psi are adequate for the intended purpose.

Mr. T. W. Bishop  
ANPP-29987  
Page Two

## II. Analysis of Safety Implications

This condition as described in Section I does not present a safety significant condition. However, it is evaluated as reportable under the requirements of 10CFR50.55(e) because this condition represents a breakdown in the Quality Assurance Program. The lack of surveillance to ensure compliance with established vendor requirements for proper crimping in accordance with the electrical specification (13-EM-306) is considered an extensive deviation as defined by the regulation.

## III. Corrective Action

Work Plant Procedure/Quality Control Instruction 255.0 has been revised to require that a maintenance and check program for the hydraulic crimp units be implemented. This procedure is applicable to Units 1, 2, and 3. Each Hydraulic Crimp Unit shall be serialized to allow traceability of tool application, to ensure that terminations are performed at specified crimping pressures and that correct dies have been utilized in accordance with the vendor's instruction as outlined in their Customer Manual CMI950 and telex dated 3/19/84 (attachment D). All future lug terminations for the subject wire sizes shall therefore be crimped at a minimum of 7900 psi. The serial no. will be included on each applicable EE-580 card.

The referenced NCR will be dispositioned us -as-is since the terminations already completed are adequate.

TABLE I

Wire Size	Test Tensile Strength Pounds	UL-468A Tensile Strength Pounds (Min)	MIL-T-7928G Tensile Strength Pounds (min)
2/0	943	300	750
4/0	2243	450	875
250MCM	1859	500	1000
350MCM	1819	600	1125
500MCM	2821	800	1500
700MCM	4939	1000	2000

Summarization of Tensile Strength Test Results  
on Wire Samples Termined by Bechtel Crimping  
Tools at 4500psi - See Attachment A

TABLE 11

Wire Size	Conductor Allowable Ampacity (Project Design Criteria) (Amps)	Test Current by Amp (Amps)	Corresponding max. Mil-volt Drop Results		MIL-T-7928G	
			At 8200psi	At 4500psi	Test Current (Amps)	Mil-volt Drop (Max.)
2/0	182	150	1.47	1.44	283	4
4/0	249	225	2.36	2.12	380	6
250MCM	281	250	2.63	2.54	540	6
300MCM	343	300	2.99	2.96	670	6
500MCM	427	400	2.50	2.34	860	6
700MCM	517	500	2.74	2.58	1190	6

Summarization of Mil-volt Drop Test Results on  
 Bechtel Wire Samples terminated by Vendor  
 Crimping tools at (1) 4500 psi and (2) 8200 psi  
 (See Attachment B)



Valley Forge Penna 19482  
(215) 647-1000

July 20, 1982

EPV N  
R0344  
EM/106A

Bechtel Power Corporation  
Palo Verde Nuclear Generating Station  
P.O. Box 49  
Phoenix, Arizona 85343

Attention: Mr. Bill Saylor

Dear Mr. Saylor,

The sample wire that you submitted to my attention and the terminations that you made on the site have been tested in records in Tensile. The terminations and terminals identified by wire markers, the report and the samples are being submitted to your attention.

We are taking the testing one (1) step further: We crimped on your wire on one end at 4500 P.S.I. and the other end at 8200 P.S.I. I am submitting these samples, a total of twelve (12), two each of: 2/0, 4/0, 350, 250, 500 and 750 MCM to our Environmental Test Lab in Harrisburg, Pennsylvania for MIL-VOLT Drop testing. I placed an urgency on this request and as soon as I receive the results, I will call you prior to forwarding the reports.

I would like to mention, one (1) of your samples, 500 MCM was crimped in the reverse position. Another sample, 750 MCM was crimped with the wrong die, 800 MCM. In all cases, samples crimped at 4500 P.S.I. well exceeded the UL and Military Specifications with the exception of one (1) sample: 2/0, #6, circled 680 pounds. The reduction in Tensile was contributed to the wire not being inserted to its fullest. So, actually, #6 could be ignored. It just goes to show you how important it is to have the wire all the way in the terminal barrel.

If you have any further questions in regards to this report, please do not hesitate to contact me.

Regards,

AMP SPECIAL INDUSTRIES

*Ted Updegrave*  
Ted Updegrave,  
Manager, Quality Assurance

EWU:mrt

Attachments

cc: Q.A. Retention File

RECEIVED

JUL 20 1982

CONSTRUCTION  
PVNCS

# TENSILE TEST

SPECIFICATION NO. 1514

TECHNICIAN DR  
 AMBIENT TEMPERATURE 72  
 RELATIVE HUMIDITY 75

TEST NO. 769  
 PAGE 1 OF 1  
 DATE 1-1-68

ATTACHMENT A DER 82-37  
 (sheet 2 of 2)

SPECIMEN NUMBER										REMARKS	
3/0	Aval.	4/0		5/0		6/0		7/0		HEAD SPEED INCHES/ MINUTES	
		LBS.	TYP.	Sample No.	LBS.	TYP.	Sample No.	LBS.	TYP.		
1	1120 A	8	G	15	1500 A	32	1600 A	36	1600 A		
2	1040 A	9	G	16	1750 A	23	1750 A	37	1750 A		
3	900 A	10	A	17	1740 A	24	1740 A	38	1740 A		
4	940 A	11	A	18	1740 A	25	1740 A	39	1740 A		
5	1010 A	12	G	19	1740 A	26	1740 A	40	1740 A		
6	1000 A	13	G	20	1740 A	27	1740 A	41	1740 A		
7	110 A	14	G	21	1740 A	28	1740 A	42	1740 A		
Backed Samples		Backed Samples		Backed Samples		Backed Samples		Backed Samples			
# 6 & 7		# 13 & 14		# 20 & 21		# 27 & 28		# 34 & 35			
UL - 300 lbs		UL - 450		UL - 600		UL - 500		UL - 1000			
MTL - 750 lbs		MTL - 875		MTL - 1125		MTL - 1000		MTL - 1500			
										MINIMUM	
										MAXIMUM	
										AVERAGE	

*9 meaning*

KEY TO TYPE OF FAILURE  
 "A" PULLED OUT  
 "G" HALF BROKE

"G" BROKE OUTSIDE GRIP  
 "A" BROKE INSIDE GRIP

✓ "G" BROKE BETWEEN CARREL AND STUD HOLE  
 "A" BROKE INSIDE STUD HOLE





AMP  
SPECIAL  
INDUSTRIES

ATTACHMENT B  
(Sheet 1 of 2)

DER 82-37

Valley Forge, Penna 19482  
(215) 647-1000

August 17, 1982

Bechtel Power Corporation  
P.O. Box 49  
Palo Verde, Arizona 85343

Attention: Bill Saylor

Subject: Millivolt Drop on Cable Terminations: 2/0, 4/0, 250, 350, 500 & 700  
Terminated at: 8200 P.S.I. & 4500 P.S.I.

Dear Bill,

The tests conducted at AMP Environmental Lab, Harrisburg, Pennsylvania, are attached.

As mentioned in the subject of this memo, we terminated six (6) cable sizes supplied by you with the Hydraulic Unit set at 8200 P.S.I. and the same amount of samples terminated at 4500 P.S.I. As you will notice by the report, there was little difference between the two (2). The test currents used are those defined in the MIL-T-7928G Specification. This report along with the Tensile data previously submitted to you, I hope will be of great value. There is no charge for these two (2) test reports.

I am sorry for any inconvenience you have encountered and hope we can maintain a good customer/vendor relationship and continue to supply you with high quality products.

Should you have any comments or questions regarding these test reports, please contact me at your convenience.

Regards,

AMP SPECIAL INDUSTRIES

*Ted Updegrave*  
Ted Updegrave,  
Manager, Quality Assurance

EWU:mrt

cc: W. Bingham  
C. Brown  
B. Eister  
L. Pendergast  
E. Reichert  
G. Richards  
Q. A. Retention File

Attachments

TEST RECORD  
ENVIRONMENTAL LABORATORY

ATTACHMENT B  
(sheet 2 of 2)

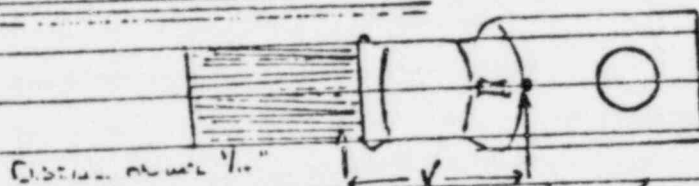
TV	3P TEST	TEST NO.
(VVL) AT	Heating	STR. 4763
DATE STARTED	DATE FINISHED	PAGE
8-17-82	8-17-82	1 of 1

TEST DATA

DER 82-37

VOLTAGE DROP AT HEATING CURRENT

FR. EX. POINTS



		MILLIVOLT (DAP)		TEST CURRENT USED
SAMPLE #		Positive Amps	1500	DC
				1500amps
A	2/C	137	141	
B		147	136	
				225amps
A	4/C	277	212	
B		236	212	
				250amps
A	250	254	254	
B	250	263	237	
				300amps
A	300	292	276	
B	300	297	264	
				400amps
A	500	244	234	
B	500	250	218	
				500amps
A	700	259	256	
B	700	274	258	

TEST RESULTS: No abnormal difference in performance at a heating current was noticed.

EQUIPMENT USED: Power Supply CR-666

SHUNT E-1682

BY: [Signature] DATE: 8-17-82

AMBIENT TEMPERATURE

79.1

RELATIVE HUMIDITY

51%

TECHNICIAN

[Signature]

BECHTEL PLVR

BECHTEL PLVR

AMPRD B BERN

3/4/83

ATTN: V.F. STUBBLEFIELD/D. BORGER

REF: 69120 ELECTRIC HYDRAULIC CRIMPING UNIT

UPON EVALUATION BY AMP HYDRAULIC ENGINEERS, THE FOLLOWING INFORMATION WAS COMPILED AND PASSED ON TO YOU TO SHOW OR DISCUSS W/YR QUALITY ENGINE PERSONNEL. THE MAIN PURPOSE OF HAVING THE 69120 UNIT SET W/PEAK KICK-OFF PRESSURE OF 8000-8200 P.S.I. IS TO HANDLE THE LARGEST CABLE RECOMMENDED BY YR UNIT: ONE MILLION MCM CABLE.

IT WAS FOUND THAT THE UNIT SET AT 7300 P.S.I. DELIVERS A FORCE OF 50,600 LBS. WE KNOW W/AVAILABLE DATA THAT 41,500 LBS IS REQUIRED TO MAKE A 750MCM CRIMP THAT WILL MEET ALL SPECIFICATIONS IN REGARDS TO TENSILE, MILLIVOLT, VIBRATION, ETC. SO, THE DIFFERENCES BETWEEN 41,500 TO 50,600 LBS GIVES YOU A 22 PERCENT SAFETY FACTOR AT 7300 P.S.I., CRIMPING 750MCM. BUT, KEEP IN MIND, AT ANY TIME YOU FIND YR UNIT BELOW THE SPECIFIED PRESSURE OF 8000-8200, RESET YR UNIT TO THESE PRESSURES. SO IN ESSENCE, WHAT I AM SAYING IS IF YOU HAVE MADE ANY CRIMPS AT 7300 ON 750MCM YOU WILL HAVE NO PROBLEMS.

SHOULD YOU NEED ADDITIONAL INFO., PLS CONTACT THIS OFC.

EDWARD W. UPDEGRAVE  
MGR. QUALITY ASSURANCE  
AMP SPECIAL INDUSTRIES  
BERYIN, PA.  
TELEX: 345405

AMPRD B BERN

BECHTEL PLVR  
.....?

ATTACHMENT D

DER 82-37

2307  
BECHTEL PLUR

3719/84

13EM-106A

ATTN: DALE BORGER

REF: CUSTOMER MANUALS 1950 & 1980

ON THE HYDRAULIC FOOT PUMP & THE ELECTRICAL HYDRAULIC, THE PRESSURE IS FACTORY SET V/A MIN. OF 3000 PSI TO A MAX. OF 3400 PSI. WE BOTH KNOW THAT HYDRAULIC PRESSURES FLUCTUATE W/DIFFERENT MAT'LS UNDER COMPRESSION, LOSS OF OIL, DIFFERENT LENGTHS OF HOSES, & SMALL & LARGE CYLINDRICAL HEADS. THIS IS THE REASON FOR THE 3000 TO 3400 SPREAD. THE UNITS ARE TESTED AT 13,000 PSI AS A SAFETY FACTOR IN THE FACTORY, BUT THROUGH EXTENSIVE TESTING, WE AT AMP KNOW THAT 300 PSI IS ALL THAT IS REQ'D FOR ONE MILLION CMA CRIMPS. IF THE UNIT FLUCTUATES TO 1900 TO 3500 PSI, THERE IS NO HARM DONE & THE END CRIMP WILL MEET THE SPECS. KEEP IN MIND, THE PISTON BOTTOMS INSIDE THE HEAD GIVING YOU EACH & EVERY TIME THE SAME CRIMP DIE DIMENSION. IN ORDER TO CALIBRATE THE UNIT THERE ARE TWO (2) WAYS OF ACCOMPLISHING THIS FEAT:

1. IN ALL CASES, THE END OF THE HOSE MUST EITHER HAVE THE HEAD ON THE END OF THE HOSE & A TAGE USED ON THE UNIT OR,
2. REMOVE THE HEAD & PLACE THE TAGE ON THE END OF THE HOSE.

CORRECTION: MIDDLE OF PARA, SHOULD RD:

BUT THROUGH EXTENSIVE TESTING, WE AT AMP KNOW THAT 3000 TO 3400 PSI IS ALL THAT IS REQ'D ...

IF YOU HAVE ANY QUESTIONS, PLS CONTACT MY OFC.

TED UPDEIRAVE  
AMP SPECIAL INDUSTRIES  
BETHVYN, PA  
AMP#RD 4-1<