UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of PACIFIC GAS AND ELECTRIC COMPANY (Diablo Canyon Nuclear Power Plant, Units 1 and 2)	Docket Nos. 50-275 50-323 Construction Quality Assurance

AFFIDAVIT OF H. R. ARNOLD, F. C. BREISMEISTER AND R. K. RHODES

STATE OF CALIFORNIA)
) ss.
COUNTY OF SAN LUIS OBISPO)

The above, being duly sworn, depose and say:

I, Howard Arnold, am Instrumentation Engineer for the H.P. Foley Company.

I, Fred C. Breismeister, am Manager of the Research and Engineering/Materials and Quality Services Department, San Francisco Office for the Bechtel Group.

I, R. Keith Rhodes, am Technical Services Supervisor for Pacific Gas and Electric Company.

OFFICIAL SEAL
IDA DUTRA
NOTARY PUBLIC - CALIFORNIA
SAN LUIS OBISPO COUNTY
My comm. expires JAN 2, 1987

JI #112, Motion at 32.

It is alleged that:

> The procedures themselves may not be reliable, due to manipulation of procedure qualification tests. The same procedure to install copper and stainless steel tubing for the instrument systems flunked at least twice at an independent laboratory before it produced minimally acceptable work. The results are unlikely to be any better in the plant, since the test sample was produced under ideal conditions. A 33% pass rate, or worse, could be disastrous during an accident. (citing 1/16/84 Anon. Aff. at 7-8.)

1. This allegation is completely false. The procedures in question were qualified prior to their use. Results from qualification tests of these procedures demonstrate their acceptability. The braze procedure qualification tests assure that the braze procedure will produce a joint with sufficient tensile strength to perform its design function. The allegation in the JI Motion is incorrect in stating that the same brazing procedure is used for copper and stainless steel; separate procedures for each material are used. The procedure did not "flunk" at least twice and where the "33% pass rate" reference came from is totally nondiscernable.

2. Brazing is used to join small diameter stainless steel tubing used for sensing instrument lines, sampling lines, instrument air lines and other applications. The brazing process for stainless steel consists of a ring of preplaced filler metal alloy (largely silver) inserted into a braze sleeve followed by fit up of the tube. A ring torch is used to melt the preplaced filler ring and capillary action causes the filler material to flow through the sleeve.

3. The brazing process used at Diablo Canyon is the optimum technique since it requires the use of a preplaced filler metal and the use of a ring torch to achieve uniform heating. This procedure assures a high quality braze joint since visual observation of filler metal at the tube/sleeve joint is possible, allowing verification of adequate flow and fusion of the preplaced filler ring.

4. In August 1977, H. P. Foley Co. (Foley) assumed responsibility for the mechanical portion of PGandE Contract 8802 from a previous subcontractor, S and Q Construction. Upon assuming this responsibility, Foley was required to have qualified braze procedures.

5. Since the braze procedure specifications (BPS) for both copper and stainless steel tubing had been previously qualified by the subcontractor, Foley decided to continue to use these procedures. However, Foley was required to conduct new procedure qualification tests for both copper and stainless steel tubing. The test of braze specimens were performed by an independent laboratory, Central Coast Labs (now Pacific Geoscience Inc.), in late August and September 1977. Records of these brazing procedures and qualification tests are attached as Exhibit 1.

6. During a planned review of existing brazing procedures for copper and stainless steel by Foley QA personnel in September, 1981, it could not be verified that stainless steel tubing BPS number M0045 had been qualified in all braze flow positions (vertical-up, vertical-down, horizontal and

flat), since the procedure qualification tests performed in 1977 did not include the vertical-up flow position. This variation was properly documented on Foley Non-Conformance Report (NCR) #8802-675 in accordance with approved procedures.

7. Even though it was not necessary to resolve the NCR for other than the vertical-up position, a decision was made to requalify all the existing copper and stainless steel braze procedures for all positions, rather than simply qualifying the stainless steel braze procedure for the vertical-up position.

8. A total of twenty-four test specimens were prepared by a qualified Foley brazer (See Affidavit of Mr. D. Backes, Jr. attached as Exhibit 2) and submitted to Central Coast Labs for procedure qualification testing to ASME, Section IX requirements; twelve copper braze specimens for tensile and metallographic testing and twelve stainless steel specimens for tensile and metallographic testing. For each material, two tensile and two metallographic specimens were required for each of the three positions included in qualification tests. The tensile test determines the joint's ultimate strength by pulling a sample to failure. The metallographic test determines the area of fusion or degree of filler metal flow by peeling or sectioning the sample and performing microscopic examination.

9. Procedure qualification reports show that all copper and all stainless steel tensile test specimens submitted passed with acceptable results. Records obtained from Central Coast Labs indicate that there was one

failure in the twelve specimens initially submitted for metallographic testing. This failure, identified by a section test, occurred in a stainless steel test specimen due to lack of sufficient flow (73 percent) in the braze joint to meet ASME, Section IX requirements (80 percent).

10. The records also indicate that one additional stainless steel braze specimen was received by the testing lab for metallographic retest. This additional specimen passed the metallographic sectioning test.

11. Test records indicate the one metallographic failure that occurred was in a test specimen brazed in the flat flow position. The reduced flow in this specimen was obviously an anomalous result for several reasons: First, this position, flat flow, is the easiest position for brazing; second, the same procedure had been qualified at least three times for this position (as discussed in paragraphs 5, 6 and 7 above, and paragraph 1 below in response to JI # 113); third, all tensile specimens and the other metallographic specimen tested in 1981 passed, and finally, the test for the one additional specimen passed. Therefore, there was no reason to consider revising the Brazing Procedure Specification.

12. It should also be noted that the current version of ASME, Section IX, requires only 70% flow for braze specimens examined by Peel Tests instead of Sectioning Test.

JI #113, Motion at 32-33.

It is alleged that:

> The circumstances for resubmitting the test procedure were not controlled, which raises questions whether the procedure that finally passed was identical to the procedure on paper. The laboratory had no way to know if the same procedure was used for the second and third test samples. Having failed the first time, Foley had a strong motive to improve the procedure in a way that would help insure approval -- such as a hotter temperature. The lack of controls for resubmission is another reason why a procedure should not be accepted for retesting after failing the first time. (citing 1/16/84, Anon. Aff. at 8.)

1. This allegation is completely false. The same stainless steel braze procedure specification had been previously qualified by two other companies (S and Q Construction and Imperial-Eastman, the manufacturer of the braze fittings) prior to Foley's initial qualification in September, 1977. Therefore, there was no need for Foley to change any of the essential brazing variables in order to qualify the procedure and none were changed.

2. Mr. D. Backes, Jr., the Foley pipefitter/welder who brazed all the test specimens sent to Central Coast Labs in 1981 stated that all test specimens were brazed in accordance with the braze procedure and that no brazing variables were manipulated in order to pass metallographic testing. (See Affidavit of Mr. D. Backes, Jr. attached as Exhibit 2).

3. The brazing of the initial test specimens as well as the specimen for retest were witnessed by a Foley QC inspector involved with the qualification program in 1981. Neither the ASME Code nor Foley procedures require documentation of these inspections. Therefore none

were documented. ASME Section IX recognizes the function of independent mechanical test contractors such as Central Coast Lab, and does not require them to witness the actual brazing.

4. In summary, contrary to the allegation, the test specimens were prepared according to the existing brazing procedure and the brazing process was witnessed by a QC Inspector. The performance of these qualification tests was in complete compliance with ASME Section IX requirements.

JI #114, Motion at 33.

It is alleged that:

> The circumstances for the tubing procedure intensifies concern about all the welding and NDE procedures qualified after the fact of their use. Resubmitting the procedure was necessary because it already had been used; the tubing was installed. If the procedure failed at that point, the tubing would have to be ripped out and reinstalled at severe cost in terms of time and money -- both at a premium in 1982 when the procedure was "qualified." If the procedure had properly been submitted before its use, the kinks could have been ironed out without severe economic impact. This allegation raises two significant additional questions: (1) Were the multiple tests and initial failures disclosed on the procedure qualification test records? (2) How many of the welding and NDE procedures that were qualified flunked initially and passed only after multiple tests? (citing 1/16/84 Anon. Aff. at 8.)

1. As previously stated in response to JI # 112, the braze procedures were properly qualified in 1977 with the possible exception of vertical up-flow in stainless steel. The procedures were submitted for qualification in the vertical up-flow position and all other positions as stated in the approved disposition of Foley NCR #8802-675. Had the test specimens failed to qualify in the vertical up-flow position, this

would have been documented in the subject NCR and processed as a reportable incident under established procedures. In actuality, all four test specimens associated with the vertical up-flow position passed the qualification requirements.

2. Acceptable test results were documented on procedure qualification test reports. The single test failure noted in Central Coast Lab's Metallographic Test Record Log was for the flat flow position which had been qualified in 1977.

3. It is obvious from a review of the true facts surrounding J.I. allegations 112, 113 and 114 above, that the brazing activities at Diablo Canyon were conducted under a fully functioning QA program. A minor deficiency in brazing qualification for the up-flow position was identified during a QA review. This deficiency was properly resolved and there was no indication of any breakdown in construction QA for brazing activities. Copper and stainless steel braze joints installed in the various plant systems at Diablo Canyon are installed in accordance with all requirements of the Foley Specification and Contract 8802 as well as applicable ASME Codes. The facts demonstrate that the QA program was properly functioning.

Dated: March 16, 1984

H. R. ARNOLD

P. C. BREISMEISTER

R. K. RHODES

Subscribed and sworn to
before me this 16th day
of March, 1984.

Ida Dutra
Notary Public in and for the
County of San Luis Obispo,
State of California.
My commisson expires
January 2, 1987

OFFICIAL SEAL
IDA DUTRA
NOTARY PUBLIC - CALIFORNIA
SAN LUIS OBISPO COUNTY
My comm. expires JAN 2, 1987

LIST OF EXHIBITS

1. H. P. Foley Company Procedure Specifications for Brazing Stainless Steel and Copper Tubing.

2. Affidavit of D. Backes, Jr.

EXHIBIT NO. 1

THE HOWARD P. FOLEY COMPANY

PROCEDURE SPECIFICATION FOR BRAZING STAINLESS STEEL FITTINGS

Specification No. 8802 Date: 8/22/77

A change in any of the essential variables which are described in succeeding paragraphs will require a new procedure specification.

BASE METAL: The base metals shall conform to the specifications for ASTM A-403 (A-182 or A-276) and A-213 which are found in materials group P-number 102.

BRAZING FILLER METAL: The brazing filler metal shall conform to ASME specification number B Ag 3 and Classification number F-102.

FLUXES: The flux shall be Handy Flux, AWS type 3A or equivalent.

POSITION: The brazing can be done in all positions.

BRAZING TEMPERATURE: A ring torch will be used to heat the materials to be joined until the brazing alloy appears evenly at both ends of the braze fitting. This will be 1270°-1500°F.

BASE METAL THICKNESS: This procedure is proposed to allow for brazing of material thicknesses between .0325 and .130 inches.

PRE-CLEANING OF BASE METAL: The base metal shall be prepared for brazing by use of emery cloth, distilled water, or acetone as necessary to ensure cleanliness. Cut ends are to be deburred.

PLACEMENT OF BRAZING FILLER METAL: The brazing filler metal shall be applied by preplaced insert ring with equal flow around the surfaces joined.

TOLERANCES OR CLEARANCE OF JOINTS: The clearance shall be the nominal clearance for materials used.

POST BRAZE CLEANING: After brazing, the joint shall be cooled and cleaned with distilled water to assure adequate removal of possible flux residue

Prepared by: Greg Southcott Date 8-23-77

Approved by: Roger L Ford Date 8/23/77

VOID

THE HOWARD P. FOLEY COMPANY

BRAZING PROCEDURE QUALIFICATION TESTS

Specification No. 8802 Date 8/24/77
Brazing Process STAINLESS STEEL Manual or Machine MANUAL-RING TORCH
Material Specification A276 to A213 of P No. 102 to P No. 102
Thickness Range this test qualifies .032 - .130 in.
Brazing Filler Metal Group No. F.- 102 BAg-3 FLUX AND/OR ATMOSPHERE
Brazing Filler Metal analysis if not covered by F-No. N/A Flux Trade Name or Composition
Shielding gas N/A
Brazing Temperature range 1270°-1500°F Character of furnace atmosphere N/A
Position of Joint VERT. DOWN Postheat treatment N/A
(See QB 462 ;

INFORMATION ONLY

Brazing alloy type (whether insert, rod, preformed, shim, etc.). Joint dimensions accord with Sketch No. ___

REDUCED SECTION TENSILE TEST (QB-463.1, QB-463.2, and QB-463.3)

Specimen No.	Dimensions		Area	Ultimate Total Load, Lb	Ultimate Unit Stress, Psi	Character of Failure and Location
	Width	Thickness				
2-1	3/8"	.065"	.068	5820	85590	PARENT
2-2	O.D.		.068	5820	85590	METAL

GUIDED BEND TESTS (QB-463.5 and QB-463.6)

Type and Figure No.	Result	Type and Figure No.	Result
N/A	———	———	———

PEEL OR SECTIONING TEST (QB-463.8, QB-463.9, and QB-464.1)

Type and Figure No.	Result	Type and Figure No.	Result
2-3 VERT. DOWN	ACCEPT	2-3 VERT. DOWN	ACCEPT

Brazer's Name H. Logue Clock No. 260 Stamp No. ___
Who by virtue of these tests meets brazer performance requirements.
Test Conducted by ~~CENTRAL COAST LABS~~ Laboratory Test No. CC03077
per ASME SECT. IX

We certify that the statements in this record are correct and that the test brazes were prepared, brazed, and tested in accordance with the requirements of Section IX of the ASME Code.

Signed THE HOWARD P. FOLEY COMPANY
(Manufacturer)

Date 8/31/77 By Scott R. Watson

This form may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

THE HOWARD P. FOLEY COMPANY

BRAZING PROCEDURE QUALIFICATION TESTS

Specification No. 8802 Date 8/24/77

Brazing Process STAINLESS STEEL Manual or Machine MANUAL-RING TORCH

Material Specification A276 to A213 of P No. 102 to P No. 102

Thickness Range this test qualifies .032-.130 In.

Brazing Filler Metal Group No. F. 102-BAg-3

Brazing Filler Metal analysis if not covered by F-No. ~~N/A~~

Brazing Temperature range 1270°-1500°F

Position of Joint HORIZONTAL (See QB 462)

FLUX AND/OR ATMOSPHERE

Flux Trade Name or Composition HANDY FLUX

Shielding gas N/A

Character of furnace atmosphere N/A

Postheat treatment N/A

INFORMATION ONLY

Brazing alloy type (whether insert, rod, preformed, shim, etc.). Joint dimensions accord with Sketch No. ___

REDUCED SECTION TENSILE TEST (QB-463.1, QB-463.2, and QB-463.3)

Specimen No.	Dimensions		Area	Ultimate Total Load, Lb	Ultimate Unit Stress, Psi	Character of Failure ~~and Location~~
	Width	Thickness				
1-1	3/8" O.D.	.065"	.069	5820	84,350	PARENT
1-2				5820	84,350	~~METAL~~

GUIDED BEND TESTS (QB-463.5 and QB-463.6)

Type and Figure No.	Result	Type and Figure No.	Result
N/A			

PEEL OR SECTIONING TEST (QB-463.8, QB-463.9, and QB-464.1)

Type and Figure No.	Result	Type and Figure No.	~~Result~~
1-3 HORIZ.	ACCEPT	1-4 HORIZ.	ACCEPT

Braze's Name W. LOGUE Clock No. 260 Stamp No. ___

Who by virtue of these tests meets brazer performance requirements.

Test Conducted by CENTRAL COAST LABS Laboratory Test No. CC03077

per ~~ASME SECT. IX~~

We certify that the statements in this record are correct and that the test brazes were prepared, brazed, and tested in accordance with the requirements of Section IX of the ASME Code.

Signed THE HOWARD P. FOLEY COMAPNY (Manufacturer)

Date 8/31/77 By Scott R. Watson

This form may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

THE HOWARD P. FOLEY COMPANY

PROCEDURE SPECIFICATION FOR SILVER BRAZING
COPPER TUBE WROT SOCKET TYPE FITTINGS

Specification No. 8802 Date 8/22/77

A change in any of the essential variables which are described in the succeeding paragraphs will require a new procedure specification.

BASE METAL: The base metals shall conform to the specifications for ASTM B-88 and ASTM B-62 which are found in materials group P-number 107.

BRAZING FILLER METAL: The brazing filler metal shall conform to ASME specification number B CuP-5 and classification number F-102.

FLUXES: None required.

POSITION: The brazing can be done in all positions.

BRAZING TEMPERATURE: The brazing temperature shall be 1300°-1500°F.

BASE METAL THICKNESS: This procedure is proposed to allow for brazing of material thicknesses between .0175 and .070 inches.

PRE-CLEANING OF BASE METAL: The base metal shall be prepared for brazing by ensuring the absence of foreign material by utilizing emery cloth as required. Cut ends are to be deburred.

PLACEMENT OF BRAZING FILLER METAL: The brazing filler metal shall be applied by face feeding with major flow involved.

TOLERANCES OR CLEARANCE OF JOINTS: The clearance shall be the nominal clearance for the materials used.

POST BRAZE CLEANING: After brazing, the joint shall be water quenched and polished with emery cloth.

Prepared by: Greg Southcott Date 8-23-77

Approved by: Roger L Grant Date 8/23/77

THE HOWARD P. FOLEY COMPANY

BRAZING PROCEDURE QUALIFICATION TESTS

Specification No. 8802 Date 8/26/77
Brazing Process COPPER SILVER BRAZE Manual or Machine MANUAL
Material Specification B88* to B62 of P No. 107 to P No. 107
Thickness Range this test qualifies .0175" TO .070"
Brazing Filler Metal Group No. F.- 103 BCuP 5 FLUX AND/OR ATMOSPHERE
Brazing Filler Metal analysis if not covered by Flux Trade Name or Composition NONE
F-No. NA Shielding gas NA
Brazing Temperature range 1300°-1500°F. Character of furnace atmosphere NA
Position of Joint HORIZONTAL Postheat treatment NA
(See QB 462 ;

INFORMATION ONLY

Brazing alloy type (whether insert, rod, preformed, shim, etc.). Joint dimensions accord with Sketch No. ___

FULL ~~REDUCED~~ SECTION TENSILE TEST ~~XXXXXXXXXXXXXXXXXXXXXXXXXXXX~~ QB 463.4

Specimen No.	Dimensions		Area	Ultimate Total Load, Lb	Ultimate Unit Stress, Psi	Character of Failure and Location
	Width	Thickness				
1-1	-----	------	.037	1130	30540	PARENT METAL & BRAZED JOINT
1-2	-----	------	.038	1130	29740	PARENT METAL

GUIDED BEND TESTS (QB-463.5 and QB-463.6)

Type and Figure No.	Result	Type and Figure No.	Result
NOT REQUIRED	----------	----------	----------

PEEL OR SECTIONING TEST (QB-463.8, QB-463.9, and QB-464.1)

Type and Figure No.	Result	Type and Figure No.	Result
1-3 HORIZONTAL	SATISFACTORY	1-4 HORIZONTAL	SATISFACTORY

Brazer's Name R. PERSON Clock No. 343 Stamp No. ----
Who by virtue of these tests meets brazer performance requirements.
Test Conducted by CENTRAL COAST LABS Laboratory Test No. CC 03077
per ASME SECTION IX

We certify that the statements in this record are correct and that the test brazes were prepared, brazed, and tested in accordance with the requirements of Section IX of the ASME Code.

Signed THE HOWARD P. FOLEY CO.
(Manufacturer)
Date 9/13/77 By J. L. Watson

This form may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017

THE HOWARD P. FOLEY COMPANY

BRAZING PROCEDURE QUALIFICATION TESTS

Specification No. 8802 Date 8/24/77
Brazing Process COPPER SILVER BRAZE Manual or Machine MANUAL
Material Specification B88* to B62 of P No. 107 to P No. 107
Thickness Range this test qualifies .0175" TO .070"
Brazing Filler Metal Group No. F. 103 BCuP 5 FLUX AND/OR ATMOSPHERE
Brazing Filler Metal analysis if not covered by Flux Trade Name or Composition NONE
F-No. NA Shielding gas NA
Brazing Temperature range 1300°-1500°F. Character of furnace atmosphere NA
Position of Joint VERTICAL UP Postheat treatment NA
(See QB 462);

INFORMATION ONLY

Brazing alloy type (whether insert, rod, preformed, shim, etc.). Joint dimensions accord with Sketch No. ___

FULL ~~XXXXXX~~SECTION TENSILE TEST ~~XXXXXXXXXXXXXXXXXXXXXXXX~~ QB 463.4

Specimen No.	Dimensions		Area	Ultimate Total Load, Lb	Ultimate Unit Stress, Psi	Character of Failure and Location
	Width	Thickness				
2-1	----	------	.037	1110	30000	PARENT METAL
2-2	----	------	.037	1070	28920	PARENT METAL

GUIDED BEND TESTS (QB-463.5 and QB-463.6)

Type and Figure No.	Result	Type and Figure No.	Result
NOT REQUIRED	----------	----------	----------

PEEL OR SECTIONING TEST (QB-463.8, QB-463.9, and QB-464.1)

Type and Figure No.	Result	Type and Figure No.	Result
2-3 VERTICAL UP	SATISFACTORY	2-3 VERTICAL UP	SATISFACTORY

Brazer's Name R. PERSON Clock No. 343 Stamp No. -----
Who by virtue of these tests meets brazer performance requirements.
Test Conducted by CENTRAL COAST LABS Laboratory Test No. CC 03077
per ASME SECTION IX

We certify that the statements in this record are correct and that the test brazes were prepared, brazed, and tested in accordance with the requirements of Section IX of the ASME Code.

Signed THE HOWARD P. FOLEY CO.

Date 9/13/77 By J. L. Watson (Manufacturer)

This form may be obtained from the Order Dept., ASME, 345 E. 47th St., New York, N.Y. 10017