AUG 25 1971

J. P. O'Reilly, Director, Region I, CO
J. G. Davis, Director, Region II, CO
B. H. Grier, Director, Region III, CO
J. W. Flora, Director, Region IV, CO
R. W. Smith, Director, Region V, CO

CONSUMERS POWER COMPANY (MIDLAND 1 AND 2) - DOCKET NOS. 50-329/330 - TESTIMONY OF DR. SIDNEY A. BERNSEN

Enclosed for your information is a copy of testimony of Dr. Sidney A. Bernsen, Manager of Quality Assurance, Bechtel Corporation. This testimony was offered by Consumers Power Company in the Midland Hearing pursuant to questions asked by Myron M. Cherry, attorney for the Saginaw Intervenors, during cross examination of Dr. Bernsen regarding specific changes in Bechtel's present Field Inspection Manual. The testimony was also submitted to respond to Mr. Cherry's questioning regarding procedures contained in present manuals which are intended to prevent, identify and correct problems of the type which occurred at the Palisades Plant.

As you know, during the past two or three years we have had considerable dialogue with Dr. Bernsen and members of his staff in order to better understand the organization and implementation of the Bechtel quality assurance program. Dr. Bernsen has met with us on numerous occasions and has on occasion been critical of CO's quality assurance inspection efforts, particularly as they relate to the interpretation and implementation by Bechtel of the Appendix B Quality Assurance Criteria. As a matter of additional interest, CO testimony at the Midland Hearing revealed a number of deficiencies in the implementation of the QA program and Dr. Bernsen later called Jim Henderson to determine if Compliance intended to submit additional testimony which would reflect more favorably on Bechtel. He was informed that CO planned no such testimony.

You may find the enclosed testimony useful in understanding some of the more recent developments in the organization and philosophy of the Bechtel QA effort. Obviously for Compliance purposes we should continue to evaluate each Applicant's performance, including the performance of its contractors, solely against the information submitted in application for a construction permit. The enclosed document,

however, does enjoy official status since it was submitted as testimony in an official hearing. As such, I believe it can properly be used to better understand the Bechtel QA program and to help in evaluating the performance of their field organization.

Original signed by
R. H. Engelken

R. H. Engelken, Assistant Director
for Inspection and Enforcement
Division of Compliance

Enclosure:
As Stated

cc:w/enclosure
A. Giambusso, CO
J. B. Henderson, CO

OFFICE ▶	CO					
SURNAME ▶	RHEngelken:nw					
DATE ▶	8/24/71					

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter of	)	
	)	Docket Nos. 50-329
CONSUMERS POWER COMPANY	)	50-330
	)	
(Midland Plant Units 1 and 2)	)	

TESTIMONY OF DR. SIDNEY A. BERNSEN

Dated July 29, 1971

Dupe

TESTIMONY OF

DR. SIDNEY A. BERNSEN

I am the same Dr. Sidney A. Bernsen who was previously sworn and testified in this proceeding. The testimony contained in this statement is given under oath.

I have been in attendance at substantially all of the public hearings in Midland in which testimony was given concerning quality assurance, and have reviewed the transcript of the testimony with respect to that subject.

This testimony is based upon my personal knowledge and knowledge available to me as Manager of Quality Assurance for Bechtel.

At pages 2914-2915 of the transcript Dr. Goodman asked a question concerning the changes in Bechtel's Quality Assurance Program during the last four years, and at pages 4532-4533 Chairman Murphy asked a general question about the way in which quality activities are supervised. The first portion of this testimony is in response to those questions.

As indicated in my oral testimony, changes in Bechtel's Quality Assurance Program have been largely evolutionary as a result of many years of Bechtel experience and, with few exceptions, the principal one being Appendix B of 10 CFR 50, were not specific procedures designed solely to satisfy AEC regulations. The following are the significant changes in the program which have occurred since 1967:

1. The program was revised and new procedures prepared where necessary to implement the requirements of 10 CFR 50, Appendix B which became effective July 27, 1970. While it would unduly extend this testimony to review each change in Bechtel's program which are reflected in the Field Inspection Manual (Saginaw Intervenors Exhibit 28), Nuclear Quality Assurance Manual (Saginaw Intervenors Exhibit 16), Quality Control Manual - ASME Nuclear Components (Saginaw Intervenors Exhibit 15) and the quality assurance plan set forth in the PSAR (Amendment 6), some examples are as follows: Formalization of Bechtel policy with regard to verifying and checking the adequacy of design by individuals other than those who performed the original design; established program of regular quality assurance audits of construction and design quality assurance activities by representatives of Quality Assurance Management; prepared specifications for vendors quality assurance programs to incorporate the applicable requirements of 10 CFR 50, Appendix B (Nuclear Quality Assurance Manual, Section 2.33 and Exhibit 10 [Saginaw Intervenors Exhibit 16]).

2. A formal quality assurance group headed by a Manager of Quality Assurance was established to guide, review and audit project quality assurance programs and provide and oversee staffing of Field Quality Assurance Engineers.

3. Established the position of Field Quality Control Engineer whose duties solely relate to quality control activities including coordinating of inspection programs, assuring that the field engineers make the inspections required by the Quality Assurance Program and reviewing quality control documentation for accuracy and completeness.

4. Established home office Quality Control Coordinators for the construction department to give guidance and implement the construction department quality control program and provide quality control support to construction.

5. Expanded existing vendor inspection programs and initiated formal quality assurance audits of vendors.

6. Standardized and improved field quality control procedures by means of preparation of Field Inspection Manual (Saginaw Intervenors Exhibit 28) and initiated quality control orientation and indoctrination of field personnel.

7. Initiated formal audits of welding and non-destructive testing programs (Quality Control Manual - ASME Nuclear Components, [Saginaw Intervenors Exhibit 15] and section 6.22 of the Nuclear Quality Assurance Manual, [Saginaw Intervenors Exhibit 16]).

8. Implemented requirements of ASME Boiler and Pressure Vessel Code, Section III (see Quality Control Manual - ASME Nuclear Components [Saginaw Intervenors Exhibit 15]). After extensive review by ASME, Bechtel was authorized to perform work covered by ASME Code Rules including use of the "N" stamp.

It is my opinion, based upon my experience in quality assurance and quality control activities and my knowledge of Bechtel's Quality Assurance Program, that the Quality Assurance Plan in Amendment 6 of the PSAR and documents referred to therein meet and satisfy the requirements of 10 CFR 50, Appendix B.

The importance of people to the achievement of quality construction is strongly endorsed by Bechtel and its current position and record of successful performance is due in large part to the abilities of its personnel. The following testimony describes, in general, the current practices with regard to staffing, training, supervision and review of quality assurance/quality control personnel on Bechtel jobs.

1. Quality Assurance Engineers

The total quality assurance staff within Bechtel's Power and Industrial Division currently numbers approximately 50. This group includes individuals with formal training and experience in quality assurance and quality control, some

with specific non-destructive testing experience, and others with facility design and field engineering experience. A large percentage are college graduates and those who are not have practical engineering experience to compensate. In addition, some are registered professional engineers.

A new quality assurance engineer is given direct personal attention by QA Coordinators and Quality Assurance Management which is specifically tailored to complement his prior experience. Quality assurance engineers assigned to the field are initially assigned to work with the project engineering design team in the Home Office in order to become familiar with project design, and the members of design team. This is an indoctrination period, and the quality assurance engineer is given direct personal attention by the Project Engineer. Quality assurance engineers assigned to the design office are given similar indoctrination. Upon completion of the initial indoctrination field quality assurance engineers participate in construction site quality control indoctrination and training sessions which also include the field organization. Office quality assurance engineers attend monthly training and program review meetings with QA Management. In addition, formal QA program seminars are being held at least annually. Continuing

surveillance and supervision of field quality assurance engineers is achieved through review by the Project Engineer and QA Management of Weekly Reports submitted by the quality assurance engineers, and is supplemented by visits to the jobsite by the Project Engineer and Quality Assurance Management personnel for discussions with the field quality assurance engineers. In addition, performance of field quality assurance engineers as well as the field Quality Control Program is formally audited at least twice a year and normally 4 times a year in the course of Management Quality Assurance audits of the field operation. The office quality assurance engineers are similarly monitored through frequent supervisory contact.

2. Quality Control Engineers

Quality control engineers are selected by the Quality Control Coordinators and are assigned to projects by the coordinators with concurrence of the cognizant Construction Manager. Qualifications of quality control engineers are similar to those previously identified for the quality assurance engineers. At present, there are approximately 40 quality control engineers in the division. Quality control engineers supervise and monitor the field inspection program for the construction department. Field personnel who are performing non-destructive examination

are selected and assigned by the Chief Welding Engineer in the Materials and Fabrication Quality Control Services section. These personnel are qualified in accordance with the requirements of the American Society for Non-Destructive Testing (SNT-TC-1A).

Quality Control Coordinators visit the construction site at frequent intervals and conduct training sessions for quality control engineers, field engineers and field supervision to explain the requirements of the Quality Assurance/Quality Control Program and to assist them in implementation of the various procedures. They also observe the performance of quality control and field engineers during these visits. Each jobsite is also required by Construction Management to hold regularly scheduled Quality Control Indoctrination and Training sessions.

Quality control engineers are continually monitored and supervised by the project field engineer and project superintendent. Additionally, the overall performance of the Quality Assurance/Quality Control Program and individual field personnel is monitored by the quality assurance engineer stationed at the jobsite, who is in a position to initiate remedial action through

The project field engineer, the project superintendent or appropriate Home Office personnel in the event of unacceptable individual performance.

The performance of all quality assurance and quality control personnel is formally reviewed and evaluated on at least an annual basis by supervision and management.

Saginaw Intervenors Exhibits 17 through 27 have been offered in an attempt to show an inadequacy in the Quality Assurance Program for Midland because of an alleged failure to prevent the occurrence of problems at Palisades, where a low power testing license has been issued. While it is not the purpose of this testimony to review such alleged problems, as they have been fully discussed in the redirect testimony offered in the Palisades hearing and submitted in this proceeding, it is my opinion and I believe that it must be recognized that no quality assurance program can absolutely prevent discrepancies from occurring. However, a properly implemented quality assurance program will demonstrate the reliability and safety of a nuclear power plant by identifying, controlling and correcting any discrepancies which occur, and provide means for modifying procedures, where necessary, in order to preclude repetition of significant conditions adverse to quality.

Although I do not have detailed personal knowledge of the matters referred to in Exhibits 17 through 27 I believe that it would be of assistance to the Board to elaborate upon some of the procedures by which the Bechtel Quality Assurance Program for Midland will deter, identify and correct various hypothetical problems which could occur on any undertaking of the magnitude and complexity of the Midland project where they may not have been fully described in other testimony. (Specific steps taken to ensure the proper implementation of the Quality Assurance Program by Bechtel personnel are dealt with in a prior portion of this testimony.)

Adequate record keeping. Section 5.2 of Field Inspection Procedure G-1 (Saginaw Intervenors Exhibit 28) requires that the quality control file reflect the current status of construction and be available at all times for review by Consumers Power Company and the AEC. In addition Section 1.8 of the Nuclear Quality Assurance Manual (Saginaw Intervenors Exhibit 16) identifies and states the requirements of the documentation necessary for the quality assurance/quality control files.

Following of Field Procedures. Sections 4.2.1 and 4.2.3 of Field Inspection Procedure G-1 (Saginaw Intervenors Exhibit 28) require that field procedures be established and approved by project engineering for the implementation of unique installation inspection requirements. Furthermore, the Quality Assurance Engineer audits work done pursuant to the field procedures to assure that they are followed (Paragraph 7.23 1 of Nuclear Quality Assurance Manual, Saginaw Intervenors Exhibit 16), and is empowered to stop work if it is not being performed in accordance with quality procedures (Paragraph 7.23 7 of Nuclear Quality Assurance Manual, Saginaw Intervenors Exhibit 16). Additionally, the Quality Assurance Program's general audits of field activities (Procedure 8.2 of Nuclear Quality Assurance Manual [Saginaw Intervenors Exhibit 16]) provide for periodic independent assessment of adherence to such procedures and correction of any discrepancies found. In order to provide for reporting, control and correction of discrepancies, Significant Deficiency Reports must be prepared and processed in the event

non-compliance with field procedures is detrimental to quality work. (Paragraphs 7.23 10 and Procedure 8.1 of Nuclear Quality Assurance Manual, (Saginaw Intervenors Exhibit 16).

Witnessing of Inspections by Field Engineers. The Field Inspection Manual (Saginaw Intervenors Exhibit 28) specifically provides in the third paragraph of the Introductions to Sections 2, 3, 4 and 5:

> "The terms, verify, check, confirm as utilized in the procedures have the common meaning that the assigned Field Engineer shall perform the inspection/test, witness the performance of the inspection/test, or have knowledge and records to substantiate that other responsible Field Engineering personnel or qualified sub-contractor technicians have performed the inspection, surveillance or tests that have been specified."

Proper correction of discrepancies. Procedure G-3 of Field Inspection Manual (Saginaw Intervenors Exhibit 28) provides detailed requirements for the identification, control and correction of non-conforming items including necessary documentation for follow-up and assurance that the proper correction was made.

Coordination between engineer-constructor and nuclear steam supply system supplier. Page 12 of the Quality Assurance Plan (submitted with Amendment 6 to PSAR) specifically states that Babcock and Wilcox will furnish erection criteria for its equipment, supply erection consultants to assist Bechtel and Consumers in interpreting Babcock and Wilcox requirements and advise Bechtel and Consumers of field conditions and actions which do not meet such requirements. The specific

responsibilities of each of the companies is further delineated in the contracts previously submitted and in the answers to Saginaw Interrogatories 142 and 154. Similar requirements are contained in Section 3 of Procedure M-1 of the Field Inspection Manual (Saginaw Intervenors Exhibit 28).

Cleanliness. Bechtel has traditionally required high levels of construction site and system cleanliness consistant with work being performed. Specific guidance on this subject is now provided in Section 7.3.2.3 of Procedure M-1 of the Field Inspection Manual (Saginaw Intervenors Exhibit 28). Additionally each project must prepare a specification for cleanliness control as is indicated in that section. Similarly cleanliness requirements for storage of components either in designated storage areas or in place are delineated in Section 5 of Procedure G-5 of the Field Inspection Manual (Saginaw Intervenors Exhibit 28).

Prevention of Reoccurrence of Significant Conditions Adverse to Quality. The primary mechanism for accomplishing this is contained in the Procedure for Significant Deficiencies (Procedure 8.1 of the Nuclear Quality Assurance Manual [Saginaw Intervenors Exhibit 16]).

At page 4245 of the transcript a question was raised concerning stacking of crates on top of each other. Section 5.5.4.2 (6) of Procedure G-5 of the Field Inspection Manual (Saginaw Intervenors Exhibit 28)

requires for Midland that crates of components not be stacked upon each other unless the crate is capable of sustaining the load.

The foregoing are examples of specific procedures and requirements which are representative of the manner in which the Bechtel Quality Assurance Program is designed to identify, control and correct problems.

Beginning on page 4296, line 25, and continuing through three subsequent pages of the transcript, I was asked to compare the field inspection procedure as set forth in Section 7 of the Palisades QA/QC Manual (Saginaw Intervenors Exhibit 30) with the field inspection procedure provided in Procedure W-1 for the Midland project in the Bechtel Power & Industrial Division Field Inspection Manual (Saginaw Intervenors Exhibit 28.) A similar comparison could be made between many sections of Exhibit 30 and Exhibit 28. However, this comparison is generally representative of the evolution and continuing improvement of Bechtel's Quality Assurance Program since 1967.

The following testimony will summarize the provisions of Field Inspection Procedure W-1 on a section-by-section basis, which were either not a part of Section 7, Exhibit 30, or which are different from that section. (A copy of Section 7 of Exhibit 30 is attached to this testimony as Appendix 1, and a copy of Field Inspection Procedure W-1 is attached to the testimony as Appendix 2 in the event the board wishes to make its own comparison.) The numbers in the following paragraphs refer to the sections in W-1:

1.0 Scope. The scope of W-1 is simplified and clarified.

2.0 References. W-1 describes, in detail, applicable references, including welding and non-destructive testing procedure specifications, and a specific cross reference to the Quality Control Manual-ASME Nuclear Components (Saginaw Intervenors Exhibit 15).

3.0 Responsibility.

3.1 Clarifies responsibility of non-destructive testing laboratories and references the technical specification governing their work.

3.2 Provides a single comprehensive definition of the responsibilities of Field Welding Engineers.

4.0 Material Control.

4.2 Incorporates the receiving inspection requirements contained in Field Inspection Procedure G-5 from Exhibit 28 so as to provide increased assurance of proper receiving inspection and control. For example, Field Inspection Procedure G-5 requires planning for inspection prior to receipt of material, provides a more comprehensive receipt inspection report form and clarifies requirements for review of documentation and control of nonconforming material.

4.4 Formalizes existing practice by specifically requiring the Welding Engineer to report to the Project Field Engineer or the Quality Control Engineer any instance when corrective action is not properly taken so as to ensure proper correction of the item, and effectuate supervision of the personnel involved.

5.0 Welder Qualification. This section is essentially the same. However, W-1 has been expanded to include cadweld operator qualification testing and test recording requirements.

6.0 Surveillance of Welding.

6.1 Subcontractor Surveillance.

Provides additional and detailed instructions for surveillance of welding subcontractors and non-destructive testing subcontractors.

6.2 Field Welding Inspection.

6.2.1 Clarifies the requirement that all welding procedure specifications are to be approved by Project Engineering.

6.2.2/
6.2.3/
6.2.4 These sections provide more detailed instruction for in-process welding inspection, specifically directed to each of the three major areas of welding fabrication: civil-structural, pipe, and tanks and liner plate.

6.2.5 Post Weld Heat Treatment Inspection. Requires inspection of heating equipment installations, requires inspection of the calibration of temperature measuring devices and provides for inspection sign-offs on temperature charts.

7.0 ASME Code Inspection. Requires use of Quality Control Manual - ASME Nuclear Components (Saginaw Intervenors Exhibit 15) for welding covered by the ASME Code.

8.0 Non-destructive Tests. Requires use of specifically identified non-destructive testing procedures.

9.0 Repairs. Requires use of the Procedure for Handling Nonconforming Materials (Field Inspection Procedure G-3) for extensive repairs which provides for proper identification and review of the defect as well as appropriate direction and approval of the repair.

10.0 Documentation.

10.1.1 References Non-destructive Testing Procedure WD-1 which contains and requires the use of extensive and detailed instructions and forms for welding documentation.

10.1.2 Requires a weekly report which provides information on status of field welding operations.

10.1.4 Nonconforming material reports added pursuant to required use of Field Inspection Procedure G-3.

10.2 Clearly defines records required to be maintained in quality control files.

W-1 deletes paragraph 8 from Section 7 of Exhibit 30, entitled "Causes for Weld Rejection", because these are contained in specifications appropriate to the specific welding work to be performed.

Paragraph 3 of the Introduction to Section 5 of Exhibit 28 emphasizes the requirement that field welding engineers cannot accept reports from craftsmen or superintendents (e.g., the welder or his supervisor) to verify that work operations were completed satisfactorily.

July 29, 1971

Sidney A. Bernsen
Manager of Quality Assurance
Bechtel Corporation
Fifty Beale Street
San Francisco, California 94119

Subscribed and sworn to before me this 29th day of July, 1971.

Maxine E. Loewenstein
Notary Public
San Francisco County, California
My Commission expires: May 25, 1972.

MAXINE E. LOEWENSTEIN
NOTARY PUBLIC - CALIFORNIA
CITY & COUNTY OF SAN FRANCISCO
My Commission Expires May 25, 1972

SECTION 7

QC INSPECTION

FIELD WELDING UNITS AND SYSTEMS

Inspection reporting for field welding of units and systems shall follow procedures issued by the Metallurgy and Quality Control, the QC general procedure outlined under Section 4, and as detailed hereunder. QC construction inspection reporting is required for units and systems as designated on NQAM Form QC-1, "Inspection Assignments".

A. SCOPE

Documentation of welding and non-destructive testing in significant sequential steps shall be required for units and systems designated by the Project Engineer to receive QC inspection. Engineering documents applicable to each unit or system governing field welding and test shall be referenced, including identification of qualified welders, design or erection drawings, and procedures approved under Code provisions by Engineering.

B. RESPONSIBILITY

The Field Welding Engineer shall be responsible for inspection and documentation of field welding accomplished for Structural, Mechanical, Piping, Electrical, Instrumentation and other engineering groups.

He shall also monitor, inspect and keep records on subcontractor welding. He shall report receiving of welding supplies (primarily electrodes) on Form QC 101. He shall report alignment, fit-up, and weldment inspection on Forms QC 102, QC 102 (Welding), and/or Form QC-150.

C. FORMS AND RECORDS

1. In general the Field Welding Engineer shall use Form QC 102 (Welding) (Appendix 7D) and shall not use Forms QC 101-2-3 except as noted.

Exceptions are Form QC 101 for quality control welding supplies. Form 102 shall be used for reporting reworked weldments including retests.

Form QC-150 (Appendix 7A) shall be used for individual welds except Primary Coolant 30" and 42" I. D. Welds. (See Paragraph C. 3 below.)

Form 102 (welding) shall be used for inspection of an isometric section of a system covered by a Form QC-150.

2. QC 101 - Engineer's Receiving Report

The Field Welding Engineer shall use this form to report general quality control inspection of supplies, electrodes, and accessories. Jobsite Storage, identification, and issuance of welding electrodes shall conform to Field Procedure 20.

3. Forms QC 102 (Welding) (Appendix 7D)

In the appropriate sequence of construction process requiring welding inspection, the PFE shall make arrangements for inspection by the Field Welding Engineer. Depending upon the scope of welding to be inspected, the PFE can assign the Field Welding Engineer to report inspection of weldments. In general, QC inspection of Field welding is to be done on a "units" or "systems" basis. Pipe welding will be reported by isometric drawing, except 30" and 42" I.D. primary pipe welds which will be reported individually on a QC 102 Form. The verification of correct electrodes and welding accessories used by welders for each designated Q unit and system shall be reported by the Field Welding Engineer on Form QC 102 (Welding). Dye checking, X-Rays and other non-destructive tests will be reported on QC 102 (Welding) on an isometric basis.

4. Supplemental QC Records and Drawings

Systematic back-up records and suitable drawings shall be prepared prior to and during construction. Such erection records and drawings may be referenced in Form QC 102 for designated units and systems and shall be accorded identification by Q number and filed. Supplemental Field Welding Records and Drawings are outlined as follows:

a. Containment Structure Liner Plate

(1) Radiographic Inspection

Form QAE-6 and drawings shall be used to show progressive inspection of designated welds and identification of certified welders. Supplementary records will be kept of the following information:

(a) Legend showing location of radiographs.

(b) Radiographs of acceptable and unacceptable welds.

(c) Detailed design of joints showing corner welds bottom seam, overhead seam, girth seam and vertical seams.

(d) Welder's identification to be shown.

(2) Welding Inspection

Roll-out type drawings should show all the necessary information, such as:

(a) Welding procedures
(b) Inspection procedures
(c) Welders performing the work
(d) Defects and method of repair
(e) Results of final inspection
(f) Correlation of each plate with heat number

(3) For other types of testing use the same type of a drawing as recommended above, such as:

(a) Unit number - job number
(b) Areas showing type of test and dates
(c) Type of tests
    (1) Vacuum
    (2) Dye Check
    (3) Air test - pressure system numbers
    (4) Magnetic particle testing
    (5) Visual

b. Welding of Reinforcing Bar

Progressive inspection and documentation requires drawings that show elevations and locations. Records of welder qualification must also be in order.

c. Nuclear Power Plant Piping

Progressive inspection and methods of documentation for permanent inspection records of critical piping systems require:

(1) An Index of all critical systems.

(2) Form QC-150 (Appendix 7A) to be prepared and maintained.

(3) Individual isometric drawings showing field weld numbers, prefabricated spool numbers, and other pertinent information.

(4) When applicable, the stress relieving chart will be included in the X-ray envelope.

(5) All welding will be done in accordance with Bechtel Welding procedures designated on Form 84 (Bechtel Dwg. 5935-M-249).

(6) Forms WR-5 and WR-6 (Appendix 7B & C) may be used to facilitate weld inspection and completion of Form 150.

5. Qualification of Welder and Welding Procedures

a. Welding Procedure Specifications

All welding and weld testing performed for designated units and systems shall be in strict accordance with the applicable job specifications. Specifications shall not include procedures but shall require Engineering approval of appropriate procedures when required to be submitted, or shall require welding to be done in accordance with appropriate procedures authorized by the Field Welding Engineer. No welding shall be permitted without prior approval of such procedures by Engineering. The Field Welding Engineer shall be responsible for correct welding procedure and welder qualification used for Structural, Mechanical, Electrical, Instrumentation units and systems. Welding Procedure for Piping is specified on "Schedule of Field Welding Procedures" Form 84. Necessary clarification or interpretation shall be obtained from Engineering.

c. Welder Qualifications

All welders shall be qualified by performing the tests required by Welder Performance Specification WQ-F-1 for ferrous materials and/or WQ-NF-1 for non-ferrous materials. No welder shall be permitted to perform any welding on units and systems, as designated on NQAM Form QC-1, "Inspection Assignments", for the Constructor or Sub-contractor until he has passed the necessary tests and has the Welder Performance Qualification Test Record, Form No. WR-1, on file with the Field Welding Engineer at jobsite.

D. INSPECTION

The general instruction for welding inspection which follows is intended to cover welding performed on designated units and systems.

1. Welding Procedure Specification

It is the responsibility of the Field Welding Engineer to assure that all welding performed on Q units and systems is in strict accordance with the appropriate qualified welding procedure specifications. Specific items to be checked are:

a. Determine that the proper welding procedure specification has been selected to match the base materials being welded and the welding process being employed.

b. Permit only welders properly qualified under the essential variables of each welding procedure specification to make welds under that procedure.

c. Check to see that the welding electrodes, bare filler rod, consumable insert rings, and backing rings all match that which has been specified.

d. Inspect weld joints, as necessary, prior to welding to insure proper edge preparation, cleaning, and fit-up.

e. Check to see that the welding machine settings are correct and fall within the range of current and voltage specified.

f. Check for proper preheat and interpass temperature.

g. Inspect the in-process welding for proper technique, cleaning between passes, and appearance of individual weld beads.

h. Determine that correct shielding and purging gases are being used for inert gas welding.

2. Postweld Heat Treatment

The Field Welding Engineer shall inspect each postweld heat treatment (thermal stress relieving) operation to insure conformance with the applicable job specifications. Specific items to be checked are:

a. A sufficient number and proper location of thermocouples shall be selected to accurately record temperatures.

b. The thermocouples shall be connected to temperature indicator records which will provide a permanent record of the heating rate, holding temperature and time, and the cooling rate.

c Temperature charts shall be checked for proper heating rate, holding temperature, holding time, cooling rate, and that the proper weld identification is recorded on the chart.

3. Visual Inspection of Welds

The Field Welding Engineer shall be responsible for carrying out the necessary visual inspection to insure the following prior to, during, and after welding:

a. All weld beads, passes, and completed welds shall be free of slag, cracks, porosity, incomplete penetration, and lack of fusion.

b. Cover passes shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads.

c. Butt welds shall be slightly convex, of uniform height, and shall have full penetration.

4. Non-destructive Tests

a. General

When the applicable job specifications require non-destructive inspection test of welds made by the Constructor or Sub-contractors, the Field Welding Engineer shall be responsible for determining that standard methods are followed and that the completed tests are properly interpreted and reported. He

shall require the responsible personnel to demonstrate their knowledge and understanding of the applicable specifications, standard methods and procedures prior to beginning the tests. He shall also review and record each completed test.

b. Inspection Agencies

Where non-destructive testing is specified to be performed, the services of a qualified independent inspection laboratory may be employed under the direct supervision of the Field Welding Engineer.

c. Acceptance Standards

Standards of acceptance shall be in accordance with the applicable specification conforming to recognized methods.

d. Methods

Specified non-destructive tests shall be in accordance with Bechtel NQAM-7.

e. Leak and Hydrostatic Tests

Leak and hydro testing shall be the responsibility of the assigned Field Engineer.

5. Repairs

It shall be the responsibility of the Field Welding Engineer to determine that all weld defects in excess of specified standards of acceptance shall be removed, repaired, and re-inspected in accordance with the applicable job specifications.

6. Storage and Identification of Welding Supplies and Accessories

a. Electrodes

Classification shall be in accordance with AWS-ASTM Classification System. ASTM (Vol. 4) specifications are illustrated as follows:

ASTM A 233	Mild Steel Covered Arc-Welding Electrodes

ASTM A 298	Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes
ASTM A 316	Low Alloy Steel Covered Arc-Welding Electrodes
ASTM A 559	Mild Steel Electrodes for Gas Metal-Arc Welding

b. Storage

Electrode storage and control shall be in accordance with Field Procedure 20.

7. Records

a. It shall be the responsibility of the Field Welding Engineer to prepare records and use the appropriate Q number to identify units and systems reported.

b. Records shall be maintained and used for effective operation of the program and shall be subject to review to determine completeness and usefulness.

c. Records shall be subject to regular analysis by the Field Welding Engineer to determine cause for scrap and rework and to develop trends in processes and work performance.

Corrective action in regard to performance of suppliers and vendors shall be recommended to the Project Engineer.

Corrective action in regard to discrepant material shall be recommended to the Project Superintendent.

8. Causes for Weld Rejection

All welding of Q units and systems, including welder qualification tests, shall comply with the following requirements. Any weld having one or more of the typical defects listed below shall be subject to rejection by the Field Welding Engineer. Records of weld defects and repair shall be kept on the weld X-Ray envelope.

a. Failure to meet radiographic acceptance requirements.

b. Less than 100 percent penetration for entire weld length.

c. The presence of porosity or inclusions in excess of that permitted under the specification.

d. Lack of fusion.

e. Cracks.

f. Cold lapping.

g. Evidence of peening.

h. Undercutting adjacent to complete weld.

i. Welds not reasonably uniform in appearance.

j. Failure to meet required tests.

k. Welding performed by unqualified personnel.

l. Unacceptable indications as disclosed by magnetic particle or liquid penetrant inspections.

SHEET NO. _____

LINE DESIGNATION _____

WELD NO. / DATE STARTED	ISO DWG. NO	AUTHORIZED BY	BETWEEN WELD NO.	BETWEEN WELD NO.	MTL / SIZE	WALL THICKNESS	PIPE ALIGN - INITIAL	FAB REQUIREMENTS: P NO	FAB REQUIREMENTS: INITIAL	FAB REQUIREMENTS: W. PROCED DATA S. NO.	FAB REQUIREMENTS: WELDER IDENT.	NONDESTRUCTIVE TESTS (DATE PERFORMED & INITIAL): T NO.	RADIO GRAPH	LIQUID PENET.	ULTRA SONIC	OTHER	DATE COMPLETE INITIAL	REMARKS

Form GS-139

APPENDIX 7A

Form WR-5

BECHTEL JOB NO. _____

Field Weld Check-Off List

System _____ ISO _____ Weld No. _____

Material _____ Dia. _____ W. T. _____

Root Pass _____

Welding Filler Metal

Filler Passes _____

Weld Procedure _____

Proper Fit up _____ Alignment _____

Preheat _____

Purge _____ Post Heat _____

Released for Welding _____ Welding Completed _____

NDT

Liquid Penetrant _____ Visual Inspection _____

Magnetic Particle _____ Radiographed _____

Results _____

Welders Name _____ Symbol _____

Welders Name _____ Symbol _____

Certified as correct:

_____ Name _____ Date _____

Foreman Welding Inspector

BECHTEL JOB NO. _____ Form WR-6

Filler Metal Withdrawal Authorization

System _____

ISO _____

Weld No. _____

Weld Procedure _____

Filler Rod
Type _____
Size _____

Coated Electrode
Type _____
Size _____

Authorized by: _____ Date _____

Warehouse:
Issued by _____ Date _____

DATE	LINE(S)/SCHEME(S)	REQN/SPEC. NO.	BLDG. AREA	Q NUMBER
				☐ UNIT OR SYSTEM ☐

DESCRIPTION

SERVICE

REQUESTOR JOB ENG.

REF. DOCUMENT	INSPECTION PROCESS			EXCEPTS NOTED	DATE	BY FIELD ENGINEER
DWG.	WELD NO.					
	MATERIAL	THICKNESS	DIAM.			
	WELD PROCED. NO.					
	WELDER INDENT					
ASTM E 94	RADIOGRAPH	ACCEPTED	REJECTED			
ASTM E 109	MAG. PARTICLE	ACCEPTED	REJECTED			
ASTM E 164	ULTRASONIC	ACCEPTED	REJECTED			
ASTM E 165	LIQ. PENETRANT	ACCEPTED	REJECTED			
	PREHEAT TEMP.					
	POSTHEAT TEMP.	TIME				
	ELECTRODES					
	(CROSS OUT THE NON-APPLICABLE)		ACCEPTED BY QAE			

COMMENT

FEEDBACK

DISTRIBUTION
No. 1–To the Project Engineer
No. 2–To the Job Engineer
No. 3–To QAE

INSTALLED INSPECTION REPORT FORM QC 102

APPENDIX II TO TESTIMONY OF DR. SIDNEY A. BERNSEN

SECTION FIVE

WELDING

INTRODUCTION

The contents of this section will be utilized by field engineering personnel involved in welding to perform the activities defined in both Project, and Materials and Fabrication Quality Control Services specifications and procedures.

The procedure will be applied in accordance with the specifications approved by Project Engineering for the project. It shall provide standard direction but not limit or exclude other inspection practices which may be required to ensure the quality and integrity of the completed installation; it shall provide direction to fulfill the specification requirement, insure the proper performance of the work and provide records of inspection to verify compliance to the design.

The terms verify, check and confirm as utilized in the procedures have the common meaning that the assigned field engineer shall perform the inspection or tests, witness personally the performance of the inspection or tests or have knowledge and records to substantiate that other responsible field engineering personnel, subcontractor's technician or other authorized personnel have performed the inspections, surveillance, and tests that have been specified

SECTION FIVE

WELDING

Field Inspection Procedure W-1

THE INSPECTION OF WELDING

1.0 SCOPE

This procedure provides direction for Field Engineers performing inspection and surveillance of field welding operations.

2.0 REFERENCES

The Project Specifications and design documents including the following shall be utilized in performing inspection under this procedure and shall establish the basis for acceptable installation:

2.1 Project Specification for the Field Fabrication and Installation of Piping and Instrumentation.

2.2 Project Specification for Piping, Material, Classification and Standards.

2.3 Project Specification for Radiographic Inspection of Field Welded Pressure Vessels and Piping.

2.4 Nondestructive Testing Standard Procedure Specification.

Form 84	Welding and Nondestructive Testing Requirement for field erected Piping.
MT-P-1	Magnetic Particle Inspection.
PT-SR-1	Liquid Penetrant Inspection.
RT-XG-1	Radiography, Non-Nuclear.
GR-NDT	General Requirements.
WO-1	Welding and Nondestructive Testing Documentation.

2.5 Welding Standard Procedure Specifications

WQ-F-1 Performance specification, Ferrous.

WQ-NF-1 Performance specification, Non-ferrous.

WFMC-1 Welding Filler material control.

PHT-500 Postweld heat treatment of field welds.

2.6 Project Specification for Field Welding.

2.7 Quality Control Manual - ASME Nuclear Components.

3.0 RESPONSIBILITY

The requirements of this procedure are implemented by:

3.1 Testing Laboratories, which provide qualified technical personnel to implement NDT procedure are sub-contracted in accordance with Reference 2.3 Technical Specification for Radiographic Inspection of Field Welds.

3.2 The assigned Welding Engineer, who shall perform the inspection defined by the procedure and the surveillance of the nondestructive testing subcontractor. He shall resolve conflicts, lack of clarity or deviation from the reference documents by the Procedure for Design Document Control G-2 prior to the performance of the work. He shall requisition welding materials required by the project welding procedures. He shall coordinate his activities with the associated piping, electrical, mechanical and civil field engineers relative to performing integrated inspection, as required. He shall coordinate with field supervision to insure timely inspection and repair or correction of deficiencies. He will judge the acceptability of nondestructive testing as performed relative to welding and shall monitor or complete documentation in accordance with project requirements.

4.0 MATERIAL CONTROL

4.1 The field welding engineer shall utilize Welding Standard Procedure Specification number WFMC-1, Welding filler material control, sections 1.0 through 7.0 for direction in the Procurement, Material Receiving, Storage Control and Disbursal of Welding Materials.

4.2 The receiving personnel shall record the receiving inspection and status of documentation for welding materials by signing the (MRR) in accordance with procurement procedures or the Field Procedure for the Control of Materials G-5.

4.3 The welding engineer shall coordinate with field supervision the control of material storage areas and the utilization of welding rod in accordance with procedure WFMC-1. He shall inform field supervision of discrepancies in the application of the procedure as determined by inspection.

4.4 The welding engineer shall inform the Project Field Engineer or Quality Control Engineer when corrective action is not properly taken.

5.0 WELDER QUALIFICATION

Welder qualification and testing shall be under the direction of a field welding engineer.

All welders who are to make welds under Bechtel Welding Procedure Specifications shall be qualified by performing tests required by the applicable Technical Specification WQ-F-1 for ferrous materials and WQ-NF-1 for non-ferrous materials.

No welder shall be permitted to perform any welding until he has passed the necessary tests and has the appropriate Welder Performance Qualification Test Record (Form WR-1) or Caldweld Operator Qualification Test Record on file at the jobsite.

6.0 SURVEILLANCE OF WELDING OPERATIONS

The assigned welding engineer shall be responsible for performing the necessary inspection and/or surveillance of welding operation involved in the construction of the project by Bechtel or Bechtel Subcontractors.

6.1 Subcontractor Surveillance

A welding engineer will be assigned to perform inspection and surveillance of subcontractors performing welding and nondestructive testing on the project. The welding engineer shall verify that the performance of the subcontractor is in accordance with the requirements of the design documents, and is in compliance with his own quality control program, where required, auditing such programs in conjunction with Quality Control and Quality Assurance engineers in a manner compatible with NQAM requirements.

6.1.1 Specifically the welding engineer shall:

6.1.1.1 Confirm engineering approval of all welding procedures used by the subcontractor.

6.1.1.2 Confirm that subcontractors welder and nondestructive testing personnel are qualified as required before they perform any work.

6.1.1.3 Check subcontractors welding filler material control practices.

6.1.1.4 Check the subcontractors in-process welding control practices. Assure that the subcontractor's visual acceptance of welds is compatible with the applicable sections of this procedure under paragraph 6.2.

6.1.1.5 Designate location of spot radiographs in accordance with contractual requirements.

6.1.1.6 Check the subcontractor's records for documentation of nondestructive tests. Confirm

interpretation and acceptability of associated documentation such as x-ray film and stress relieving charts.

6.1.1.7 Verify repair of all welding defects and repairs made by welding.

6.1.1.8 Witness all subcontractor pressure and vacuum tests.

6.1.1.9 Confirm that all applicable records are available at the site and are readily available for review or audit.

6.2 Field Welding Inspection:

The welding engineer will perform visual inspection prior to, during and after welding to verify the compliance to welding procedures and acceptable workmanship.

6.2.1 General:

The welding engineer shall, for all welding operations, verify the following:

6.2.1.1 Ascertain that the welding procedure specifications are those approved by project engineering for utilization on the project.

6.2.1.2 Ascertain that all welders are qualified and that qualifications are so documented.

6.2.1.3 Ascertain that only welders who are properly qualified under the essential variable of each welding procedure specification make welds under that procedure.

6.2.1.4 Verify that the proper welding procedure designated on the Form 84 matches base materials and the process being employed.

6.2.1.5 Ascertain that the welding machine settings are correct and fall within the range of current and voltage specified by the welding procedures.

6.2.1.6 Ascertain that the welding electrode or base filler wire utilized match the welding procedure requirements and application for root pass or filler.

6.2.2 Civil/Structural Welding Inspection

The welding engineer shall perform inspection on Civil/Structural welding to ensure compliance with design. The engineer shall:

6.2.2.1 Inspect weld joints as necessary prior to welding to insure proper fit-up, edge preparation and cleaning.

6.2.2.2 Inspect the in-process welding for proper technique, cleaning between passes, appearance of individual weld beads and sequence of welding where required.

6.2.2.3 Verify that proper preheat and interpass temperature is being used.

6.2.2.4 Verify that correct shielding and purging gases are being used for inert gas welding.

6.2.2.5 Inspect fillets for specified size with full throat and legs of uniform height.

6.2.2.6 Verify that butt welds are slightly convex, are of uniform height and have full penetration.

6.2.2.7 Verify that weld beads, passes and completed welds are free of slag, cracks, porosity, incomplete penetration, undercut, or lack of fusion.

6.2.2.8 Verify that cover passes are free of coarse ripples, irregular surfaces non-uniform bead pattern, high crown, deep ridges or valleys between beads.

6.2.2.9 Confirm inspection of cadwells and rebar splices in accordance with the Field Inspection Procedure for the Installation Inspection of Reinforcing Steel and Wire Mesh C-4, when assigned.

6.2.3 Pipe Welding Inspection

The welding engineer shall perform inspection on pipe welding to ensure compliance with project references.

The engineer shall:

6.2.3.1 Ascertain that the cleanliness of piping is acceptable prior to making fit-up as required.

6.2.3.2 Inspect weld joints and pipe before welding and the following during fit-up operations.

a. Edge preparation.
b. Edge transition, from thick to thin sections.
c. Mismatch - internal tolerances.
d. Internal piping cleanliness.
e. Utilization of insert or backing ring.
f. Spacing between ends.

6.2.3.3 Inspect in-process welding for proper technique, cleaning between passes, and appearance of individual weld beads.

6.2.3.4 Verify that proper preheat and interpass temperature is being used.

6.2.3.5 Verify that required shielding and purge gases are being used for inert gas welding.

6.2.3.6 Inspect fillet welds for specified size with full throat and legs of uniform height.

6.2.3.7 Check nondestructive testing of fillet welds where specified.

6.2.3.8 Verify the surface weld reinforcement limitations, both internal and external, on piping butt welds.

6.2.3.9 Verify that the fit-up practices on socket weld fittings comply with applicable applicable standards and codes.

6.2.3.10 Verify that repair, chipping or grinding of welds is done in such a manner as not to gouge, groove or reduce the adjacent base metal thickness.

6.2.3.11 Verify that the correction and nondestructive testing of surface defects has been done in accordance with project specification requirements.

6.2.3.12 Verify that weld beads, passes and completed welds are free of slag, cracks, porosity, incomplete penetration, undercut, or lack of fusion.

6.2.3.13 Verify that cover passes are free of coarse ripples, irregular surfaces, non-uniform bead pattern, high crown, deep ridges or valleys between beads and that they blend smoothly and gradually into the surface of the base metal.

6.2.3.14 Determine weld shrinkage, when required.

6.2.3.15 Check that each welder stamps or identifies his weld upon completion, whether required by code or not.

6.2.4 Tanks or Line Plate Welding Inspection

The welding engineer shall perform inspection on tanks, liner plates, and vessels to ensure compliance with design. The engineer shall:

6.2.4.1 Verify that weld area is free of protective surface coating and is clean prior to welding.

6.2.4.2 Verify that alignment, root opening and fitup is in accordance with welding procedure.

6.2.4.3 Verify that the plate thickness variations are in accordance with design drawings.

6.2.4.4 Inspect in-process welding for proper technique, cleaning and back gouging between passes and appearance of individual weld beads.

6.2.4.5 Verify that the welds are uniform in width and size through the full length.

6.2.4.6 Verify the establishment of welding sequence, as required to maintain alignment, etc.

6.2.4.7 Assure that each layer of welding is smooth and free of slag, inclusions, cracks, porosity, lack of fusion and undercut. In addition assure that the cover pass is free of coarse ripples, irregular surface, nonuniform bead patters, high crown deep ridges or valleys between beads.

6.2.4.8 Assure that butt welds are slightly convex, of uniform height and have full penetration.

6.2.4.9 Witness testing, vacuum or pressure of weld on bottoms, nozzle reinforcement, leak detection channels, etc.

6.2.4.10 Verify that each welder identifies his weld in accordance with specification requirements.

6.2.5 Postweld Heat Treatment Inspection

6.2.5.1 A sufficient number of properly located thermocouples shall be selected to record temperatures accurately.

6.2.5.2 The thermocouples shall be connected to temperature indicating-recorders which will provide a permanent time-temperature record.

6.2.5.3 Check to ensure that coils or resistance matts are properly applied and insulated in accordance with manufacturer's directions.

6.2.5.4 Temperature charts shall be checked for recorder number, proper heating rate, holding temperature, holding time, cooling rate, date, weld identification and inspection signoff on each recorded chart.

6.2.5.5 Check to assure that thermocouples and recorders are properly classified and calibrated.

7.0 ASME CODE INSPECTION

Field inspection of welding covered by the ASME Code as noted on Form 84 shall be in accordance with the Quality Control Manual - ASME Nuclear Components.

8.0 NONDESTRUCTIVE TESTS

Specification requirements calling for nondestructive testing will be done in accordance with the following Procedure Specifications published

by Materials and Fabrication Quality Control Services:

GR-NDT	General Requirements
RT-XG-1	Radiographic Testing
MT-P-1,2	Magnetic Particle Testing
PT-SR-1,2	Liquid Penetrant Testing

9.0 REPAIRS

It shall be the responsibility of the field welding engineer to determine that all weld defects in excess of the specified standards of acceptance shall be removed, repaired, and re-inspected in accordance with the applicable job specifications.

The field welding engineer shall initiate the application of the P ocedure for Handling Nonconforming Materials when he discovers the existence of unique or abnormal defects requiring extensive repairs. Acknowledgment or engineering direction will be obtained, according to the procedure, prior to proceeding with the repair.

10.0 DOCUMENTATION

10.1 The field welding engineer shall initiate and maintain the following records to implement this procedure and provide verification of compliance to design.

10.1.1 Documentation as listed in Nondestructive Testing Procedure WD-1.

10.1.2 A weekly report and records covering the status of the following:

10.1.2.1 Nondestructive Testing.

10.1.2.2 Welders Qualified by craft on hand.

10.1.2.3 The number of welds performed and the reject rate for Pipe Fitters.

10.1.2.4 The material inventory and filler metal control.

10.1.2.5 Accept/Reject rate of process piping welds.

10.1.3 Field Inspection Reports

For a record of field inspection performed on civil components, subcontractor activities field fabrication of tanks and conventional piping to define, what was inspected, nature of inspection, result, corrective action, as required.

10.1.4 Nonconforming Material Reports

For a record of nonconformances as determined by application of the Field Procedure for the Control of Nonconforming Materials.

10.2 The records required by Nondestructive Testing Procedure WD-1, paragraph 10.1.1, Field Inspection Reports, paragraph 10.1.3, and the Nonconforming Material Reports, paragraph 10.1.4 should reflect the current status of construction and shall be in the Quality Control files.

The weekly reports and records Paragraph 10.1.2 are administrative information that may be obtained from the Welding Group upon Project Superintendent approval.

FIELD WELD CHECK-OFF LIST

Job No. _____ Unit No. ____

GENERAL INFORMATION	Bechtel W. E.		Authorized Code Insp	
	Initials	Date	Signature	Date
System _____				
Iso. No. _____				
Weld No. _____				
Material _____				
Diameter _____ Wall Thickness _____				
Welding Procedure _____				
Filler Metal: Root _____				
Filler Passes _____				
Preheat _____				
Proper Joint Preparation and Fit-Up _____				
Released for Welding _____				
Welders Name & Symbol _____				
Welders Name & Symbol _____				
WELD INSPECTION DATA				
Visual Inspection _____				
Post Heat Temp. _____ Time _____				
Liquid Penetrant: Root _____				
Cover _____				
Magnetic Particle _____				
Radiographed _____				
Radiography Results: Accepted _____				
Rejected _____				

CERTIFIED CORRECT

Bechtel Welding Engineer _____ Date _____

Signature

FORM WR-6
Revised 8/6/69

BECHTEL JOB NO. _____

FILLER METAL WITHDRAWAL AUTHORIZATION
FOR SPECIAL NUCLEAR SYSTEMS

Welder's Name _____

System _____

ISO _____

Weld No. _____

Procedure Spec. No. _____

Special Certified Test
Reports Required: (Yes) (No)

1. Bare Rod & Consumable Inserts

Type _____ Size _____
Quantity _____ *Heat No. _____

2. Coated Electrodes

Type _____ Size _____
Quantity _____ *Lot No. _____

Authorized by _____
(Field Welding Engineer)

Date _____

Issued by _____
(Warehouseman)

Date _____

*NOTE: Heat and Lot Nos. required only when so designated on Form 84.