

U. S. ATOMIC ENERGY COMMISSION  
REGION II  
DIVISION OF COMPLIANCE

Vendor Inspection Report

Pipe

Vendor: Southwest Fabricating and  
Welding Company  
Houston, Texas

Report No.: Southwest Fabricating and  
Welding Company 70-1

Components Inspected For: Diablo Canyon (50-275)

Date of Inspection: April 16-17, 1970

Inspectors: Uldis Potapovs 5-18-70  
U. Potapovs, Reactor Inspector (Metallurgy) Date

F. J. Long 5/18/70  
F. J. Long, Senior Reactor Inspector Date

Persons Contacted: P. E. Wecker, Sr. QA Engineer, Pacific Gas and Electric  
L. Iswell, Sr. QA Engineer, Pacific Gas and Electric  
G. H. Lockwood, President, Southwest Fabricating  
and Welding  
B. A. Graham, Assistant Vice President, Sales,  
Southwest Fabricating and Welding  
F. E. Sewell, Manager, QC, Southwest Fabricating  
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R. C. Green, Chief Engineer, Southwest Fabricating  
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Report Reviewed By:

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Proprietary Information:

Entire Report

SCOPE

On April 16-17, 1970, U. Potapovs and F. J. Long visited Southwest Fabricating and Welding Company, Houston, Texas, as part of the Compliance vendor inspection program. The visit was arranged through the Pacific Gas and Electric Company and had as a specific objective the review of Diablo 1 primary loop spool piece fabrication.

SUMMARY

1. Southwest Fabricating and Welding Company is a wholly-owned subsidiary of International Utilities Company and is one of the largest manufacturers of fabricated piping assemblies. Nuclear work constitutes approximately 10 to 15% of the gross production. The plant has no design or stress analysis capability. (See Section A.)
2. Westinghouse is the largest nuclear customer. At the time of the Compliance visit, Southwest Fabricating and Welding had completed 25 Westinghouse primary loops of the original order for 28. A new order has been placed recently for 55 additional loops with option for 15 more. Extruded pipe (ASTM A376) was used in fabricating the spool pieces under the original order while the new order will be fabricated using mostly centrifugally-cast pipe. (See Section A.)
3. Southwest Fabricating and Welding has no pipe manufacturing capability. The large diameter primary loop piping and fittings for Westinghouse contracts are supplied by Westinghouse (from other sources). The branch nozzle fittings and small diameter pipe are procured by Southwest Fabricating and Welding. (See Section B.)

4. Southwest Fabricating and Welding has been recently surveyed by ASME and has reportedly been recommended by the surveying team for the issuance of nuclear stamps in piping, pressure vessels (limited), and nuclear parts. (See Section C.)
5. The plant has a QA manual and the responsible personnel are cognizant of the nuclear code requirements. In-plant NDT capability includes radiography, MP, LP, and UT. No laboratory facilities are available. (See Section D.)
6. The pressurizer surge line piping is hot formed followed by solution annealing, spray quenching, and sand blasting to remove scale. The forming and heat treating procedures were considered satisfactory. (See Section F.)
7. Welding procedures and procedure qualifications were reviewed and found to be satisfactory. Welding material control was considered good. (See Section G.)
8. Identification marking is accomplished using low stress interrupted dot stamps. (See Section H.)
9. The Diablo 1 piping was approximately 40% completed at the time of the visit. The spool pieces are being fabricated in accordance with Westinghouse E Spec. G-676343 which references ASA B31.1 and Code Case N-7 as the applicable code requirements.
10. The large diameter piping for Diablo 1 spool pieces (and all Westinghouse contracts) is purchased by Westinghouse from pipe suppliers and delivered to Southwest Fabricating and Welding with the appropriate mill certification. These do not include NDT documentation, which is retained at Penn Center. The Diablo 1 primary loop pipe was purchased to WAPD E Spec. G-676341, which designates ASTM A376, TP 316, with several supplementary requirements. (See Section I.) Hydrotest of the individual pipe lengths has reportedly been waived by the Westinghouse purchase order.
11. Other Westinghouse supplied items include large cast fittings (27-1/2-inch I.D. and larger) and temperature detector bosses. The fittings are purchased to WAPD E Spec. G-676342 which designates the material as ASTM A351 GR CF8M, with additional supplementary requirement (Section I.1) and requires the fittings geometry to conform with USAS B16.9. Again, the shop hydrotest has reportedly been waived by the Westinghouse purchase order.

12. The branch nozzles are procured by Southwest Fabricating and Welding to ASTM A182, GR F316. For nozzles two inches in diameter and smaller, ASTM A276, TP 316, bar stock may be used. (See Section I.1.)
13. Other Southwest Fabricating and Welding procured items include thermal sleeves (ASTM A312, TP 304), pressurizer spray scoop elbows (ASTM A403 WP 316) and surge line (ASTM A376, TP 316 + S2, S6). (See Section I.1.)
14. Observation of work in progress on the Diablo 1 spool pieces did not identify any significant problems or causes for concern. The welding procedures conformed to the applicable requirements, workmanship was satisfactory, and identification of the individual components and weld seams was adequate. (See Section I.2.)
15. Radiography of two butt welds was reviewed. Radiographic quality was good and in accordance with the applicable requirements. No rejectable defects were identified. The weld surface was not ground, but this condition did not significantly impair film readability. (See Section I.2.)
16. Westinghouse E Spec. G-676343 does not specify shop hydrotest of the fabricated spool pieces, although a warranty of 3,750 psi hydro capability is required. (See Section I.2.)
17. Westinghouse and Pacific Gas and Electric quality control surveillance in the Southwest Fabricating and Welding shop appeared to be above average. (See Section I.3.)

Management Interview - A short management interview was held at the conclusion of this visit with Green, Sewell, Page, Wecker, and Iswell. The general findings were summarized, and no particular problem areas were identified with respect to the Southwest Fabricating and Welding operation. The inspector expressed concern over the omission of shop hydrotesting the individual pipe lengths and fittings since this could be a technical violation of the applicable ASTM standards, but since this was Westinghouse rather than Southwest Fabricating and Welding responsibility, no Southwest Fabricating and Welding action or response was required. The inspector also noted that some of the material certifications for small diameter pipe did not specifically state that hydrostatic test had been performed. Although the manufacturer's certification of compliance with the applicable ASTM specification implies that all requirements of that specification have been met, the inspector suggested that it is the buyer's responsibility to assure that this has in fact been done and that some pipe fabricators have been known to omit hydrotesting as standard practice. Green indicated that their vendor qualification program to date had not encountered this condition and that they would watch for it.

DETAILS

A. Plant and Product Description, Product Distribution

Southwest Fabricating and Welding is a wholly-owned subsidiary of International Utility Company, who also owns Delta Southern Company. Southwest Fabricating and Welding fabricates piping spool pieces and assemblies, headers, and small pressure vessels mainly for the petroleum industry. The plant employs 400 to 450 people and does approximately \$15 to 20 million business annually, of which approximately 10 to 15% is for nuclear assemblies. There is an engineering department of 40 to 50 people, but the plant has no design or stress analysis capability. No piping is manufactured at Southwest Fabricating and Welding. Fabrication is limited to cold and hot forming, welding, and machining. Seamless and welded pipe is obtained from outside sources.

Westinghouse is by far the largest nuclear customer. As of the time of the inspection, Southwest Fabricating and Welding had fabricated 25 primary piping loops for Westinghouse and had 3 additional loops to fabricate under the original contract (Westinghouse P. O. 54Z 70499B). Westinghouse has recently placed an order (5546-CRW-116871 BN) for 55 additional loops with an option to buy 15 more. No work has been done on the new contract. According to Page, Southwest Fabricating and Welding will be the only supplier for Westinghouse primary loop spool sections. It was also learned that most of the piping to be used under the new contract will be centrifugally cast - probable supplier: U. S. Pipe and Foundry Company, Burlington, New Jersey.

In addition to the Westinghouse contact, Southwest Fabricating and Welding will supply recirculating loop piping sections for two G-E facilities: Edwin I. Hatch and Shoreham.

They are also supplying auxiliary system spool pieces for several facilities including Maine Yankee, Beaver Valley, and Palisades plants.

Most of the nuclear work is currently done in a restricted bay area of the shop, but future plans include a separate building for this work.

B. Subcontractors

Since Southwest Fabricating and Welding has no pipe fabrication capability, all piping is procured from outside sources. The large-diameter pipe, as well as the cast fittings for Westinghouse primary loop spool pieces, are purchased by Westinghouse from the pipe mill or foundry and supplied to Southwest Fabricating and Welding with the original material certifications. The material certifications do not include NIT reports. These are sent

to and retained at Penn Center and eventually delivered to the licensee as a part of the complete data package. Westinghouse is responsible for the quality conformance of this material. Westinghouse is also supplying all thermal well bosses for the spool pieces. Up to now, all the large-diameter primary loop pipe has been obtained from Cameron Iron Works and the cast fittings from Esco Corporation. It was indicated that on the new Westinghouse purchase order at Southwest Fabricating and Welding, only four projects will use Cameron pipe; the balance will utilize centrifugally-cast pipe (U. S. Pipe and Foundry). It was also indicated by the Westinghouse resident that the last Westinghouse order for cast fittings was split between Esco and Mitsubishi Atomic Power Industries, Japan.

All branch nozzle fittings and small diameter pipe are procured directly by Southwest Fabricating and Welding. The larger nozzles are forged while smaller (under three inches) are generally machined from bar stock. The major forging suppliers are:

- Cameron Iron Works, Houston, Texas
- Green River Steel Corporation, Owensboro, Kentucky
- Texas Metal Works, Incorporated, Beaumont, Texas
- Beaumont Well Works, Houston, Texas
- Bonney Forge Division, Allentown, Pennsylvania

Some pipe suppliers are:

- U. S. Steel Corporation, Pittsburgh, Pennsylvania
- Swepeco Tube Corporation, Clifton, New Jersey
- Cameron Iron Works, Houston, Texas
- Tube Associates, Incorporated, Houston, Texas
- Capitol Pipe and Steel Products, Incorporated, Bala Cynwyd, Pennsylvania

Only light-wall seamless pipe (schedule 10 and less) is reportedly being purchased from Tube Associates. No Tube Associates pipe was observed in spot checking typical material certification. When purchasing material from supplier stock, the original mill certifications are always requested. There is a program for auditing of material suppliers, and all material sources have reportedly been audited unless the supplier is in possession of the ASME N stamp. In such cases, audit may be waived.

No fabrication or welding work is subcontracted. Mechanical testing and chemical analysis, when required, are performed by outside sources.

C. Code Stamp Authority

The Southwest Fabricating and Welding facility was originally surveyed by the ASME in January 1970 and approved by the surveying team for code stamp issuance at that time pending some revisions to the QA manual. ASME, however, made the issuance of the code stamp subject to a resurvey at a later date. Southwest Fabricating and Welding reportedly rewrote the QA manual and requested an immediate resurvey. This was completed on April 15-16, 1970, the last day coinciding with the Compliance visit. A favorable recommendation was reportedly made. Southwest Fabricating and Welding has requested three stamps: Nuclear piping, nuclear vessels (limited to 48-inch diameter or 5 tons), and nuclear parts.

D. QC Organization, NDT Capability

The plant has a QA manual. Because of the very recent ASME survey and reportedly favorable findings, the QA manual was not reviewed in detail during this inspection. The Southwest Fabricating and Welding general organization chart and QC organization chart are attached as Exhibits A and B, respectively. A breakdown of the quality control department, showing the personnel qualification levels, is shown in Exhibit C. In-house capability exists in radiographic, dye penetrant, magnetic particle, and ultrasonic examinations. X-ray (250 kv), as well as gamma radiography, is performed in the shop. The radiographic processing and reading laboratory is well equipped and organized.

The shop has no mechanical testing or metallurgical laboratory. This work, when required, is subcontracted. A hydrostatic test facility is available, but no hydrotesting is required on the Westinghouse spool pieces.

The QC personnel appeared cognizant and up to date on the applicable codes and quality control requirements. The Chief Engineer, Green, who also takes an active part in quality assurance, is on the B31 Executive Committee and is the Chairman of the Committee on Fabrication, Assembly, and Erection.

E. Standard Procedures, Records

The nuclear and nonnuclear work though the shop is handled in a similar manner, except that the inspection and documentation requirements may differ considerably. Standard procedures are used. These are supplemented when additional requirements are contained in a specific contract. A standard manufacturing record sheet has been recently adopted. This becomes a permanent record for each spool piece and contains provisions for signoff by Southwest Fabricating and Welding QC inspectors, as well as code and customer inspectors on all phases of fabrication and testing. A copy of this record sheet is attached as Exhibit D.

Each spool piece has on file a complete package of records - material certifications (including welding material), dimensional checks, NDT results, and heat treatment charts when applicable. The records were readily retrievable.

The spool piece drawings are prepared by the Southwest Fabricating and Welding Engineering for each individual assembly and are submitted to Westinghouse for approval prior to fabrication. The only items not requiring a spool piece drawing are 1.5° cast elbows which are shipped as individual units and receive no fabrication effort at Southwest Fabricating and Welding.

F. Forming, Heat Treating, Descaling

Hot forming of austenitic stainless steel pipe is done at temperatures between 1600 and 1950°F as determined by optical pyrometer. The pipe is packed with commercial iron-free sand and heated to 2050°F in a natural gas-fired clamshell furnace adjacent to the work area. The forming is done by bending the pipe around a contoured shoe. The bending procedure has been qualified to produce less than 6% ovality and assure no thinning below the minimum wall thickness. The wall thickness is checked ultrasonically when there is any reason to suspect excessive thinning. Following the hot forming operation, the sand is removed and the entire pipe is solution annealed in a natural gas-fired annealing oven at 1950°F followed by spray quenching. The annealing oven has six control zones and is reportedly capable of maintaining set temperature within 25° tolerance throughout its length. A temperature record is generated for each heat treatment cycle and placed in the spool piece file. The temperature controlling and recording instrumentation is calibrated yearly by outside sources.

Spray quenching is performed using a manifold with multiple spray heads. This system is reportedly capable of cooling the pipe from the annealing temperature to less than 300°F in 2-1/2 to 3 minutes.

Following the heat treatment, the pipe is sand blasted using iron-free sand and steam detergent cleaned with halogen and boron-free detergent. The cleaning is followed by a deionized water rinse. No acid pickling is done at Southwest Fabricating and Welding.

The only Westinghouse pipe sections subjected to hot forming at Southwest Fabricating and Welding are the pressurizer surge line pieces.

G. Welding and Welding Material Control

Tungsten arc, manual metal arc and submerged arc welding, or combinations of these processes, are used at Southwest Fabricating and Welding. A

review of applicable welding procedures showed these to be in conformance with applicable ASME and ASA requirements. A sheet showing up-to-date weldor qualifications and identification was available in the fabrication area.

The control of welding material (receiving and in process) was very good. Upon receiving, the electrodes are quarantined and not released to the storage area until the material certifications have been checked by QC. Open containers of all low hydrogen electrodes are placed in drying ovens at 250-300°F in the locked storage area. From the storage room, the electrodes are removed to rod boxes located near the fabrication area. The rod boxes are maintained at 135 to 150°F and access to these is supervised by the welding foreman. Only one type of electrode is placed in each rod box, and no more than a two-hour supply of covered electrodes is issued to the weldors at any time. All unused welding material at the end of a shift is either discarded or returned to the drying oven.

#### H. Cleaning, Marking, Packaging

Following the fabrication, all spool pieces are washed with acetone and steam cleaned. A visual inspection is performed at this time to pick up arc strikes and surface irregularities not previously removed. Such areas are marked and reworked by localized buffing followed by a second steam cleaning cycle and deionized water rinse. End covers are then put in place and the spool pieces are strapped to the bracing. Carpet strips are used to protect the spool pieces from steel strapping.

A recently adopted practice on Westinghouse contracts involves coating all cast fittings with a wax-type clear liquid to protect the somewhat coarse-textured casting surface from exposure to environment. The material, which is painted on, solidifies as a clear film. It was identified as TECTYL 131 and has reportedly been analyzed and approved by Westinghouse as meeting their chemical restrictions with respect to halogens and other impurities and having no effect on welding.

All identification marking on the spool pieces and the individual components is applied using low stress interrupted stamps.

#### I. Diablo Canyon 1 Piping

##### 1. Status of Completion, Applicable Criteria

The Diablo 1 piping was estimated as about 40% completed at the time of the visit. The primary loop is being fabricated in accordance with ASA B31.1, Sections 1 and 6, plus Code Case N-7. The applicable Westinghouse E Spec. is G-676343, Revision 1, "Reactor Coolant Piping Shop Fabrication." The design conditions are 2485 psig at 650°F (680°F for the surge line).

The large diameter pipe (27-1/2 inch I.D.) furnished by Westinghouse conforms to WAPD E Spec. G-676341 which designates ASTM A376 TP 316 except that defects referenced in paragraph 10.3.1 of that specification are restricted to 3% nominal wall thickness, supplementary requirements S2 and S6 are invoked, and a complete LP examination of all surfaces is required on each length of pipe in accordance with ASME Code Section VIII, Appendix VIII, with acceptance per Code Case N-9. According to Page, the shop hydrotest is waived by the Westinghouse purchase order in lieu of as-fabricated system hydro.

The large cast fittings supplied by Westinghouse conform to WAPD E Spec. G-676342. The fitting geometry is required to conform to USAS B16.9, and the material is designated as ASTM A351 GR CF8M with supplementary requirements S2 and S4. One hundred percent volumetric radiography is specified in accordance with Westinghouse PS 595141 and acceptance per ASTM E186, severity level 2, except that defect categories D and E are not permissible. Again, the hydrostatic test is reportedly waived by the purchase order.

The branch nozzles (Southwest Fabricating and Welding procured) are required by the E Spec. to conform to ASTM A182, GR F316. The basic purchase order, however, permits the use of ASTM A276 TP 316 bar stock for nozzles of two-inch diameter and smaller. UT of the bar stock is required.

Thermal sleeves are specified as requiring ASTM A312, TP 304 or Westinghouse approved equivalent.

The pressurizer spray scoop elbows are specified as ASTM A403 GR WP316 or WP304.

The surge line is required to conform to ASTM A376 TP 316, Schedule 140 wall plus S2 and S6 supplementary requirements with the S2 requirement applicable to each length and the S6 requirement being 100% volumetric.

2. Examination of Hardware, Review of Radiography Material Certification, and Fabrication Procedures

Shop fabrication of the Diablo spool pieces was observed during the visit. The general workmanship appeared good, and no significant problems were identified. Identification of the individual components was maintained during fabrication. The pipe segments are supplied by Cameron Iron Works with square ends with identification stamping on the ends. The marking (heat number and serial)

is transferred to the pipe O.D. at Southwest Fabricating and Welding using interrupted dot stamps. The fittings are marked with the heat number and pattern number on nameplates. All welds examined were identified with the welder symbol. Butt welds in the large diameter pipe were made using a combination tungsten inert gas and automatic submerged arc welding procedure (SW-P8-HA-1). The welds were left in the as-welded condition (unground) on the O.D. and blended smooth by manual grinding at the I.D. The weld profile and reinforcement appeared good. The O.D. weld ripples were generally smooth and even and contained no sharp discontinuities. Dimensional checks were being made during the machining of the weld end prep, fitup, and I.D. grinding to aid in maintaining the minimum wall thickness. Although not observed on the Diablo spool pieces, eccentricity resulting from the extrusion process has caused some difficulties in machining concentric weld preps and maintaining the minimum wall thickness. In some cases, buttering of the weld prep area has been required to maintain the dimensional tolerances.

The branch nozzles were generally welded using tungsten inert gas and manual metal arc procedure (Procedure SW-P8-HA3) and ground smooth after welding.

The welding procedures were reviewed and found to be in conformance with the applicable ASME Code requirements. A Westinghouse supplement to the Southwest Fabricating and Welding procedures specified ferrite contents of the deposited filler metal between 5 and 15% and required that the weld interpass temperature not exceed 350°F as checked by contact pyrometer. The use of tempilsticks was prohibited.

Two primary loop butt welds were completed and radiographed at the time of the Compliance visit (Serial 7524F PGE loop 1-1). The radiographs were taken using 7" x 17" Kodak AA film (single film technique) and 19 curie Co-60 source. The film was reviewed and showed satisfactory technique and good quality. No rejectable defects were identified. The delineation of the submerged arc weld beads on the pipe O.D. did not significantly impair radiographic interpretation.

It was noted that the applicable Westinghouse E Spec. (G-676343) does not require shop hydrostatic testing of the fabricated spool pieces, although a Southwest Fabricating and Welding certification is required stating that the spool pieces are capable of 3,750 psi hydro.

A spot review was made of material certifications applicable to the Diablo piping. No items of nonconformance were identified.

3. Westinghouse and Pacific Gas and Electric QC Coverage

Westinghouse has a resident inspector (Page) in the Houston area. Besides Southwest Fabricating and Welding, his inspection assignment includes Cameron Iron Works; Delta Southern Company; Engineers and Fabricators, Incorporated; Wyatt Industries, Incorporated; and Esco. He reportedly averages approximately one to three days per week in the Southwest Fabricating and Welding shop. He appeared to be knowledgeable in the applicable codes and specifications and thorough in approach. The Westinghouse resident is responsible for signing off on QC release of all spool pieces shipped from Southwest Fabricating and Welding. Highlights of the inspection effort required to sign the QC release on the spool piece were summarized by Page as follows:

- a. Radiography of Shop Welds - 100% review of all radiographs.
- b. LP of Welds - spot review (approximately 10 to 20%).
- c. Dimensional Inspection - based on review of critical dimensions. Westinghouse inspector reviews the data sheets and picks out critical dimensions for verification in his presence.
- d. Visual Inspection (100%) - for arc strikes, weld spatter, rust, contamination, stress raisers, surface finish, weld transitions, mechanical damage, and identification.
- e. Cleanliness - Examination for conformance to cleanliness requirements specified in WPS 292722-1.
- f. Mill Certifications - Review of all material certifications for conformance with the applicable specifications.

The Pacific Gas and Electric Company has six senior materials inspectors in the eastern United States working out of their private homes. Their assignments are principally based on geographical considerations and include fossil as well as nuclear plant equipment. The inspectors appear to be well qualified and experienced. Iswell has been recently hired by Pacific Gas and Electric and will relocate in Chattanooga, Tennessee. His background includes QA engineer positions at Westinghouse and at Babcock and Wilcox Company. The current visit was reportedly the third Pacific Gas and Electric inspection at the Southwest Fabricating and Welding shop.