UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

17

NOV 12 1982

MEMORANDUM FOR: H. R. Denton, Director, Office of Nuclear Reactor Regulation

FROM: R. H. Engelken, Regional Administrator, Region V

SUBJECT: SOUTHERN CALIFORNIA EDISON COMPANY, SAN ONOFRE UNIT 3 DOCKET NO. 50-362

Based on the results of our inspection efforts, we have determined that construction and preoperational testing of the subject facility have been completed in substantial agreement with docketed commitments and regulatory requirements, with the exceptions listed in Enclosure 1. Region V has no further items which would preclude issuance of an Operating License to permit facility operation up to five percent (5%) of full power. It is recommended, however, that the operating license be conditioned with the information contained in Enclosure 1.

In addition, we have several comments on the draft license transmitted by the T. M. Novak memorandum to J. L. Crews, et al, dated October 21, 1982. These comments are presented in Enclosure 2.

We have reviewed the applicant's preparations for implementation of the Quality Assurance Program for operations and have found that they meet the requirements of 10 CFR 50, Appendix B, as specified in the applicant's Quality Assurance Program (Chapter 17 of the FSAR), which was reviewed by the Office of Nuclear Reactor Regulation.

Allegations of deficient welding and welding code requirements implementation at San Onofre Units 1, 2 and 3 were received and investigated by the Region V office. Although the special inspection report has not been finalized and issued, thus far none of the allegations have been substantiated. Therefore, these allegations do not appear to impact the issuance of the Unit 3 Low Power license.

R H Engelken

R. H. Engelken
Regional Administrator

Enclosures:
As stated

8212010524

XA Copy Has Been Sent to PDR

XA

cc: T. M. Novak, A/D, DL, NRR
G. Knighton, Chief, LB3, NRR
H. Rood, LB3, NRR
B. H. Faulkenberry, RV
J. L. Crews, Director, DRRP&EP, RV
T. W. Bishop
D. F. Kirsch, RV
R. J. Pate, SRI, San Onofre 3, RV
A. E. Chaffee, SRI, San Onofre 2, RV
R. C. DeYoung, Director, IE
B. Grimes, Director, DEP, IE
J. Taylor, Director, DRP, IE
E. Jordan, Director, DE&QA, IE
L. Cobb, Director, DFFM&S, IE
G. S. Spencer, Director, DTI, RV
L. Norderhaug, RV
D. Schuster, RV
W. Mortensen, RV
H. Book, RV
F. Wenslawski, RV
M. Cillis, RV
G. Yuhas, RV
J. Eckhardt, RV
J. Stewart, RV

ENCLOSURE 1

RECOMMENDED LICENSE CONDITIONS FOR SAN ONOFRE UNIT 3

A. The following items must be completed prior to loading fuel:

~~1. The set point and seat tightness of pressurizer safety valves shall be verified to be in accordance with Technical Specification 3.4.2.~~

NONE*

B. The following items must be completed prior to initial criticality:

1. The deficiency identified by the SCE letter, dated July 19, 1982, to R. H. Engelken from Dr. L. T. Papay regarding discrepant inputs to the Core Protection Calculator from Reactor Coolant Pump shaft speed and Control Element Assembly position indication shall be corrected.

* Per telephone conversation (H.Rood, NRR to T. Bishop, RV) on 11/13/82 Technical Specification 3.4.2 has been revised to allow verification testing (set point/seat tightness) of one pressurizer safety valve within 18 hours of entering Mode 3, if the second valve has previously been verified.

TW Bishop for R.H. ENGELKEN
11/13/82

REGION V COMMENTS ON DRAFT LICENSE FOR SAN ONOFRE UNIT 3

1. Delete condition 2.C.(17). The adequacy of surveillance procedures and their implementation was of concern for Unit 2. Similar concerns do not exist for Unit 3, therefore, this condition may be excluded from the license.

2. Per discussions with NRR representatives it was determined that consideration is being given to deleting conditions 2.C.(16).3 (NUREG-0737 item I.C.1) and 2.C.(16).e (NUREG-0737 item I.C.6). It is recommended that these items be retained to facilitate enforceability, if necessary. In addition, it is recommended that implementation of NUREG-0737 item II.E.3.1 (emergency power for pressurizer heaters) be established as a condition to exceeding 5% power.

3. Comments on Emergency Preparedness:

   a. Requirement C.(16).j.

   This requirement should be eliminated. By letter dated October 15, 1982, the licensee notified Region V that the upgraded Emergency Operations Facility was complete and became operational on October 15, 1982. The other emergency support facilities (TSC and OSC) were operational during the emergency planning exercise conducted on April 15, 1982. The results of the inspection of the April 15, 1982, exercise have been documented in Inspection Report No. 50-361/82-18.

   b. Requirement C.(18).a.1.

   The word "demonstrate" should be replaced with "Provide evidence to the NRC" (or NRC Regional Administrator, Region V). As written, it is not possible to ascertain to whom the demonstration is to be made or how the demonstration is to be satisfied. During a telephone conversation on October 26, the licensee informed Region V that both meteorological towers were installed and operational. The Health Physics Computer System is expected to be operational by the end of November.

   The requirement for SCE to "maintain" offsite assessment and monitoring capabilities references a portion of the ASLB Initial Decision (Paragraph D.1-12, pp. 136-140). The first part of this reference (D.1-7, pp. 136-138) concerns the "Applicants' Onsite Monitoring Capabilities" and does not appear to be applicable to the ASLB decision. The other two references (Paragraph D.27, pp. 145-146 and Section V, Paragraph B, pp. 213-214) should be eliminated because they do not provide information related to SCE's maintaining this offsite assessment and monitoring capabilities.

It appears that the offsite emergency response organizations now provide the requisite capabilities for assessing and monitoring offsite consequences of a radiological emergency in the Plume EPZ for San Onofre. By memorandum dated July 7, 1982, FEMA (Richard W. Krimm) notified the NRC (Brian Grimes, DEP) that FEMA Region IX has concluded "with respect to the status of the offsite emergency preparedness... that all participating jurisdictions exhibited an adequate or better capability to respond to an offsite emergency." This July 7, 1982 memorandum relates to the April 15, 1982 San Onofre Nuclear Generating Station emergency planning exercise and other actions taken during the period May 22, 1981 to May 1, 1982, including a March 25, 1982 drill conducted to evaluate the planning and response capability regarding ingestion pathway zone actions. We would also note that a July 1, 1982 memorandum from FEMA to NRC (Krimm to Grimes) states that they have reviewed the SOPs for the EOF, Offsite Dose Assessment Center and Liaison (representatives) and found them to be adequate. Therefore, per the ASLB findings (Paragraph D.27, pp. 145-146), SCE need no longer provide the offsite assessment and monitoring capability because the offsite response organizations are now capable of performing this function. If SCE is not required to provide the capability for offsite assessment and monitoring, this should be eliminated from Requirement C.(18).a.1.

c. Requirement C.(18).a.3.

The ASLB has retained jurisdiction of the matters related to arrangements for medical services (to the general public) for the purpose of reviewing the adequacy of the remedial action. Therefore, the only appropriate requirement would seem to be one requesting copies of the proposed plans or remedial actions sent to the ASLB also be sent to the NRC. The licensee's September 3, 1982 submission to the ASLB, responding to the Board's August 6, 1982 Memorandum and Order (Concerning Whether Further Proceeding on the Adequacy of Offsite Planning for Medical Services Should be Conducted), states that their position remains "there is no need for further medical service arrangements beyond those presently in place." The September 3, 1982 document describes the extent of the existing medical service capabilities in southern California. Based on the information in the September 3, 1982 document, the ASLB could find this to be an adequate response to the related finding which would raise a question whether this proposed requirement, as presently written, had been satisfied.

d. Requirement C.(18).a.4.

This requirement has already been satisfied. By letter dated July 8, 1982, the licensee provided NRC (F. Miraglia) with a revised copy of the San Onofre Nuclear Generating Station (Units 2 and 3) Emergency Plan. This revision satisfies the ASLB finding concerning the deletion of the "extended" Emergency Planning Zone (EPZ) concept and extending the Plume Exposure Pathway EPZ boundary to include Dana Point and all of San Juan Capistrano. During a telephone conversation on October 26, 1982, the licensee informed Region V that seven (7) new sirens will be added in the San Juan Capistrano and Dana Point areas. These new sirens are expected to be completely installed and operational about December 15, 1982.

e. Requirement C.(18).b.

This requirement should be eliminated. The identified Federal Emergency Management Agency's proposed rules (44 CFR 350) establish the policy and procedures by which FEMA will review and approve state and local emergency plans and preparedness. These rules do not impose any requirements on the licensee or the offsite agencies involved in the emergency preparedness. Also, the paragraphs in 10 CFR 50.54, conditions of licenses, are deemed conditions of every license. Therefore, these is no need to specifically identify 50.54(s)(2) in one of the conditions, as was done in this requirement.

f. As a general statement, this proposed license is equivalent to the one that presently exists for Unit 2, Docket No. 50-361. Both provide for activities at power levels not to exceed five percent of full power. This being the case, we believe the conditions relating to emergency preparedness should be consistent (as contained in the Unit 2 license).

4. Typographical errors:

a. Paragraph 2.c.(5).b. change "audible" to "auditable"

b. Paragraph F. delete "pefore" in the last sentence.

c. Paragraph H. change "a" to "as"

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

NOV 30 1982

Docket Nos. 50-206, 50-361, 50-362

Southern California Edison Company
P. O. Box 800
2244 Walnut Grove Avenue
Rosemead, California 91770

Attention: Dr. L. T. Papay, Vice President
Advanced Engineering

Gentlemen:

Subject: Special NRC Inspection of San Onofre Units Nos. 1, 2, and 3

This refers to the special inspection conducted by Messrs. G. Hernandez, W. Wagner and D. F. Kirsch of this office during the period of October 15 through November 15, 1982 of activities authorized by NRC License Nos. DPR-13 and NPF-10 and Construction Permit No. CPPR-98, respectively.

The inspection was an examination of alleged violations of established industry codes and standards related to welding and welding inspection. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspectors.

No items of noncompliance with NRC requirements were identified within the scope of this inspection.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room unless you notify this office, by telephone, within ten days of the date of this letter and submit written application to withhold information contained therein within thirty days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1).

Should you have any questions concerning this inspection, we will be glad to discuss them with you.

Sincerely,

T. W. Bishop

T. W. Bishop, Chief
Reactor Projects Branch No. 2

Enclosure:
Inspection Report
Nos. 50-206/82-31
50-361/82-31
50-362/82-27

cc w/o enclosure:
R. Dietch, Vice President
Nuclear Engineering & Operations, SCE

cc w/enclosure:
H. B. Ray, SCE (San Clemente)

U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report No. 50-206/82-31
50-361/82-31
50-362/82-27

Docket No. 50-206, 50-361, 50-362 License No. DPR-13, NPF-10, CPPR-98

Safeguards Group ________

Licensee: Southern California Edison Company

P. O. Box 800

2244 Walnut Grove Avenue

Rosemead, California 91770

Facility Name: San Onofre Nuclear Generating Station (SONGS) - Units Nos. 1, 2, and 3

Inspection at: San Onofre Site, San Diego County, California

Inspection conducted: October 15 - November 15, 1982

Inspectors: D. F. Kirsch for G. Hernandez, Reactor Inspector — 11/30/82 Date Signed

W. J. Wagner, Reactor Inspector — 11/30/82 Date Signed

D. F. Kirsch, Chief, Reactor Projects Section No. 3 — 11/30/82 Date Signed

Approved by: D. F. Kirsch, Chief, Reactor Projects Section No. 3 — 11/30/82 Date Signed

Summary:

Inspection on October 15 - November 15, 1982 (Report Nos. 50-206/82-31, 50-361/82-31, and 50-362/82-27).

Areas Inspected:

A special inspection of all three units by regional based inspectors and investigators of allegations concerning design inadequacies and deficiencies in implementation of welding codes and standards.

This inspection involved 218 inspection-hours by three regional based NRC inspectors and 24 hours by two regional based investigators for a total of 242 inspection hours.

Results: No items of noncompliance or deviations were identified.

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DETAILS

1. Individuals Contacted

a. Southern California Edison Company (SCE)

J. M. Curran, Manager, Quality Assurance
D. E. Nunn, Project Manager, Units 2/3
D. B. Schone, Project Quality Assurance Supervisor, Unit 2/3
N. M. Ferris, Quality Assurance Engineer
G. P. Vaslos, Quality Assurance Engineer
P. R. King, Operations Quality Assurance Supervisor, Unit 2/3

b. Bechtel Power Corporation (Bechtel)

L. R. Brown, Chief Plant Design Engineer
R. Gavankar, Assistant Chief Plant Design Engineer
R. L. Patterson, Division Quality Assurance Manager
J. H. McCarty, Project Quality Assurance Manager
S. H. Freid, Assistant Project Engineer
J. W. Sheppard, Project Field Quality Assurance Supervisor
B. O. Faber, Project Quality Control Supervisor
R. J. Kosiba, Chief Civil/Structural Engineer
L. G. Hersh, Assistant Chief Civil/Structural Engineer
F. B. Marsh, Project Engineer
D. C. Martin, Level III Nondestructive Examiner
W. W. Lahr, Quality Control Inspector
N. P. Bessich, Lead Welding Quality Control Engineer, Retired
R. Ruiz, Quality Control Engineer
E. Puckett, Quality Control Engineer
M. Ellis, Construction Field Welding Engineer
G. L. Dawes, Field Contracts Administrator
R. Reinsch, Quality Control Engineer
C. L. Brown, Quality Control Engineer
P. R. Huber, Supervising Quality Control Engineer

Several pipefitters, welders and welding quality control engineers/inspectors were also interviewed in the course of the special inspection.

c. University Mechanical - Engineers and Constructors (UMEC)

J. W. Clark, Project Manager
W. A. Robinson, Quality Control Supervisor
P. T. Dakin, Quality Assurance Supervisor

d. Others

E. Earl Kent, Alleger

e. Other NRC Personnel Participating in the Special Inspection

O. C. Shackleton, Director, Office of Investigations, Region V
P. V. Joukoff, Investigator, Office of Investigations, Region V
D. E. Smith, Senior Materials Engineer, Materials Engineering Branch, NRR

2. Background

During the week of September 13, 1982 the licensee notified the inspector that certain allegations had been received by SCE regarding welding adequacy at SONGS 2 and 3. The licensee had interviewed the alleger on September 7, 1982 and had documented and resolved the concerns expressed by the alleger. The inspector reviewed the licensee's actions to resolve the allegations and noted that the licensee's investigation did not substantiate any of the alleger's concerns. The inspector's review of the licensee's actions was documented in NRC Inspection Report Nos. 50-361/82-27 and 50-362/82-19, paragraph 6.

On October 6, 1982 the NRC, Region V, was contacted by a reporter for the Los Angeles Times who relayed several concerns which had been expressed to the media by the alleger. The reporter could not provide specifics, as to plant area or components involved, and would not provide a telephone number contact for the alleger. The reporter did, however, agree to contact the alleger and recommend that the NRC be provided information regarding the expressed concerns.

The alleger contacted the NRC on October 6, 1982 and relayed six concerns, in addition to those four previously expressed to the licensee on September 7, 1982. The NRC immediately made plans to conduct a special inspection at the site in order to conduct an interview with the alleger and to resolve the expressed concerns.

The alleger was interviewed by two Region V investigators and one section chief on October 15, 1982. The interview was conducted under oath and, with the permission of the alleger, tape recorded. The interview began at 10:08 a.m. and concluded at 5:02 p.m. The concerns expressed by the alleger were summarized in a statement and presented to the alleger for review and signature on October 16, 1982. The alleger refused to sign the statement, however, the alleger advised the two investigators that his concerns stated in the statement were true and correct. The fourteen concerns summarized in the statement included the original four expressed to the licensee on September 7, 1982 and additional concerns expressed during the NRC interview. The statement is included as Appendix 1 to this report.

3. Summary of NRC Activities and Findings

A team of NRC personnel, consisting of two inspectors and one regional supervisor, conducted a special inspection at the San Onofre Nuclear Generating Station site during the period of October 18-27, 1982 to examine procedures, installed plant conditions, and documentation related to the concerns expressed by the alleger. Additional examinations were conducted at the Region V office, during the period of October 28 - November 15, 1982, including examination of additional information provided by the alleger on November 12 and 15, 1982. The results of this special inspection are detailed in subsequent paragraphs of this report.

During the interview on October 15, 1982, the alleger supplied the names of three additional people whom the alleger considered knowledgeable about his concerns. Two of these individuals were interviewed by a Region V investigator and a Region V supervisor on October 21, 1982. With the permission of those interviewed, these two interviews were recorded on tape. These interviews did not produce any additional information to substantiate the alleger's concerns other than a reiteration, during one interview, of the alleger's concern regarding the 92 page nonconformance report (see Appendix 1, item 7). The third individual was contacted by telephone on October 22, 1982 and did not provide any information in substantiation of the alleger's concerns and, thus, this individual was not interviewed and recorded under oath.

On October 25, 1982, at the request of the NRC, the licensee provided for the alleger to tour the site and point out specifics regarding the alleged welding inadequacies. The site tour began at 9:40 a.m. and concluded at approximately 2:30 p.m. The alleger was accompanied on the tour by an NRC inspector, a regional NRC supervisor, an NRC investigator and several staff members of Southern California Edison Company and Bechtel Power Corporation. Items identified by the alleger during the plant tour are detailed in subsequent paragraphs of this report. The concerns dealing with end returns and development of maximum joint strength, by welding "all around" or placement of additional weld metal, were topics previously identified in the alleger's statement and the interview tape recording.

On October 29, 1982, the NRC Region V issued a Confirmatory Action Letter to the licensee detailing the understanding that SCE would provide a discussion of certain practices employed at SONGS, including how code requirements were fulfilled in the areas of weld end returns, pipe support visual inspection criteria, and visual inspection criteria related to weld crater fill. The Confirmatory Action Letter is attached to this report as Appendix 2.

On November 3, 1982, the licensee submitted responses containing the requested information. Those responses are attached to this report as Appendix 3.

The licensee's responses to the Confirmatory Action Letter were provided to the NRC Office of Nuclear Reactor Regulation for review and evaluation. The results of the staff's review and evaluation are attached to this report as Appendix 4.

In summary, none of the nuclear safety-related allegations were substantiated.

4. Concerns Regarding the Adequacy of Established Industry Codes and Standards

It was apparent, during the course of the interview, that the alleger felt certain established industry standards do not provide the desired degree of conservatism or clarity. Thus, the alleger felt that certain codes and standards, namely SNT-TC-1A (Nondestructive Testing Personnel

Qualification and Certification), AWS D1.1 (Structural Welding Code), and the ASME Boiler and Pressure Vessel Code, Division 1, Section III, should be revised to provide for additional conservatism and clarity. The alleger was requested to provide the NRC Region V office a letter detailing specific code topics, which he considered to be in need of revision, and recommendations for improvement.

5. Concerns Regarding Illegal Use of Controlled Substances

The alleger expressed concern regarding the possible use of narcotics ("dope") at the site by construction workers. While the alleger apparently had not seen narcotics used on site, he had "heard" about such use by construction personnel. The alleger could not provide specifics regarding identification of "dealers" or "users."

The NRC has surveyed various licensees concerning drug and alcohol abuse programs for operating nuclear power plants. Based upon the information gathered, the Task Force published NUREG-0903, which contains the results of the licensee meetings. In addition, a Fitness-for-Duty Rule, an amendement to 10 CFR 50.54, was published in the Federal Register on August 5, 1982. In view of the vagueness of this allegation no further specific action is planned for the San Onofre plants.

6. Alleged Violations of CAL-OSHA Requirements

In the course of the October 15, 1982 interview, and during the October 25, 1982 tour of the site, the alleger identified conditions which he stated were in violation of OSHA requirements. The alleger was informed that OSHA had regulatory cognizance of areas involving occupational health and safety and that these areas were outside the bounds of NRC jurisdiction. The NRC:RV contacted the Regional OSHA Office regarding the alleger's concerns. The OSHA representative requested that the alleger be provided the appropriate names and phone number of the cognizant OSHA representatives. The alleger was provided the names and telephone number of the regional OSHA representatives.

The concerns expressed by the alleger in this area are listed below:

a. The alleger stated that he observed cranes lifting loads with only one clip on the wire rope rigging assembly. The alleger could not state for certain whether or not the load being lifted was a nuclear safety-related component.

b. During the tour on October 25, 1982, the alleger stated that stairway handrails throughout the plant were made of piping material of outside diameter less than the 1.9 inches required by CAL-OSHA and the Uniform Building Code.

c. During the tour on October 25, 1982, the alleger pointed out several access ladders on which the bottom rung distance from the floor was not the same as the spacing between other rungs, as required by CAL-OSHA and other codes.

The above concerns are enumerated here to assure that the licensee has been made aware of each item so that appropriate evaluation and resolution may be effected by the licensee.

No items of noncompliance with or deviations from NRC requirements were identified.

7. <u>Concerns Regarding Non-Nuclear Safety-Related Areas</u>

During course of the October 15, 1982 interview and during the site tour on Octobe 25, 1982, the alleger identified several concerns which related to systems and components which were not classified as quality class 1 or 2 and as such are <u>not</u> nuclear safety-related.

The concerns identified by the alleger regarding non-nuclear-safety-related systems and components are listed below.

a. The alleger stated that welding of structural support steel used in the columns and roof of a site office building, designated as OB-1/2, was not in conformance with the AWS D1.1 code and Uniform Building Code.

b. The alleger pointed out several areas of significant corrosion in the fish traps area of Unit 1, a non-safety-related part of the plant. For example, the splash plate on the traveling screen enclosure was severely corroded; supports on the polyvinylchloride (PVC) chlorination line exhibited significant corrosion of the weld metal and base metal, and significant corrosion was evident on the trash bin crane structure.

c. The alleger stated that, in his opinion, weld ripple irregularities existed on the Unit 2 and 3 main turbine mounting structure welds. The welds, according to the alleger, were made by an offsite vendor and had only about four ripples per lineal inch of the weld. The alleger felt this could be caused by excessive welding speed or use of a large diameter welding electrode.

d. The alleger stated that he had seen rodent "holes" in the ground in the vicinity of the plant buildings and was concerned that those rodents, which may gain access to plant areas, may cause damage to electrical cable insulation. The alleger stated, however, that he had never seen rodent-caused damage to electrical cables at SONGS 1, 2 or 3.

The above concerns are enumerated here to assure that the licensee has been made aware of each item so that appropriate evaluation and resolution may be effected by the licensee.

No items of noncompliance or deviations were identified.

8. Allegations Regarding Nuclear Safety-Related Systems and Components

a. Allegation: "Pipe fitters sometimes used pipe cutters to make scribe marks for socket weld fitup measurements. These scribe marks caused grooves in both stainless and carbon steel pipes about 1 inch back from the weld area. I am concerned that these grooves might cause stress raisers. These conditions exist on socket welded fittings at random in Units 2 and 3, and possibly a few in Unit 1."

NRC Findings: The allegation was not substantiated.

Bechtel has established procedure WPI/QCI-400 (ASME Section III Piping Installation) as the work plan and inspection instruction for the installation, inspection, and documentation of piping to which the ASME B&PV Code, Section III, Division 1, Classes 1, 2 and 3 are applicable. Paragraph 6.2.8.1 of this procedure establishes acceptance criteria for surface defects in the wall of pipe and socket welded fittings as "having a depth not exceeding 5% of the nominal pipe wall thickness or 1/16", whichever is less." Simple calculation establishes that for the 1/16" criteria to be limiting the pipe wall thickness must be on the order of 1.25" and greater. Piping with that large wall thickness is butt welded and not socket welded.

In order to preclude establishing crud traps, Bechtel does not normally use socket welded fittings on systems containing radioactive fluids, thus minimizing radiation "hot spots" in piping systems due to crud entrapment in the socket fitting/pipe gap area. Socket welded fittings are, however, used in vent and drain configurations in radioactive fluid systems and are used in the Chemical and Volume Control System. The thinnest wall pipe used extensively in socket welded fittings (Schedule 40S) would provide a limiting depth of about 0.006" in order to approach the 5% criterion limit. Bechtel uses socket welded fittings on 2 inch and smaller piping. The thickest wall piping, on which socket welded fittings are used, is 2" schedule 160 carbon steel which has a nominal wall thickness of 0.344 inches. Therefore, the 1/16 inch criterion would not be the limiting condition and, instead, the 5% of nominal wall thickness would be the limiting criterion for socket welded fittings.

One instance was identified, to the inspector, where a pipe cutter had been used to scribe a pipe. Nonconformance Report (NCR) No. P-3330 documents the improper use of a pipe cutter to put the scribe line on a 3/4 inch, carbon steel, schedule 160 pipe in the Unit 3 Auxiliary Feedwater System. The scribe line was repaired and the pipe was verified to comply with code specified minimum wall thickness requirements. The NCR was written on August 25, 1981. The apparent cause of the discrepancy was identified on the NCR as craft error. To prevent recurrence, craft supervisors were required to instruct their men on the proper manner for making scribe lines, and document the giving of these instructions on an attachment to the NCR.

The inspector interviewed several pipefitters to determine if pipe/tubing cutters were ever used by them or others on their crews to make socket weld scribe marks. The pipefitters stated that none had ever used pipe cutters or tubing cutters, nor had they ever seen one used on site, to make the scribe marks used in socket weld fitup measurements. All of the fitters interviewed stated that they had received specific instructions, at the beginning of their employment onsite, that prohibited the use of pipe/tubing cutters for making the socket weld fitup scribe marks. All pipe fitters interviewed had worked at San Onofre since the 1974-1977 time period. Therefore, the inspector concludes that such use of pipe/tubing cutters was not an established practice among the crafts.

To determine the practices and criteria used by inspectors in the inspection process of socket welded fittings, the inspector interviewed Welding Quality Control Engineers (WQCE) and their Supervision. These interviews established that the WQCEs did not utilize pit gages in all cases to verify compliance with the 5% of nominal wall criteria. These interviews also established that if the WQCEs observed cases where the scribe line looked excessively deep, a pit gage was used to determine the depth of the mark and establish conformance with the 5% of nominal wall criteria.

The WQCEs and crafts personnel were knowledgeable of acceptance criteria and limits in the conduct of their particular activities.

According to the pipefitters interviewed, early in the pipe socket welding program Bechtel had constructed jigs of various sizes to facilitate the installation of scribe marks on socket weld fittings and pipe in accordance with pre-established criteria for the locations of the scribe marks. The marking unit was a pointed screw type marker or plunger type marker. The depth of the mark is a function of how much pressure the craftsman applies to either the plungers (not a spring loaded plunger) or the pipe. In other instances, the placement of scribe marks was made using a machinists scale and a Vibra-etcher.

To establish a basis for the conduct of field examinations, the NRC inspector scribe marked various sizes and schedules of carbon steel and stainless steel pipe, using both a pipe/tubing cutter and the special scribing tool constructed and commonly used by Bechtel for that purpose. When using the scribing tool, the inspector applied the maximum force that he could physically apply to assure that the scribe mark depth would be maximized.

The marks made by the pipe/tubing cutters were rounded at the bottom of the mark and material had been forced up on each side of the indentation. Scribe marks made using the special tool did not exhibit the above characteristics and, furthermore, did not circumscribe a perfectly uniform, even line onto the pipe. Based upon visual comparison of the scribe marks made using both methods, the inspector concluded that to an individual not familiar with the unique differences, the scribe marks made using the special tool may appear to have been made with a pipe/tubing cutter, when in fact they were not.

The inspector made measurements of scribe mark depth using a pit gage. The inspector established that, even when using maximum force, the scribe marks made using the special tool developed by Bechtel did not in any case make a scribe mark exceeding the 5% of nominal wall criteria even on the thinnest piping utilized (Schedule 40S) in socket welds at Units 2 and 3. To establish a basis for judgment of scribe line depth, to be observed in the field, the inspector scribed lines of varying depth using the pipe/tubing cutter on pipe samples.

The inspector examined a sample of about 200 socket welded fittings of varying sizes in the Units 2 and 3 Auxiliary Feedwater pump rooms, Component Cooling Water piping in three Unit 3 Safety Injection pump rooms, and one Component Cooling Water Surge Tank room. The inspector measured the distances between scribe lines on many of these fittings to verify compliance with established acceptance criteria. In addition, the inspector measured the depth of the marks on several of the fittings inspected.

Based upon the above field examinations, the inspector concluded that:

- scribe marks had been made using either the special Bechtel tool or a vibra-etcher.

- none of the scribed lines observed exceeded the 5% of nominal wall criteria.

- the maximum scribe mark depth was on the order of about 0.003 inches.

- minimum allowable wall thickness specified by the code could not have been violated by the scribe marks.

Based upon the results of the above examinations and the fact that Bechtel utilizes the same practices and procedures at Unit 1, the inspector concluded that inspections of Unit 1 were not warranted. In addition, the majority of Unit 1 socket welding was performed during the initial construction phase in the 1960s.

Bechtel engineering personnel performed calculations, on October 22, 1982, demonstrating that a notch depth of 5% of nominal wall would not cause stress raisers sufficient to cause Code design margins to be exceeded. The calculations were performed for several systems ranging in design pressure and temperature from 200 psi and 200°F up to 2735 psi and 560°F. The results indicated that design margins remaining ranged from 35% to 800% above calculated minimum wall thickness. The calculations had been performed using Code specified techniques.

No items of noncompliance or deviations were identified.

b. Allegation: "Bechtel designers use fillet welds on connections of beams in pipe supports and tray hangers and do not weld all around the joint to restrain forces in all directions. I feel this is a code violation. No prototype tests to my personal knowledge were conducted to verify the adequacy of these welds. Therefore, the actual structural strength of the electrical tray hanger/tube steel welds used or the actual material at SONGS may not be truly known. This also applies to the pipe supports. I also feel that the often partial joint strength (less than full joint integrity) and failure to weld all around the joint is a generic problem. Unfortunately, and in my opinion, the codes do not always demand full strength welding, whether all around or not."

NRC Findings: The allegation was not substantiated.

The alleger's contention that the failure to weld all around is a code violation could not be substantiated. No existing provision in any applicable industry structural design code requires fully welded joints for structural, pipe support, or electrical raceway support designs. It is the designer's (Bechtel) contention that the Engineer has designed all welded connections with due consideration for the intended function, applicable codes, regulatory requirements, and other applicable considerations.

The alleger's contention that no prototype testing was conducted on the adequacy of pipe support and tray hanger welds was substantiated. However, since the design at San Onofre 2/3 utilizes no unusual materials or details and utilizes accepted industry and code applications, prototype testing of welds was not considered necessary by the designer. The NRC staff's evaluation of this topic is contained in Appendix No. 4.

No items of noncompliance or deviations were identified.

c. Allegation: "The ASME Code requires adequate root penetration of fillet welds. I recall that some of the vendor supplied welded hardware appeared to not have adequate root penetration. The one vendor I recall is "Zack," I believe a supplier of HVAC equipment. I remember one instance on a piece of Zack hardware where a fillet weld with inadequate welding was identified during inspection on site. This instance was subsequently corrected by weld repair after installation in the plant. I don't remember if this equipment was used in SONGS Units 2 and 3. I recommend that the NRC examine the beginning and end of fillet welds to assure root penetration at these areas and verify that all craters are filled, and conduct destructive testing of selected supports supplied by this vendor to determine if other fillet welds and groove welds have adequate root penetration or other code violations."

NRC Finding: The allegation was not substantiated.

University Mechanical, Engineers-Constructors (UMEC), the contractor responsible for the installation and erection of HVAC equipment and supports at San Onofre Units 2/3, has not procured or installed any equipment supplied by a company named "Zack." This is true not only for safety-related equipment, but also for non-safety-related equipment. A review of UMEC's approved vendor list from August 28, 1975 to the present did not identify any company/vendor named "Zack."

In addition, the inspector contacted contract administrators for both Bechtel and Southern California Edison (SCE) to ascertain whether a company called Zack had ever supplied any equipment/components to the San Onofre Units 2/3 site. Discussions with Bechtel contract administrators, both onsite and at their Norwalk office, indicated that Bechtel had dealt with a company called "Zack," however, that company was "Zack Electronics," and the items procured were electrical resistors.

Discussion with SCE contract administrators indicated that for San Onofre Units 1, 2, and 3, no equipment or components had ever been procured from a company by the name of Zack.

It was established that Zack is a midwestern company doing business in the Region III area. The content of this allegation was supplied to NRC Region III investigators for evaluation at the Midland and Palisades Nuclear Plants.

No items of noncompliance or deviations were identified.

d. Allegation: "A steel bracket would be placed, I was told between a Unit 1 hydrogen line on trip for steam generator. This was done because the hydrogen line had worn thin due to rubbing with another line. I believe maintenance people at the site, who were working during the period when damage due to the Unit 1 diesel generator fire was being corrected, would remember and be able to locate the design change and spacer. I don't recall the exact location of the hydrogen line. To the best of my recollection, there wasn't equipment within ten feet. I don't remember if there was any nuclear safety-related equipment nearby. I am concerned for the integrity of nuclear safety-related equipment, if located nearby, and about the potential for loss of human life and fire, should this line rupture. I recommend NRC conduct an examination of this hydrogen line and make certain it has sufficient wall thickness to be safely operated. Most likely, I prevented a major fire in Unit 1 and probably saved the lives of several (or more) working there!"

NRC Findings: The specific allegation as related to the potentially thin hydrogen pipe wall, due to rubbing with another line, was not substantiated.

A hydrogen line "on trip for steam generator" does not exist at Unit 1. The reactor protection circuitry and sensors for the steam generator protective functions, or any other safety-related protective functions, do not use hydrogen as a medium. The line most probably referred to here by the alleger is the hydrogen line to the main electrical generator. This hydrogen system is not a nuclear safety-related system.

The inspector examined the line from the hydrogen bottles to its termination points. The line is a schedule 40 size piping system ranging in diameter from about ½ inch to 1 inch. The hydrogen in this line operates at about 60 psig. The maximum operating pressure is 90 psig. The inspector performed a hand-over-hand examination of this system. The inspector did not identify any instances where fretting could have been severe enough to erode the pipe wall material to a point such that the minimum wall thickness of the pipe could be encroached upon.

In the course of the walkdown, the inspector identified the following:

- Four line supports were missing.
- One support was not connected to the overhead anchor point and was hanging from the pipe.
- The line was supported with baling wire at one point and with duct tape at another.

- The line was routed beneath a cable tray, purportedly containing safety-related cables, for a distance of about 20 feet and within about 6 feet of the Auxiliary Feedwater pump.

The licensee took the following action upon identification of the above conditions:

- An inspection of the hydrogen line installation was conducted by the Unit 1 QA/QC organization.
- Deficient conditions identified during that inspection were identified by Nonconformance Report SO1-P-1221 and will be resolved in accordance with the established nonconformance reporting system.

The proximity of the line to safety-related components was referred to the licensee's Configuration Control and Compliance organization for evaluation and resolution of the safety implications of a postulated line failure.

During the tour the alleger could not locate the line on which he had previously observed the alleged condition.

No items of noncompliance or deviations were identified.

e. Allegation: "I am of the opinion that weld end returns are not required on Bechtel drawings. This is in violation of AWS-D1.1, Section 8, 1974 Edition, paragraphs 8.8.6, 8.8.6.1, and 8.8.6.2. These conditions exist on details in many structural applications. A two-page Bechtel Power Corporation table establishes that certain pipe supports and other items must conform to AWS D1.1 requirements."

NRC Findings: The allegation was not substantiated.

The licensee is committed to AWS D1.1, 1972 Edition. AWS D1.1-1972, paragraph 8.8.6.1 states that, "Side or end fillet welds terminating at ends or sides, respectively, of parts or members shall, wherever practicable, be returned continuously around the corners for a distance at least twice the nominal size of the weld except as provided in 8.8.5."

Paragraph 8.8.5 of AWS D1.1-1972 states that, "Fillet welds deposited on the opposite sides of a common plane of contact between two parts shall be interrupted at the corner common to both welds. (See Fig. 8.8.5)"

Discussions with Bechtel engineers indicated that Bechtel considers all welded connections as "engineered joints." An "engineered joint" is one that has had all the appropriate factors (dead and seismic loading, etc.) taken into account. Therefore, Bechtel interprets the AWS D1.1 requirement for end returns as an engineering prerogative; that is, end returns are specified when the engineer determines that end returns are needed to attain required structural strength.

The inspector's review of Bechtel pipe support assembly drawings determined that end returns are not normally specified. The inspector found that most drawing details on civil and pipe support drawings require welding on three sides or all around for angle clip connections. However, two instances of required end returns were identified to the inspector. In the first, a Design Change Notice (DCN) was issued when the original support was redesigned to allow installation. The new design specified a "one inch" end return. The inspector visually examined this pipe support and verified that the end return was as specified in the DCN. The inspector observed the second instance in the field. A main steam line pipe support was installed with angle clip connections using end returns. The inspector reviewed the drawings for the pipe support and noted that the end returns were as specified.

In addition, the inspector reviewed seven additional Bechtel civil drawings where end returns were specified. These drawings were for a combination of safety and non-safety-related structures. The inspector verified in the field that all welding was as required on the drawings.

A copy of the referenced two-page table was received from the alleger on November 15, 1982. The document is dated January 31, 1980; however, the document doesn't contain any identification as to the source (i.e., procedure, specification or training aid).

Page 1 of the document does establish that certain pipe supports, raceway supports, and structural steel defined as Quality Class I and II (nuclear-safety-related) and Quality Class III and IV (non-nuclear-safety-related) must conform to AWS D1.1. The inspector found that this document's definitions of AWS D1.1 applicability are consistent with those provided by Bechtel Specifications CS-P206, CS-P207, and CS-C16.

Page 2 of the document is titled, Pipe Support Weld Form Preparation, and, as such, appears to provide information regarding which weld form type (WR-5, 5A, 6 or 7) is to be prepared for the various quality classes/applications of welds. Notations made on the form, presumably by the alleger, indicate the alleger's belief that all weld types and all structural weld locations on pipe supports must conform to AWS D1.1 for Quality Class I and II applications.

The ASME Code requires that connection welds to pipe supports within the NF boundary conform to the ASME Code, Section III, Subsection NF. This requirement is properly implemented by Bechtel Construction Specifications CS-P206 and CS-P207. These specifications further require that field welding on the structural portion of pipe supports shall be in accordance with the ASME B&PV Code, for connection welds to pipe supports within the NF boundary, and the AWS D1.1 code, for connection welds to non-ASME code pipe supports or pipe support welds beyond the NF boundary. It, therefore, appears that Bechtel Specifications correctly assign code jurisdictional boundaries and provide for appropriate inspection criteria within those jurisdictional boundaries.

Therefore, the alleger's statement that the two-page table requires that certain pipe supports and other items must conform to AWS D1.1 is correct. The concern that end returns were not consistently used was evaluated by NRR and is addressed in the Safety Evaluation Report, attached as Appendix 4 to this inspection report.

No items of noncompliance or deviations were identified.

f. Allegation: "Bechtel Construction Specification CS-P207, Revision 7, dated April 18, 1980, paragraphs 5.6 and 5.7, contains visual examination criteria used by Bechtel for pipe supports and reference(s) the ASME B&PV Code, Section III, Subsection NF. I may have told John O'Dell, investigative reporter for the Los Angeles Times, that I believe the visual criteria of CS-P207 are not in accordance with the above code requirements, particularly in CS-P207, paragraphs 5.6.1.3 (porosity and slag), weld convexity height acceptance criteria, 5.6.1.9 (underfilled groove weld craters), 5.6.1.11 (arc strike acceptance criteria), and 5.7.2 (allowing groove welds with fillet caps to be welded as fillet welds)."

NRC Findings: The allegation was not substantiated.

The alleger's apparent contention is that the visual acceptance criteria contained in CS-P207 for examining finished welds on pipe supports does not comply with the ASME Code, Section III, Subsection NF.

All of the pipe support welds are not within the jurisdictional boundary of Subsection NF. Only those portions of the pipe support within the NF boundary are subject to the requirements of Subsection NF. The NF boundary is specified by the engineer on the applicable pipe support assembly drawing. The Subsection NF jurisdictional boundaries are established by the engineer in accordance with the criteria contained in Article 1000 of Subsection NF. Outside the NF boundary, the American Institute of Steel Construction (AISC) specification and the American Welding Society (AWS) Structural Welding Code D1.1 are utilized.

Any attachments made to the pressure boundary (the pipe) are subject to the requirements of the appropriate code subsection. The applicable subsections in this case would be Subsection NB (Class 1), Subsection NC (Class 2), or Subsection ND (Class 3).

Therefore, although Subsection NF pipe support welds are structural welds, the welds are not visually examined under the rules and requirements of AWS D1 1, the Structural Welding Code. Rather, the visual examination criteria are contained in CS-P207, which reflects and amplifies the requirements of the ASME Code, Section III, Subsection NF.

Licensee and Bechtel representatives, on October 18 and 23, 1982, presented information to the inspectors to reconcile the apparent differences between the ASME Code Section III, Subsection NF and CS-P207.

The results of the NRC staff's evaluation of the criteria contained in CS-P207 are provided in Appendix 4 to this report.

The following paragraphs of CS-P207 were examined and compared to code requirements.

(1) Paragraph 5.6.1.1 of CS-P207 states that, "The weld meets or exceeds specified size requirements. Either or both fillet weld legs may exceed design size by 3/16 inch for welds up to and including 5/16 inch fillet, and 1/4 inch for welds larger than 5/16 inch fillet. Welds may be longer than specified. Continuous welds may be accepted in place of intermittent welds."

The ASME Code, Section III, Subsection NF, does not specifically address the above requirements. This paragraph of CS-P207 provides additional weld acceptance/rejection guidance not provided by the Code.

No items of noncompliance or deviations were identified.

(2) Paragraph 5.6.1.2 of CS-P207 states that, "The fillet leg dimension may not under run the nominal fillet size by more than 1/16 inch for more than 10 percent of the weld length. For flange to web joints, the undersize may not be within two flange thickness of the weld end."

The ASME C de, Section III, Subsection NF does not address this criteria. However, ASME Code Interpretation No. III-80-109, Question (4) (in reply to whether undersize dimensions greater than 1/16 inch are considered relevant indications in accordance with NF-5360(a)) indicates that paragraph NF-5360 addresses weld metal indications only, and that it does not address underrun on fillet size or length. Therefore, the criteria specified in CS-P207, paragraph 5.6.1.2, appears to contain additional weld acceptance/rejection guidance not provided by the Code.

No items of noncompliance or deviations were identified.

(3) Paragraph 5.6.1.3 of CS-P207 states that, "Porosity and slag shall not be cause for rejection."

The ASME Code, Section III, Subsection NF does not address porosity and slag. Discussions with cognizant Quality Control inspectors indicated that porosity and slag are weld surface conditions which inhibit weld examination and are routinely removed prior to examination and acceptance of the weld. While it is true that this statement contains no acceptance/rejection limits (on slag and porosity) this single statement from CS-P207 cannot be taken out of context without consideration of the overall Bechtel quality program, which includes training, testing, and qualification of welders, inspectors, and welding procedures to obtain a quality product. Bechtel personnel stated that although paragraph 5.6.1.3 of CS-P207 states that, "Porosity and slag shall not be cause for rejection," the intent, as recognized by QC inspection personnel, is that the existence of porosity and slag preclude the ability to visually examine the weld. As such, the removal of porosity and slag is necessary to facilitate visual examination of the weld to determine if the weld is acceptable or rejectable.

No items of noncompliance or deviations were identified.

(4) Paragraph 5.6.1.4 of CS-P207 states that, "Convexity height may be accepted without limit. Rollover (overlap) not exceeding 1/8 inch is acceptable provided the toe or fusion line of the weld remains visible for examination."

The ASME Code, Section III, Subsection NF, Subarticle NF-4427, "Shape and size of fillet welds," states that, "Fillet welds may vary from convex to concave. The size of the fillet weld shall be determined in accordance with figure NF-4427-1." Figure NF-4427-1 depicts what actually constitutes the weld size depending on whether the weld is concave, convex, or of unequal leg size. Discussions with Bechtel engineers indicated that weld convexity is self limiting by the nature and type of weld process used and will not cause significant stress concentrations to be produced at the weld. Also, ASME Code Interpretation No. III-80-109, Question (1), in reply to whether NF provides requirements for the maximum convexity of fillet welds, states that NF does not address this subject.

Overlap is addressed in Subarticle NF-4424, "Surfaces of Welds," which states in part that, "The surfaces of welds shall be sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges and valleys ...." However, since the Code does not provide any more definitive criteria than that contained in NF-4424 for overlap, it therefore appears that paragraph 5.6.1.4 of CS-P207 provides additional acceptance/rejection guidance which is not provided in the Code.

No items of noncompliance or deviations were identified.

(5) Paragraph 5.6.1.5 of CS-P207 states that, "The height of reinforcement of butt welds on each face of the weld shall not exceed the following:

Nominal Thickness, Inches	Maximum Reinforcement, Inches
Up to 1, inclusive	3/32
Over 1 to 2, inclusive	1/8
Over 2 to 3, inclusive	5/32
Over 3 to 4, inclusive	7/32
Over 4 to 5, inclusive	1/4
Over 5	5/16

This paragraph is identical to the criteria specified in the ASME Code, Section III, Subsection NF, Subarticle NF-4426.

No items of noncompliance or deviations were identified.

(6) Paragraph 5.6.1.6 of CS-P207 states that, "There are no cracks or linear indications in the weld exceeding 1/16 inch."

This paragraph is consistent with the requirements of the ASME Code, Section III, Subsection NF, Subarticle NF-5360(a), which permits indications up to 1/16 inch and Subarticle NF-5360(b), which prohibits the acceptance of any cracks.

No items of noncompliance or deviations were identified.

(7) Paragraph 5.6.1.7 of CS-P207 states that, "Thorough fusion exists between the weld metal and base metal, except as permitted as rollover in paragraph 5.6.1.4."

The ASME Code, Section III, Subsection NF, does not address this subject; therefore, paragraph 5.6.1.7 of CS-P207 appears to contain additional acceptance/rejection guidance which is not provided in the Code.

No items of noncompliance or deviations were identified.

(8) Paragraph 5.6.1.8 of CS-P207 states that, "Undercut (underfill) not exceeding 1/16 inch may be accepted for the full length of the weld provided it does not encroach on minimum design thickness. For members welded from both sides, the criteria shall be applied independently except that the cumulative depth shall not encroach on the minimum design thickness."

The ASME Code, Section III, Subsection NF, Subarticle NF-4424(c), "Surfaces of welds," states that "Undercuts shall not encroach on the required section thickness." Therefore, the criteria specified in paragraph 5.6.1.8 of CS-P207 appears to implement Code requirements.

No items of noncompliance or deviations were identified.

(9) Paragraph 5.6.1.9 of CS-P207 states that, "Underfilled groove weld craters shall be accepted provided the depth of underfill is 1/16 inch or less. Underfilled singlepass fillet weld craters shall be accepted provided the crater length is less than 10% of the weld length. On multi-pass fillet welds, crater depth 1/16 or less shall be accepted."

The ASME Code, Section III, Subsection NF, does not specifically address acceptance criteria for underfilled groove weld craters. However, ASME Code Interpretation No. III-80-109, Question (4), questioning whether undersize dimensions greater than 1/16 inch are considered relevant indications in accordance with NF-5360(a), replies that paragraph NF-5360 addresses weld metal indications only and that it does not address underrun on fillet size or length. Therefore, paragraph 5.6.1.9 of CS-P207 appears to provide additional acceptance/rejection guidance not provided by the code.

No items of noncompliance or deviations were identified.

(10) Paragraph 5.6.1.10 of CS-P207 states that, "Adherent weld spatter, not removable by wire brushing, is acceptable unless complete removal is required for further processing such as coating."

The ASME Code, Section III, Subsection NF, does not address removal of weld spatter. However, in response to a question concerning the removal of weld spatter, ASME Code Interpretation No. III-1-79-176 states that "It is not required by Section III, Division 1 and/or Division 2 that weld spatter be removed provided it does not interfere or limit subsequent Code required activities." Therefore, the criteria stated above is consistent with the ASME Code interpretation.

No items of noncompliance or deviations were identified.

(11) Paragraph 5.6.1.11 of CS-P207 states that, "Arc strikes are acceptable provided that the craters, (1) do not contain cracks (as determined by visual examination), and (2) maximum size does not exceed 3/8 inch plan nor 1/16 inch profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of visual examination."

The ASME Code, Section III, Subsection NF, does not specifically address the removal or acceptability of either arc strikes on the weldment or arc strikes on the NF pipe support material. However, for arc strikes on the weldment ASME Code Interpretation No. III-80-109, Question (3) (in reply to whether paragraph NF-4452, "Elimination of surface defects," includes arc strikes) states that NF-4452 provides for the elimination of weld metal (weldment) surface defects without reference to the cause of the surface defect. Discussions with cognizant Bechtel Quality Control inspectors indicated that arc strikes on the weldment are routinely removed as a matter of course, because such weld discontinuities inhibit weld examination.

For arc strikes on the NF pipe support material, Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI) procedure No. 400 addresses this subject. WPP/QCI No. 400, paragraph 6.2.8.4, states that, "Arc strikes found on pressure retaining material/ items and material/items welded thereto (including ASME Code Section III-NF materials) shall always be removed. Arc strikes shall be evaluated using the following guidelines:

(a) Arc strikes categorized as minor surface defects shall be removed, but no documentation is required (that is, the Supplemental Data Report will not be required) provided the depth does not encroach on tolerances described in paragraph 6.2.8.1(a)."

(b) Paragraph 6.2.8.1(a) states in part that, "The term minor surface defects' as used in this procedure shall be defined as defects in pipe having a depth not exceeding 5% of the nominal pipe wall thickness, or 1/16 inch, whichever is less."

However, even though the term "minor surface detects" pertains to defects in pipe, both the criteria in WPP/QCI-400 and the criteria contained in paragraph 5.6.1.11 of CS-P207 are utilized for inspection and evaluation of arc strikes on NF pipe support material. Therefore, since the code does not specifically address acceptance criteria for arc strikes on NF material, the requirements contained in paragraph 5.6.1.11 of CS-P207 provides evaluation/acceptance criteria which is not provided in the Code.

No items of noncompliance or deviations were identified.

(12) Paragraph 5.7.2 of CS-P207 states that, "Pipe support drawings for B31.1 piping that indicate full penetration groove welds with fillet covers may be welded as just fillet welds. The minimum fillet weld size for B31.1 pipe integral attachments shall be as follows:

a. Fillet weld size = (0.7) x (the wall thickness of the thinner of the pipe wall or the dummy stub wall).

b. If the attachment is tension load due to a snubber or variable spring hanger, engineering calculations must be performed to justify the strength of the weld."

The criteria specified in this paragraph is for non-safety-related piping systems designed and constructed to the requirements of ANSI B31.1. Discussion with cognizant Bechtel engineers indicated that the original design for all full penetration groove welds with fillet cover welds in B31.1 piping systems was found to be very conservative. Therefore, the criterion contained in 5.7.2.(a) was developed to specify the minimum fillet weld size that would be required for the intended function. The criterion contained in paragraph 5.7.2.(b) apparently has never been used, but was developed to assure substantiating calculations were performed when required.

No items of noncompliance or deviations were identified.

g. Allegation: "Bechtel generated (I was told) a 92 page NCR on electrical tray hangers. I question whether the welds made on electrical supports prior to the NCR resolution were adequately or completely fixed."

NRC Findings: The implied allegation, that the welds made on electrical tray supports, prior to the establishment of technical resolution for the concern identified by the referenced NCR, were not adequately or completely fixed, was not substantiated.

The NCR in question, No. E-1941, dated August 6, 1980, consists of 106 pages in its resolved and closed condition. The NCR identified a concern that flare-bevel welds may not be inspectable using previously established criteria and that welding symbols for such welds on drawings were not correctly shown on drawings. The NCR was based on conditions found to exist on four pieces of tube steel in the Unit 2 penetration area. The NCR resolution included the following:

(1) the acceptance criteria for flare-bevel welds were revised in Specification CS-C16, "Visual Inspection Criteria for Structural Steel and Miscellaneous Metal Welding to Meet Design Requirements"

(2) welding symbology for flare-bevel welds used on Bechtel drawings was determined to be acceptable as drawn

(3) a 100% inspection of all flare-bevel welds made on tube steel supporting electrical raceways, prior to the generation of the NCR, was conducted and documented in the NCR

(4) 15 tube steel supports were reworked as directed by Bechtel engineering

(5) all other supports identified by the field inspection reports attached to the NCR were determined, by Bechtel engineering, to be acceptable consistent with actual support loading and the revised acceptance criteria

This NCR was evaluated for reporting applicability pursuant to the requirements of 10 CFR 21 and 10 CFR 50.55(e) and determined to be non-reportable by the licensee. The inspector concurs with the licensee's determination.

The revised criteria for acceptance of flare-bevel welds were provided to the staff at NRR, for review, in April, 1981, by Amendment 24 to the FSAR revising FSAR section 3.8A, paragraph 3.8A.3.1.9.1.

Bechtel Engineering performed calculations, on December 31, 1980, to determine the capacity of flare-bevel welds at SONGS-2/3. The calculations were checked as required by the Bechtel design control program on July 10, 1981. In addition to determining the capacity of flare-bevel welds the engineer defined acceptance criteria for field inspection. The engineer used, as a basis, the computed weight of cable tray sections filled to design fill conditions. It should be noted that this assumption provides conservatism in that the predominant number of cable trays in the field are filled to less than design fill conditions. The analysis included consideration of dead load and seismic (dynamic) loading conditions. Additional conservatisms applied during the calculation process include:

- The weld was assumed to have a shear strength equal to that of the base material; not the weld rod, which has a much greater shear strength. The maximum allowed stress on the weld was, therefore, based on the maximums allowed by code for the base material.

- The bending moment assumed in the calculation process was the worst case condition. The span length required to give the maximum bending moment was computed to be about 21 feet. Since the span length encountered in the field is about 10 feet the maximum bending moment which could be attained under actual conditions is much less than the assumed bending moment used in the calculation.

Therefore, the inspector considers that Bechtel has shown justification for not filling all flare-bevel welds on tube steel to flush conditions.

Examination of the engineer's analysis, which specified acceptance criteria to be used by inspectors in determining acceptable flare-bevel weld size, raised questions as to where flush fill was required. Specification CS-C16, in paragraph 3.1.9.3, states "Flush welds shall apply when W is not specified." The inspector determined that dimension W was not specified on details 3, 4, 7, and 15 of drawing No. 25190; details 16, 17 and 23 of drawing 25191; and on detail 4 of drawing 25199. The inspector selected a sample of quality class 2 nuclear safety related supports, for field inspection to determine conformance with the flush fill requirements of specification CS-C16, above. The following Unit 3 supports, all HVAC were examined:

Support No.	Detail/Drawing No.
P-100 thru P-106	7/25190
P-116 and P-118	15/25190
C-394 and C-395	23/25191
C-397 and C-398	23/25191
C-794	23/25191

Examination of supports C-397, 398 and 794 in the field established that the specified attachment welds were not filled to flush. However, these instances had been previously identified, analyzed and accepted based on a completed nonconformance report resolution.

No items of noncompliance or deviations were identified.

h. Allegation: "Bechtel has not, in my opinion, complied with the requirements of AWS D.1.1 (1974 edition), paragraphs 5.12.1.5.(2).(b) and 8.15.1.3 regarding filling of open weld craters on tray hangers and other items to crossection of the weld.

NRC Findings: The allegation was not substantiated.

The SONGS-2/3 project is committed to the 1972 edition of AWS D1.1 (Structural Welding Code). Paragraph 5.12.1.5.(2) involves welding procedure qualification (not field weld inspection) of pipe welds and states that "For acceptable qualifications, the pipe weld, when inspected visually shall conform to the following requirements: ...(b) All craters shall be filled to the full cross section of the weld." Bechtel Specification WQ-2, implementing this section of the AWS D1.1 code, requires that weld reinforcement be removed by grinding flush with the surface of the specimen. The requirement for flush finish appears to be consistent with the requirement to fill open weld craters to full weld cross section.

AWS D1.1 paragraph 8.15.1 requires that all welds shall be visually inspected and defines as acceptance criteria "8.15.1.3 All craters are filled to the full cross section of the welds." Bechtel has provided in specification CS-C16, paragraph 3.3.3, that "Underfilled groove weld craters shall be accepted provided that the depth of underfill is 1/16 inch or less. Underfilled single-pass fillet weld craters shall be accepted provided the crater length is less than 10 percent of the weld length. On multi-pass fillet welds crater depth 1/16 inch or less shall be accepted." Specification CS-C16 is included in the SONGS-2/3 FSAR as Section 3.8A. The Final Safety Analysis Report (FSAR) was submitted to the NRC as a part of the application for Operating License.

The Bechtel Engineering position is that the criteria of CS-C16 are based on conservative evaluation of the decreased load carrying effective throat area and the fact that the weld metal used in welding of steel structures has a substantially higher minimum specified yield strength than does the base metal to which the weld metal is fused.

Bechtel appears to have used code allowed engineering prerogative judgement in the definition of weld crater acceptance criteria based on evaluation of additional conservatisms applied by Bechtel in the engineering of structural joints.

The results of the NRC staff's evaluation of the Bechtel criteria regarding filling of craters is contained in Appendix 4 to this report.

No items of noncompliance or deviations were identified.

i. Allegation: "Bechtel has not in my opinion removed all arc strikes or blemishes from base metal on pipe supports or structural steel as required by AWS D1.1 paragraph 4.4."

NRC Findings: The allegation was not substantiated.

The alleger's concerns apparently are not based on his personal experiences during his four weeks in the field but on the words contained in two Bechtel construction specifications.

Construction Specifications CS-C16 (paragraph 3.3.7) and CS-P207 (paragraph 5.6.1.11) both state that "Arc strikes are acceptable, provided that the craters, (1) do not contain cracks (as determined by visual examination), and (2) maximum size does not exceed 3/8" plan nor 1/16" profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of visual examination."

AWS D1.1 states in paragraph 4.4 that "Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness."

The inspector could not find any arc strikes in the field which had not already been identified and dispositioned by Bechtel. Therefore, the inspector requested that an arc strike demonstration be performed. The purpose was to determine the effectiveness of Bechtel's arc strike evaluation criteria. Bechtel agreed to the demonstration and provided the welder and representative samples of structural steel and pipe support material. Three arc strikes, of varying severity degrees, were made on each of three test materials; ASTM-A36 plate, ASTM-A36 square tube and 516 Grade 70 plate. Discussions with Bechtel welders and quality control engineers indicated that arc strikes are never considered "accept as is" until evaluated. Bechtel field practices were provided for in this demonstration in that the surface of the material was prepared prior to evaluation; light arc strikes were buffed with emery cloth whereas heavy arc strikes containing weld rod deposits were ground out. The test specimens were then visually examined by the inspector and the Bechtel quality engineer. Visual examination established that cracks did not exist in the demonstration sample material. In order to determine the effectiveness of visual examinations used to determine the absence of cracks, a liquid penetrant examination was performed on these areas. The liquid penetrant examination verified that cracks did not exist in the demonstration materials and, therefore, provides confidence in the effectiveness of visual examination techniques utilized in the field. Ultrasonic examination of the ground surface was performed and verified that minimum section thickness criteria had not been violated in the grinding process.

In order to establish whether the arc strike evaluation criteria used in this demonstration was also reflected in Bechtel's procedures or instructions, the inspector reviewed the following documents relating to arc strikes found on ASME or AWS material.

(1) <u>WPP/QCI-400 (ASME Section III Piping Installation)</u> This procedure also applies to ASME Section III, Subsection NF material. Arc strikes are addressed in the following sections of this WPP/QCI:

- 6.2.8.2 - requires all arc strikes to be investigated.

- 6.2.8.4 - states that "Arc strikes found on pressure retaining material/items and material/items welded thereto (including ASME Code Section III-NF material) shall always be removed. Arc strikes shall be evaluated using the following guidelines:

  (a) If the arc strike is categorized as a minor surface defect it is removed but no documentation is required.

(b) Arc strikes not categorized as minor are required to be removed and documented on an Supplemental Data Report for Surface Defect Repair (SDR)." The SDR contains requirements regarding grinding, ultrasonic and liquid penetrant examinations.

(2) WPP/QCI-202 (Welding Control For AWS D1.1 Welding) Section 4.2.2 requires that arc strikes on structural steel be evaluated per CS-C16 and, if not acceptable, an NCR (Nonconformance Report) be prepared. CS-C16 and CS-P207 state that arc strikes are acceptable provided they do not contain cracks. Cracks are dispositioned, that is ground out and checked for soundness, in the resolution of an NCR. This is in compliance with AWS D1.1 which states that cracks caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

CS-C16 and CS-P207 also state that arc strikes shall be free of any foreign deposits which might interfere with the performance of proper visual examination. Bechtel considers that foreign deposits include blemishes. This is in compliance with AWS D1.1 which states that blemishes shall be ground to a smooth contour and checked to ensure soundness.

The inspector reviewed the qualification records of seven Bechtel welding quality control engineers. Their resumes indicated that all had the necessary education and/or work experience to qualify as a welding inspector. In addition, review of the training records revealed that these individuals were required to be familiar with construction specifications CS-C16 and CS-P207, and with implementing procedures WPP/QCI-400 and WPP/QCI-202, regarding investigation and evaluation of arc strikes. The inspector concludes that Bechtel does require evaluation of and remedial action for arc strikes consistent with the Code and the criteria of CS-C16.

The inspectors examined portions of several safety related piping systems and did not observe any arc strikes.

No items of noncompliance or deviations were identified.

j. Allegation; "I observed instances where run off plates had not been used as required by AWS D1.1 paragraph 4.6 on groove weld terminations. I cannot recall any specific locations, but I do recall observing this condition on beam and girder splices, as supplied by at least one vendor."

NRC Findings: The allegation was not substantiated.

AWS D1.1 - 1972, paragraph 4.6.1, states that, "Groove welds shall be terminated at the ends of a joint in a manner that will ensure sound welds. Where possible this shall be done by the use of extension bars or runoff plates."

Discussions with Bechtel engineers indicated that runoff plates or extension bars re generally restricted to high current density automated welding processes, such as submerged and gas metal arc machine welding processes, where the control of the weld end fill is not possible. This type of welding is usually not done at the plant site and would generally be seen at a supplier/vendor shop manufacturing the structural steel weldments on a large scale. Bechtel engineers also stated that where extension bars are not used, the beam or structural material is cut off at a point where the material is full section and meets the length requirements of the Purchase Order. Runoff plates are not normally used at the site since the main welding process is shielded metal arc, a low current density process wherein the welder can and does control weld-end fill to ensure a sound weld.

A review of four Purchase Orders, for structural steel and shapes, and the reference specifications indicated that Section 4.0 of the specifications titled "Specific Technical Conditions" stated that all welding was to be done in accordance with the requirements of AWS D1.1 and that each weld was to be uniform in width and size throughout its full length.

The inspector examined several exposed structural steel beams and columns and did not identify any instances of improper run off plate use.

No items of noncompliance or deviations were identified.

k. Allegation: "I believe that a spacer plate is missing on the upper inside door hinge of the Unit 2 containment personnel hatch because I observed a gap in the weld joint of about 1/4 inch. I brought this to the attention of my supervisor (name) who also shared that belief. I believe that by bringing this condition to the attention of my supervisor I had properly performed my duty to identify this condition. I did not compare the drawing requirements to the installed condition in making this determination of a missing spacer plate because my supervisor had indicated to me that it was the vendor's problem to correct it and I had other work to do immediately."

NRC Findings: The allegation was not substantiated.

The inspector examined the as-installed condition of the upper hinge plate assembly for the Unit 2 containment personnel hatch and compared the as-installed condition to the requirements of Drawing No. S023-205-369-4, section "H-H." The inspector measured a gap of about 3/16" between two plates which had been welded together. The drawing shows that no gap was the as-designed condition and, further, the drawing did not specify the installation of a spacer plate in that location. The inspector further measured and visually examined the fillet weld size and quality at the location specified and observed that the specified 1/2 inch fillet weld was undersized (about ~ 0.3 inch throat dimension) over about 3 inches of a total length of about 13 inches. The inspector further noted that Chicago Bridge and Iron, the supplier and fabricator of the containment personnel hatch assembly, had installed additional weld metal to increase the leg size of the fillet weld to compensate for the excessive fitup gap.

This same concern was brought to the attention of the licensee on September 7, 1982 during the licensee's interview of the alleger. The licensee had investigated the alleger's concern and documented the results of that investigation. The inspector examined the licensee's investigation results and interviewed the alleger's former supervisor, to whom the alleger had originally expressed this concern. The results of the NRC examinations and interview are detailed below.

The alleger's former supervisor stated that he had observed, in the company of the alleger, the fitup gap at the specified location and that he had instructed the alleger to obtain drawings, determine what was specified, ascertain whether the installed condition conformed to drawing requirements, and write a noncomformance report if the as-installed condition did not correspond to drawing requirements. On March 9, 1981 the alleger asked his former supervisor what he had done about the observed condition. The alleger evidently believed that his former supervisor had taken action to resolve the situation. The alleger's former supervisor then wrote a Field Inspection Report, dated March 10, 1981, documenting this fact and identified the condition to the Bechtel Lead Civil Field Engineer.

The Bechtel Lead Civil Field Engineer took action to have the installed condition examined by a Bechtel Welding Quality Control Engineer and documented the results of this examination by telephone notes dated March 10, 1981. This document identifies that the weld in question did have a 3/16 inch fitup gap and had a throat dimension of 0.296 inches over a three inch length and stated that the nominal throat dimension for a 1/2 inch fillet weld was required to be 0.35 inches. The conditions were described to two Bechtel Civil Engineers in Norwalk, California and the telephone note documents that these engineers determined that the as-installed condition could be left-as-is with no detrimental effect on the structure.

Following the licensee's interview of the alleger on September 7, 1982, the licensee requested that Bechtel analyze the as-installed condition and provide a determination of whether the installed condition was adequate. Bechtel performed calculations of the installed condition, based on the Chicago Bridge and Iron stress report for the personnel hatch, and determined that the existing weld on the upper hinge supports, even with the 3/16 inch gap, is adequate to carry all imposed design loads. These calculations were performed on September 10, 1982 and reviewed and stamped by a Registered Professional Engineer in the Civil Engineering discipline. The inspector reviewed the calculation and observed that the actual computed loads resulted in much less than the code allowed stress levels, thus confirming the conclusion previously reached by Bechtel Engineers on March 10, 1981.

No items of noncompliance or deviations were identified.

1. Allegation: I believe that Bechtel has misinterpreted the requirements of the ASME Section III welding standards regarding socket weld engagement length without initiating a code case and obtaining appropriate code relief. The ASME code requires a gap between the pipe end and the fitting of "approximately 1/16 inch." I believe that the code should provide a more definitive acceptance criteria than merely "approximately 1/16 inch."

NRC Findings: The allegation was not substantiated.

The ASME Code Section III, Subsection NC, paragraph 4427, "Shape and size of fillet welds", states that, "Fillet welds may vary from convex to concave. The size of the weld shall be determined in accordance with figure NC 4427-1." Figure NC-4427-1 specifies that the gap between the pipe end and the fitting shall be "approximately 1/16 inch before welding." While it is true that the Code does not provide a more definitive criteria for the socket weld fitup gap, the Bechtel socket weld procedures (which are used at all three units) do provide for definite limits on the fitup gap.

Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI) No. 200, Appendix II, Revision 13.0, paragraph 6.3.1.4 states that, "For socket welds, the fit-up root gap shall be controlled at all times to ensure having a 1/16 inch minimum and 1/8 inch maximum gap before welding. To accomplish this, during fit-up, line(s) (minimum 1/2 inch long) shall be scribed on both the fitting and the pipe so that when the pipe is fully inserted into the fitting, the lines are separated by a finite distance (x), predetermined prior to weld by the LFWE for each case and recorded on the WR-5A (or WR-5 if used). When possible, this distance (x) shall be 2 inches. After scribing, the pipe shall be withdrawn from the fitting at least 1/16 and no more than 1/8 inch so that after fit-up, the scribe marks shall be separated by a distance equal to x + 1/16 inch to x + 1/8 inch. After welding, any measurement greater than x, but less than x + 1/8 inch between the scribe markes, ensures that the initial fit-up gap was adequate."

A review of the Welding Procedure Specifications (WPS) used for socket welding, and the referenced General Welding Standards (GWS), indicated that the socket weld fitup root gap criteria specified in

WPP/QCI No. 200 was also contained in the referenced GWS. The General Welding Standards essentially provide additional welding information and are used in conjunction with the Welding Procedure Specification.

A review of earlier revisions of WPP/QCI No. 200 (from 1980 to the present) indicated that paragraph 6.3.1.4 had not been altered or changed in any manner from its present form. The 1980 to 1981 time frame was the period that the alleger was at the San Onofre site.

Discussion with Bechtel engineers, and a review of the ASME Code Cases and ASME Code Interpretations, indicated that no ASME Code Cases or Code Interpretations dealt with questions addressing socket weld fitup root gap tolerances. Further, licensee personnel indicated that no code cases were used for any aspect of socket welds or fitup root gap tolerances.

On October 19, 1982 the inspector examined approximately 40 socket welds in Unit No. 3 to ascertain whether the criteria contained in WPP/QCI No. 200 was being adhered to in the field. All socket welds examined, except for one, complied with the requirements. Line No. S3-103-ML-053, socket weld No. SMH, was observed to have one line on the pipe and two lines on the socket fitting. The distance between the line on the pipe and the first line on the fitting measured approximately 1 7/8 inches and from the line on the pipe to the second line on the fitting approximately 2 1/16 inches. Upon being informed of this condition the licensee requested that a radiographic examination be performed on the socket weld/fitting. A review of the subsequent radiographic film indicated that the actual gap was as specified by the procedure.

No items of noncompliance or deviations were identified.

m. Allegation: "Bechtel Specification WQ-2, sheet 20, note 1, requires "shall not exceed 1/3 inch..." regarding maximum groove weld reinforcement at Midland, Michigans Twin Nuclear Plant. This requirement should read "shall not exceed 1/8 inch..." as required by the ASME Section III code on groove weld reinforcement. This 1/3 inch height may be, also, mistakenly implemented at San Onofre."

NRC Findings: The allegation regarding the potential implementation of the 1/3 inch groove weld reinforcement at San Onofre was not substantiated.

This allegation was brought to the attention of NRC investigative personnel at the Region III office since that office has inspection responsibility for the Midland plant.

Bechtel procedure WQ-2 (Welding Standard Performance Specification) is the test laboratory welder performance qualification procedure for qualifying welders to the requirements of AWS D1.1 (Structural Weld Code) and not to the ASME B&PV Code. Procedure WQ-1 addresses the qualification of welders to the ASME B&PV Code. The maximum reinforcement for groove welds is defined as 1/8 inch in paragraph 3.6.2 of AWS D1.1, 1972 edition.

The drawing referenced by the alleger is WQ-2-0, Revision 0, and was identified in that issue of WQ-2 as Sheet 20 of 31. Note 1 of sheet 20 of 31 states "Butt and corner joint reinforcement shall not exceed 1/3 inch and shall have a gradual transition to the plane of the base metal surface." This issue of WQ-2 was not used at the SONGS site.

The Bechtel Materials and Quality Services (M&QS) organization in San Francisco acts as a technical library of procedures and specifications. Bechtel personnel stated that M&QS maintains several different editions of the procedures and specifications and that it is the responsibility of the appropriate site discipline project engineer to order that edition which is to be used at each particular site.

On February 22, 1977 the San Onofre Project Engineer requested certain welding and NDE procedures from M&QS. This memorandum stated that an attached list of documents was to be filed and distributed for use at the San Onofre jobsite. A copy of that letter was sent to the SONGS-2/3 Construction Superintendent. Among others, this attached list requested the issue of WQ-2, Rev. 0, dated November 11, 1975.

The inspector reviewed WQ-2, Rev. 0, dated November 11, 1975 and found this issue of the procedure contains only 17 pages and not the 31 pages contained by the document questioned by the alleger. Sheet 11 of 17 contains a note 1 addressing the required reinforcement in the preparation of bend test specimens and states "Weld reinforcement and backing strip or backing rings, if any, shall be removed by machining or grinding flush with the surface of the specimen." Therefore, the WQ-2 document used at the SONGS jobsite does implement the requirements of AWS D1.1, 1972 edition, regarding groove weld reinforcement applicable to bend test specimens.

No items of noncompliance or deviations were identified.

n. <u>Allegation:</u> "I believe that the caliber of individuals employed by Peabody Testing and others to perform nondestructive examination (NDE) on welds in nuclear service applications was not acceptable. This belief is based on the observation of many documentation mistakes and spelling errors, such as the incorrect spelling of the words "fillet" and "weld", as "filet" and "wel", on NDE reports prepared by these individuals. Because of these observed spelling and other errors, I question the abilities of these NDE personnel to perform the required examinations, as required by their procedures. I believe that established industry and Bechtel standards regarding the qualification of NDE personnel are not sufficient to assure an adequate level of personnel capability and knowledge in this very important area of inspection."

NRC Findings: The allegation was not substantiated.

GEO, formerly Peabody Testing, is the NDE subcontractor at San Onofre Units 2 and 3. For the time period in question (October 1980 through August 1981) there were approximately 3,300 NDE reports generated. The majority of these reports, about three thousand, were the results of liquid penetrant testing (PT) which was the main nondestructive testing activity being performed at the time. The inspector reviewed three hundred of these reports and found only two containing spelling errors. One report had the word "gouged" spelled "gouched" and in the other report "weldolet" was misspelled "weldlet". The inspector also examined the qualifications and certifications of the two NDE Level II individuals who prepared these reports and of nine other NDE examiners who performed NDE activities during the time period in question. These individuals were certified as qualified to SNT-TC-1A in one or more of the following nondestructive test methods:

- Radiographic Testing (RT)
- Magnetic Particle Testing (MT)
- Ultrasonic Testing (UT)
- Liquid Penetrant Testing (PT)

Ten of these individuals were designated as Level II in PT, two as Level I in MT, six as Level II in MT, two as Level I in RT, six as Level II in RT, two as Level I in UT, and one as Level III in RT, PT, MT and UT. The inspector reviewed procedure number 2.3 of the GEO Quality Assurance Plan entitled "Qualification and Certification of Nondestructive Examination Personnel" Rev. C, dated June 26, 1978. This procedure describes the program under which the above individuals were qualified and certified by GEO to perform nondestructive testing. The inspector's review verified that this procedure is in compliance with the requirements of ASME Section III, Section XI, and SNT-TC-1A. SNT-TC-1A are the guidelines established by the American Society for Nondestructive Testing for the qualification and certification of nondestructive testing personnel whose specific jobs require appropriate knowledge of the technical principles underlying the nondestructive tests they perform, witness, monitor, or evaluate. All eleven GEO NDE individuals were qualified to perform nondestructive testing, within their respective certification levels, in accordance with GEO procedures and code requirements. The certification statements of the certifying GEO Level III attesting to each individuals qualifications were on file. Also on file were the Bechtel Level III reviews and acceptance of the qualifications of each GEO Level I, II and III NDE examiner. Review of the vision test records indicated that the annual visual acuity and color vision examinations were performed and documented as required. Based on the above, the inspector concluded that the NDE inspectors were qualified and properly certified.

No items of noncompliance or deviations were identified.

o. Allegation: Examination of the October 15, 1982 interview tape identified the following concern.

The alleger indicated that Bechtel Power Corporation at the San Onofre-2/3 site allows: (1) low hydrogen weld rod to be in open air for eight hours prior to use; (2) that Bechtel does not place low hydrogen electrodes in a drying/holding oven after removal from the hermetically sealed cans; and (3) that the Bechtel site procedures allow the issuance of weld rod upon removal from the hermetically sealed can.

NRC Findings: The allegation was not substantiated.

Bechtel, through their Material and Quality Services (M&QS) Branch, has established through test that, for the San Onofre site, low hydrogen electrode exposure to the atmosphere can be a maximum of 12 hours. This position was submitted for NRC evaluation as Amendment 20 to the FSAR. This criterion has been implemented in WPP/QCI No. 200, Appendix I (Welding Filler Material Control Procedure Specification), paragraph 5.5.6, which states in part that, "Unused filler material shall be returned to the issuing rod room per the requirement of Table 2 or the completion of the assigned welds, whichever occurs first." Table 2 of the procedure indicates that for, "Austentic, high nickel and carbon steel, low hydrogen covered electrodes (E308L, E309, ENiCrFe-3, E7018, etc), the maximum time out of the holding oven is, 12 hours or the end of the shift." While out of the holding oven, the Bechtel practice at SONGS is to place the electrodes in a special closed box type container. Thus, the electrodes are not continuously exposed to the atmosphere.

WPP/QCI No. 200, Appendix I, in paragraph 5.4.1.2.2 states that, "When hermetically sealed containers of low hydrogen electrodes (such as EXX16 or EXX18) are opened the electrodes shall be color coded and then immediately placed in a vented electrode holding oven. The ovens shall be clearly marked to indicate their contents."

On October 26, 1982, the inspector confirmed, through observation and discussion with rod room attendants, compliance with the above criteria.

No items of noncompliance or deviations were identified.

p. Allegation: Examination of the October 15, 1982 interview tape identified the following concern.

The alleger indicated that: (1) to the best of his knowledge A-7 steel exists at San Onofre Units 1, 2, and 3, especially at Unit 1, (2) A-7 steel exists in pipe and tray hangers and in some structural members, (3) that he reviewed Certified Mill Test Reports (CMTR) for A-7 steel at the San Onofre site, and (4) that extensive use of rim steel is allowed in structural applications.

NRC Findings: The allegation was not substantiated.

A review of purchase orders and specifications for structural steel, by Bechtel and Southern California Edison contract administrators, indicated that, for San Onofre Units 2 and 3, no A-7 steel has been used or purchased for any safety related purpose. The minimum grade of structural s:eel allowed at Units 2 and 3 is ASTM-A36 steel. For San Onofre Unit 1, a review of all accounts payable, as far back as the licensee is able to establish, indicates that no A-7 steel was purchased for any safety-related application.

The allegers's contention that extensive use of rim steel is allowed in structural applications is apparently a reference to A-7 steel. This conclusion is based on comments made by the alleger during the NRC interview of the alleger on October 15, 1982. The inspector notes that ASTM A36-1977a states in paragraph 5.2 that "No rimmed or capped steel shall be used for plates and bars over 1/2 inch thick or for shapes other than group 1." Group 1 refers to the grouping of the various structural sizes and shapes as contained in Table A of ASTM A6-1979b. Therefore, theoretically Group 1 steel shapes less than 1/2 inch thick ar_ allowed, by ASTM-A36, to be of rim steel.

In addition, the alleger makes reference to A-7 steel Certified Mill Test Reports (CMTR) that he reviewed at San Onofre, however he stated, later during the interview, that the referenced CTMR's were for a non-safety related office building. This portion of the allegation has been brought to the attention of the licensee.

No items of noncompliance or deviations were identified.

q. Allegation: During the tour of the site on October 25, 1982 the alleger pointed to a low pressure Safety Injection System check valve bonnet to body stud which did not have full stud to nut thread engagement. The alleger stated that he believed that the ASME B&PV Code required two threads showing above the nut on bolted connections and that he believed this condition to be a violation of that requirement.

NRC Findings: The allegation was not substantiated.

The ASME B&PV Code, Section III, Division I, Subsection NC, paragraph NC-4711, titled Thread Engagement, states "All bolts or studs shall be engaged in accordance with the design" and does not provide any definitive criterion as to how may threads must be above the surface of the nut. The code further provides in paragraph NC-4720, titled "Bolting Flanged Joints", that "All flanged joints shall be made up with relatively uniform bolt stress."

The inspector established the following:

- the valve in question (No. S3-SI-MU-087) was in the as-received condition from the manufacturer (Anchor-Darling).

- all of the 16 body-to-bonnet studs, except one, had at least flush stud/nut engagement. The one stud, which did not have flush stud/nut engagement, was slightly less than 1/16 inch below the top surface of the nut.

- the vendor's valve maintenance manual does not address any criteria regarding stud/nut engagement and addresses only bolt torque requirements, in apparent compliance with paragraph NC-4720.

- the depth of stud engagement into the body of the valve was, for all 16 studs, at least equal to the length of the threaded portion of the nut attaching the bonnet to the body.

- a recognized text on Mechanical Engineering Design (Shigley) states on page 319 that the load on bolted connections is not shared equally by all threads and, instead, the first thread takes the entire force. This provides rationale for the apparent conclusion of the ASME B&PV Code that thread engagement alone is not the critical factor in determining the acceptability of a bolted connection.

The inspector finds that the as-installed condition conforms to the design requirements of the valve manufacturer and, therefore, to the requirements of the ASME B&PV Code, paragraph NC-4711.

No items of noncompliance or deviations were identified.

r. Allegation: The alleger, during the tour of the site on October 25, 1982, identified instances in the Low Pressure and High Pressure Safety Injection Systems and the Component Cooling Water System where he believed the tapering requirements of the ASME B&PV Code had been violated in the welding of piping to certain valves. As examples of the concern the alleger pointed out two Unit 3 pipe to valve attachment welds which had a section on the valve body that approached a 1:1 slope instead of the 3:1 slope that he believed should exist to conform to ASME Code requirements.

NRC Findings: The alleged violations of ASME B&PV Code requirements regarding transition slopes were not substantiated.

The inspector found that the component cooling water system valves pointed out by the alleger were socket welded connections which are exempt from the 3:1 taper requirement by the code.

Regarding the low and high pressure safety injection systems, the licensee's commitment, contained in the FSAR, is to the 1974 Edition of the ASME B&PV Code, through Summer 1975 addendum. The Code, Figure NC-4233-1, requires that a taper of 1 in rise to 3 in run be provided for a distance of 1.5 times the nominal pipe wall thickness between the 45° maximum slope section on the valve and the pipe/weld junction attaching the pipe to the valve. Similar figures exist in the 1974 ASME Code, Sections NB and ND.

The alleger, during the tour, pointed out two particular nuclear safety-related examples of valve to pipe welds which he believed violated the 3:1 taper requirements of the Code. These were on Valve MU-062, in the low pressure safety injection system, and a Kerotest vent valve in the high pressure safety injection system.

The inspector examined the manufacturer's detail drawings for the above valves in question and examined the distances from the 45° maximum transition in the field. These distances were compared with the requirements of Figure NC-4233-1 of the ASME B&PV Code, 1974 Edition.

Based upon these examinations the inspector concluded that the maximum slope (3:1 taper) requirements of the Code were complied with on each field installation in question. Further, the inspector verified that the actual slopes encountered in the field more closely approached 4:1 taper and thus were more conservative than the Code required maximum of 3:1.

On November 12, 1982, a copy of Figure NB-4250-1 was received at Region V from the alleger. The copy received was duplicated from the 1980 Edition of the ASME B&PV Code, Division 1, Section III, Subsection NB. As mentioned previously, the licensee is committed to the 1974 Edition of the ASME B&PV Code. The valve to pipe welds questioned by the alleger are governed by Subsection NC of the 1974 Code and not by Subsection NB.

The inspector examined the drawing copy supplied by the alleger and concluded that the Code required 3:1 taper requirements were complied with on the two valve to pipe welds questioned by the alleger.

No items of noncompliance or deviations were identified.

9. Exit Interview

During the course of the special inspection the inspectors had numerous discussions with licensee personnel while determining whether or not the allegations were sustantiated. On November 15, 1982, the inspector contacted the licensee's Quality Assurance Manager and discussed the scope of the special inspection. The licensee was informed that no apparent items of noncompliance or deviations were identified during the inspection.

Date: October 16, 1982
Time: 12:30pm.

I, E. Earl Kent, voluntarily make the following statement to Messrs. Philip V. Joukoff and Owen C. Shackleton Jr. who have identified themselves to me as investigators for the U. S. Nuclear Regulatory Commission (NRC). I make this statement freely with no threats or promises of reward having been mede to me.

I am 57 years old and have worked since ~~March, 1943~~ JUNE 1942 E.K. as a welder, welding quality control inspector, welding engineer, ETC. E.K. E.K. and author of welding articles for welding journals. In ~~1955~~ JAN. 1955 I received a diploma for completion of the Structural Engineering Course from the International Correspondence School, Scranton, Pennsylvania. I worked for Bechtel Power Corporation as a Senior Quality Control Engineer in welding at the San Onofre Nuclear Generating Station (SONGS) from October, 1980 until ~~September~~ E.K. AUGUST, 1981. E.K.

During my employ at SONGS I identified the following concerns which were identified to me by the NRC personnel who interviewed me on October 15, 1982 as possibly affecting nuclear safety systems, AND OTHER ITEMS. E.K.

(1) Pipe fitters SOMETIMES E.K. used pipe cutters to make scribe marks for socket weld fitup measurements. These scribe marks caused grooves in both stainless and carbon steel pipes about 1" back from the weld area. I am concerned that these grooves might cause stress raisers. These conditions exist on socket welded fittings ~~all over~~ AT RANDOM IN E.K. Units 2 and 3, & POSSIBLY A FEW IN UNIT 1. E.K.

(2) Bechtel designers ~~only~~ E.K. OFTEN E.K. use fillet welds on ~~welded web~~ connections of beams in pipe supports and tray hangers and do not weld all around the joint to restrain forces in all directions. I feel this is a code violation. TO MY PERSONAL KNOWLEDGE, No prototype tests were conducted to verify the adequacy of these welds. Therefore, the actual structural strength of the electrical tray hanger/tube steel welds used or the actual material at SONGS ~~is~~ E.K. ARE not truly known. This also applies to pipe supports. E.K. I also feel that the failure to weld all around the joint is a generic problem. PARTIAL JOINT STRENGTH (LESS THAN FULL JOINT INTEGRITY) E.K. Unfortunately, and in my opinion, ~~wrongly~~, the codes do NOT ALWAYS ~~not~~ demand FULL STRENGTH ~~all around~~ welding. E.K. ALL AROUND OR NOT. E.K.

(3) ASME requires adequate root penetration of fillet welds. I recall that some of the vendor supplied welded hardware ~~did~~ E.K. APPEARED TO not have adequate root penetrations. The one vendor I can recall is Zack, I believe a supplier of HVAC equipment. I remember one instance on a piece of Zack hardware where a fillet weld with inadequate ~~root penetration~~ WELDING E.K.

Continued Statement of E. Earl Kent....................Page 2

was identified during inspection on site. AFTER This instance was subsequently corrected by weld repair ~~before~~ installation in the plant. I don't remember if this equipment was used in SONGS Units 2 or 3. I recommend that the NRC examine the beginning and end of fillet welds to assure root penetration at these areas, AND VERIFY THAT ALL CRATERS ARE FILLED, E.K. and conduct destructive testing of selected supports supplied by this vendor to determine if other fillet welds, AND GROOVE WELDS E.K. have inadequate root penetrations, OR OTHER CODE VIOLATIONS. E.K.

(4) A steel bracket ~~was placed~~ WOULD BE PLACED, I WAS TOLD, E.K. between a Unit 1 hydrogen line on trip for steam generator. This was done because the hydrogen line had worn thin due to rubbing with another line. I believe maintenance people at the site who were working during the period when damage due to the Unit 1 diesel generator fire was being corrected would remember and be able to locate the design change and spacer. I don't recall the exact location of the hydrogen line. To my best recollection there wasn't equipment within ten feet. I don't remember if there was any nuclear safety-related equipment nearby. I am concerned for the integrity of nuclear safety-related equipment, if located nearby, and about the potential for loss of human life and fire E.K. should this line rupture. I recommend NRC conduct an examination of this hydrogen line and make certain it has sufficient wall thickness to be safely operated. MOST LIKELY, I PREVENTED A MAJOR FIRE IN UNIT 1, AND PROBABLY SAVED THE LIVES OF SEVERAL (OR MORE) WORKERS THERE. E.K.

(5) I am ~~certain~~ OF THE OPINION E.K. that weld end returns are not required on Bechtel drawings. This is in violation of AWS-D1.1, 1974 EDITION E.K., Section 8, paragraphs 8.8.6, 8.8.6.1, and 8.86.2. E.K. These conditions exist on details in ~~any~~ MANY E.K. structural applications. E.K. A two page Bechtel Power Corporation table establishes that certain pipe supports AND OTHER ITEMS E.K. must conform to AWS-D1.1 requirements.

(6) Bechtel Construction Specification CS - P207, Revision 7, dated April 18, 1980, paragraphs 5.6 and 5.7, contains visual examination criteria used by Bechtel for pipe supports and reference the ASME B&PV Code, Section III, Subsection NF. I MAY HAVE E.K. told John O'Dell, investigative reporter for the Los Angeles Times, that I BELIEVE the visual criteria of CS - P207 are not in accordance with the above code requirements, particularly in CS - P207 paragraphs 5.6.1.3 (porosity and slag), weld convexity height acceptance criteria, 5.6.1.9 (underfilled groove weld craters), 5.6.1.11 (arc strike acceptance criteria, and 5.7.2 (allowing groove welds with fillet caps to be welded as fillet welds).

(7) Bechtel generated (I WAS TOLD) E.K. a 92 page NCR on electrical tray hangers. I question whether the welds made on electrical supports prior to the NCR resolution were ADEQUATELY OR COMPLETELY E.K. fixed.

(8) IN MY OPINION, Bechtel has not complied with the requirements of AWS D1.1 (1974 edition), paragraphs 3.12.1.5.(2).(8) and 8.15.1.3, regarding filling of open weld craters on tray hangers AND OTHER ITEMS E.K. to full

(b)
E.K.

E.K.

cross section of the weld.

IN MY OPINION, (9) Bechtel has not E.K. ALL removed arc strikes OR BLEMISHES E.K. from base metal ~~of~~ ON pipe E.K. supports or structural steel as required by AWS D1.1 paragraph 4.4.

(10) I observed instances where run off plates ~~were not~~ HAD NOT BEEN E.K. used as required by AWS D1.1 paragraph 4.6 on groove weld terminations. I cannot recall any specific locations, but I do recall observing this condition on beam and girder splices, AS SUPPLIED BY AT LEAST ONE VENDOR, E.K.

(11) I believe that a spacer plate is missing on the upper inside door hinge of the Unit 2 containment personnel hatch because I observed a gap in the weld joint of about 1/4 inch. I brought this to the attention of my supervisor (DON MARTIN E.K. who also shared that belief. I believe that by bringing this condition to the attention of my supervisor I had properly performed my duty to identify this condition. I did not compare the drawing requirements to the installed condition in making this determination of a missing spacer plate, BECAUSE MY SUPERVISOR HAD INDICATED TO ME THAT IT WAS THE VENDOR'S PROBLEM TO CORRECT IT, I HAD OT. WORK TO IMMEDIATE E.K.

(12) I believe that Bechtel has misinterpreted the requirements of the ASME Section III welding standards regarding socket weld engagement length without initiating a code case and obtaining appropriate code relief. The ASME code requires a gap between the pipe end and the fitting of "approximately 1/16 inch". I believe that the code should provide a more definitive acceptance criteria than merely "approximately 1/16 inch". EVIDENTLY BECHTEL WILL ALLOW ANY DIMENSION, AS LONG AS THE PIPE IS NOT TOTALLY WITHD FROM THE SOCK E

E.K.

(13) Bechtel specification WQ-2, sheet 20, note 1, requires "shall not exceed 1/3 inch..." regarding maximum groove weld reinforcement height AT MIDLAND MICHIGAN'S TWIN NUCLEAR PLANT. This requirement should read "shall not exceed 1/8 inch ..." as required by the ASME Section III code on groove weld reinforcement. The 1/3 inch height ~~is~~ MAY BE, ALSO, MISTAKENLY E.K. implemented at San Onofre.

(14) I believe that the caliber of individuals employed by Peabody Testing E.K. OR to perform nondestructive examination (NDE) on welds in nuclear service applications was not acceptable. This belief is based on the observation of many DOCUMENTATION MISTAKES AND E.K. spelling errors, such as the incorrect E.K. AS "FILLE WEL spellings of the words "fillet" and "weld" on NDE reports prepared by these individuals. Because of these observed spelling AND OTHER errors, I question the abilities of these NDE personnel to perform the required examinations as required by their procedures. I believe that established industry E.K. AND BECHTEL standards regarding the qualification of NDE personnel are not sufficient to assure an adequate level of personnel capability and knowledge in this very important area of inspection.

I have advised the above named NRC personnel of other concerns I have regarding inadequacies that I ~~feel exist~~ KNOW EXISTS E.K. in Industry Codes and Standards (i.e. AWS, ASME, AISC, etc.). The NRC representatives have told me that these areas are not within the jurisdiction of the NRC and although I do E.K.

SOME OF THESE ALLOW INADEQUATE WELDI PROCESSES (FOR EXAMPLE, SHORT-CIRCUITING ARC IN GAS METAL ARC WELDIN ~~THAT ALLOWS~~ ADHESION INSTEAD OF COHESION IS POSSIBLE IN CRITICAL ARE

E.K.

not necessarily agree with this, I do understand that this ~~is~~ MAY BE the case.. The NRC representatives have also told me that I can report my areas of concern regarding Codes to the applicable code committee. HOWEVER, WHERE SAFETY & LIFE IS AT STAKE, I ASK THEM TO HELP MY EFFORTS AS MUCH POSS[IBLE] I further have advised the NRC representatives that I have many concerns regarding welding done on non-nuclear E.K. safety related systems and equipment. I have been advised by the NRC representatives that these areas are also not within the jurisdiction of the NRC. The NRC representatives have told me that I can report these concerns directly to the utility, SCE, or whatever other local, state, or federal agency that has jurisdiction.

N[...] O[...] AT [...] UNOF[...] BUT ALL N[...] PLANTS IN TH[E] UNITED STATES NEED HELP IN RESOLVING PROBLE[MS] THAT I KNOW EXISTS

E.K.

I have read the foregoing statement consisting of this and four other typewritten pages. I have made and initialed any necessary corrections and have signed my name in ink in the margin of each page. I swear that the foregoing statement is true and correct. Signed on ____________________ at ____________________.

Signature: ______________________________
E. Earl Kent

Subscribed and sworn to before me this __________ day of __________, 1982 at ______________________________.

Investigator: ______________________________
Owen C. Shackleton Jr.

Witness: ______________________________
Philip V. Joukoff
Investigator, OISFFO

October 19, 1982

On Saturday, October 16, 1982, at approximately 2:44 p.m., in the city of Cypress, California, E. Earl KENT stated to the undersigned that he would not sign his attached sworn statement. Mr. KENT, in response to questioning, further stated that the statement, as amended by him, was true and correct as amended.

INVESTIGATOR: Owen C. Shackleton Jr.
Owen C. Shackleton Jr., Acting Director, OISFFO

WITNESS: Philip V. Joukoff
Philip V. Joukoff, Investigator, OISFFO

NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

Docket Nos. 50-361
50-362

OCT 29 1982

Southern California Edison Company
P. O. Box 800
2244 Walnut Grove Avenue
Rosemead, California 91770

Attention: Dr. L. T. Papay
Vice President

Gentlemen:

This letter relates to an on-going special inspection by this office into allegations regarding construction quality at the San Onofre Nuclear Power Plants.

During the course of our special inspection, questions have been identified regarding how certain requirements of the AWS D.1.1 Structural Welding Code, and ASME Section III Boiler and Pressure Vessel Code were met for the San Onofre Units 2 and 3.

Based on discussions between Messrs. J. L. Crews and members of his staff and D. E. Nunn of your staff on October 28, 1982, it is our understanding that you will provide to this office in writing by November 3, 1982 a discussion of your practices, including how you fulfilled code requirements, in the following areas:

a. Weld end returns on structural steel and supports as addressed in AWS D.1.1.

b. ASME Section III, NF, pipe support weld visual inspection acceptance criteria in the areas of porosity, slag, arc strikes, and filling of weld craters.

c. AWS D.1.1 structural steel and support weld visual inspection acceptance criteria in the area of weld crater fill.

Should my understanding as stated above not be correct, you should notify this office promptly in writing.

Sincerely,

R. H. Engelken
Regional Administrator

8212170383
PDR

cc: J. G. Haynes
R. Dietch
J. M. Curran

Southern California Edison Company

P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

L. T. PAPAY
VICE PRESIDENT

TELEPHONE
213-572-1474

November 3, 1982

U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite #210
Walnut Creek, CA 94596

Attention: Mr. R. H. Engelken
Regional Administrator

Dear Sir:

SUBJECT: Response to NRC letter dated October 29, 1982, on allegations regarding construction quality at San Onofre Nuclear Generating Station, Units 2 and 3 Docket Nos. 50-361 and 50-362

REFERENCES:
1) Subject NRC Request Letter, Mr. R. H. Engelken to Dr. L. T. Papay, dated October 29, 1982
2) NRC Region V. Inspection Report 50-361/82-27, dated October 5, 1982, Page 13, Item 6
3) SCE Audit Report No. BPCS-13-82, dated September 20, 1982, Attachment 6, Pages 1 and 2, "Concern #1-End Returns." (Transmitted October 7, 1982, J. M. Curran to D. F. Kirsch, NRC.)

ENCLOSURES:
I Weld End Return Requirements
II ASME Code, Section III, Subsection NF: Pipe Supports: Visual Acceptance Criteria for Weld Porosity/Slag, Arc Strikes, and Crater Fill
III AWS D.1.1; Weld Crater Fill Criteria

This letter provides the information requested in Reference 1.

The design and construction practices employed at San Onofre Units 2 and 3 were governed by the appropriate code as defined in regulatory documents or as generally accepted as industry practice.

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The applicable national standard that deals with welding of safety-related pipe supports in nuclear power plants is the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, Subsection NF (ASME CODE). Only the ASME Code provides definitions for acceptance of pipe support welds by visual examination. The Nuclear Regulatory Commission (NRC) in their Code of Federal Regulations, 10CFR50 (Domestic Licensing of Production and Utilization Facilities) and Regulatory Guide 1.26 (Quality Group Classifications and Standards for Water, Steam, and Radioactive Waste Containing Components of Nuclear Power Plants), specifically approves the use of ASME III for nuclear safety-related elements of the plant. The portion of the ASME Code governing pipe supports is Subsection NF. For San Onofre Units 2 and 3 the 1974 Edition Summer 1974 Addendum is the applicable code. Specifically, San Onofre Units 2 and 3 construction specifications for pipe supports provide detailed acceptance criteria for welding which comply with the ASME Code and interpretations of the Code written by the ASME.

Outside the NF boundary the American Institute of Steel Construction (AISC) specification and the American Welding Society's (AWS) Structural Welding Code are utilized.

It is important that the detailed wording of particular paragraphs of the engineering prepared construction specification be evaluated in the context of the overall quality program. The quality program used for design and construction is comprised of documented criteria and guidelines that ensure the adequacy of the end product. These include design guides, National Standards and Codes, developmental work by contractors and consultants, the qualification of welds and materials, construction welding procedures, qualification of welders, and qualification of weld inspectors. To develop the criteria a welding inspector uses to inspect a weld, the following procedure is employed:

1) The code applicable boundaries are delineated on engineering drawings;

2) There are Work Plan Procedures at the jobsite which precisely define what to do;

3) Engineering documents such as construction specifications and weld forms provide inspection criteria.

Based on these documents, NF Welding (ASME III) would be visually inspected by Pipe Support Quality Control Engineers (QCE) in accordance with acceptance criteria specified in construction specification CS-P207. Attachments to pressure boundaries would be inspected by welding QCE's using visual and NDE procedures prescribed by engineering documents specified on the applicable welding forms. Structural steel, where AWS welding is appropriate, would be inspected by QCE's to the requirements of Construction Specification CS-C16. All cognizant QCE's are certified in accordance with ANSI N45.2.6, SNT-TC-1A, as applicable.

Specific responses to areas addressed in your letter of October 29, 1982 are as follows:

a. Weld end returns on structural steel and supports as addressed in AWS D.1.1.

   As stated in Enclosure I, the design of all welded connections for San Onofre Units 2 and 3 is established in accordance with the applicable code for which the structure or component is classified. Enclosure I describes the methods and practices for assuring the fulfillment of code requirements.

b. ASME SECTION III, NF, pipe support weld visual acceptance criteria in the areas of porosity, slag, arc strikes, and filling of weld craters.

   This matter is addressed in Enclosure II.

c. AWS D.1.1 structural steel and support weld visual inspection acceptance criteria in the area of weld crater fill.

   This matter is addressed in Enclosure III.

In summary, Southern California Edison design and construction practices as implemented at San Onofre Units 2 and 3 are consistent with applicable regulatory requirements, codes and normally accepted industrial practices.

Sincerely,

Enclosures

WELD END RETURN REQUIREMENTS, SAN ONOFRE UNITS 2 AND 3

Design Basis

The design of all welded connections utilized on the SONGS 2 and 3 project is established in accordance with the applicable code for which the structure or component is classified, consistent with the design criteria and FSAR requirements. The AWS Code in its "Foreword" specifies the following:

> "This Code does not concern itself with such design considerations as arrangement of parts, loading and the computation of stresses for proportioning the load-carrying members of a structure and their connection. Such considerations, it is assumed, are covered elsewhere in a general code or specification such as a Building Code, AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, . . ., or other specifications prescribed by the owner."

The AWS Code excludes from its jurisdiction the design responsibliity for the weld details, and further directs the design function to the designing professional engineer who is required to adopt and interpret other appropriate design specifications including AISC Specification for the Design, Fabrication and Erection of Structural Steel For Buildings (AISC). In this regard, AISC 1.17.10 is considered in the design and utilized accordingly. This AISC provision states as follows:

> "Side or end fillet welds terminating at ends or sides, respectively, of parts or members shall, whenever practicable, be returned continuously around the corners for a distance not less than twice the nominal size of the weld. This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connections, on the plane about which bending moments are computed. End returns shall be indicated on the design and detail drawings."

The provisions of this requirement are clearly specified to apply to structural components subject to bending where high stress concentrations due to high local weld stresses may exist in extreme edges of weld details. These include selected connection details subject to high stresses which warrant such consideration. The purpose of this provision is elaborated upon and discussed in considerable detail in technical references used by practicing professional engineers internationally. The purpose of weld end returns are to assist in the redistribution of high local stresses when the following conditions apply:

1. Where vertical welds are subject to high stresses which are calculated to exist at extreme tips of a weld group, generally from large bending moments which have a tendency to "pry" the weld apart.

2. Where the weld stress is required to perform to its maximum allowable stress value, and further, where maximum loading conditions can readily carry the local weld stress intensity into yield conditions.

3. In applications for which the local tensile stress from extreme bending effects are required to be resisted by small, narrow weld details.

In the design of all structures and components in San Onofre Units 2 and 3, AISC 1.7.10 has been considered. Where the provisions of this section are appropriate, San Onofre Units 2 and 3 construction drawings and specifications provided weld details, including weld end returns, which meet the provisions and intent of the AISC Specifications. As a whole, weld end returns have been specified for appropriate design applications when calculated weld stresses approach code allowable values. These weld end returns have been provided conservatively even though the San Onofre Units 2 and 3 design criteria limits the Design Basis Earthquake (DBE) combined stresses to 90% yield. Typical types of details where weld ends have been specified to enhance local stress conditions include:

1. Welded double angle structural connections with high weld stresses (e.g. weld stresses near code allowables) which are field welded to intersecting beams and columns and for which "prying" is a credible failure mechanism.

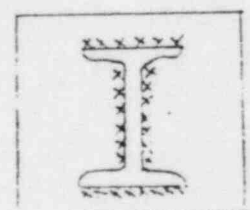
2. Special beam connections where beam brackets or seats are required designed for high stresses (e.g. weld stresses near code allowables) whose behavior has a tendency to "pry" the weld detail.

3. Special highly stressed design connections which are not resisted in tension by a large weld segment whose behavior could result in "prying" action.

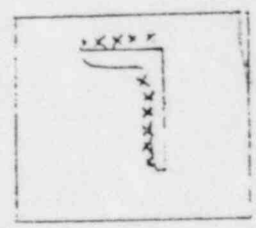
As such, the San Onofre Units 2 and 3 structural design appropriately accounts for the provisions of AISC 1.7.10 and utilizes this provision for those specific conditions for which it is intended to apply.

It is important to recognize the clarification specified in the second sentence of AISC 1.7.10 which states . . ."This provision shall apply to side and top fillet welds connecting brackets, beam seats, and similar connections, on the plane upon which bending moments are computed." The referenced allegations extend not only to Bechtel's interpretation of the provision, but also to the AISC. The allegations contend that full welding all-around is "optimum" and should be adopted for all details which are subject to seismic considerations. The contention obviously extends the interpretation of weld end returns to conditions for which it is neither recommended by the code, nor required by the specific structural design conditions by the designing professional engineer.

It was contended that weld end returns should be specified for Type A and B connection details.



TYPE "A"



TYPE "B"

1. The details are not appropriate for the types of connections for which AISC 1.7.10 is intended to apply.

2. The top and bottom welds (for Details A & B) are designed to take the tension and compression loading components from bending with a weld sized to take the full load accordingly. The vertical welds are designed to take the full shear load. In essence, the top and bottom welds behave in a tension and compression mode, not one of "prying." If the weld is sized to withstand the full design load at allowable stress levels, the weld end return would be located below the extreme weld fiber and would have limited value. The weld end return, if provided according to the interpretations included in the allegations, would remain below the stresses at the top fiber until the section reached yield levels. Since this design condition is prohibited by the DBE criteria, the weld end return, if installed, would have no meaning provided that the top weld is sized to resist the full design force.

3. The full "2t" weld may not be constructible orthogonal to the top weld since the curvature of the weld at the tip of the structural member may prohibit its installation. This condition is prevalent for angle member extreme ends and certain structural shapes. In addition, the high stress concentration caused by the nonorthogonal weld end return may increase stress concentrations.

4. The entire weld detail must be proportioned in such a manner that adequate weld exists to withstand the loads. Beam sizing is often made utilizing stock size member selection which provides some uniformity in ordering steel and some consistency in field erection. It is, therefore, not unusual to see a member with oversize beam section properties connected by a weld detail which does not develop its full section. The important and relevant design consideration is that the weld detail should be sized to withstand all design loads imposed upon it. The arbitrary selection of weld details which develop all beam sections would lead to excessive construction delays for the plant, while adding nothing to the structural integrity of the design.

5. The detail utilized for tension and compression members (e.g. axial struts) do not require the same attention to weld end returns since "prying" is not, in general, a credible failure mechanism.

11-2-82

ASME CODE, SECTION III, SUBSECTION NF PIPE SUPPORTS: VISUAL ACCEPTANCE CRITERIA FOR WELD POROSITY/SLAG, ARC STRIKES, AND CRATER FILL

Porosity and Slag

In addressing porosity and slag inclusions in pipe support welds, Paragraph 5.6.1.3 of San Onofre Units 2 and 3 Construction specification CS-P207 states:

"Porosity and slag shall not be cause for rejection."

From ASME NF-5360, porosity and slag are not cited as bases for rejection of pipe support welds by visual examination. The ability to visually examine a pipe support weld is a function of the surface condition of the weld. This surface condition of the weld may be minimally obscured by overlying slag. Surface slag is not of itself a cause for rejection of the weld and does not limit the weld inspector's requirement to accept the weld. Removal of the surface slag then allows the inspector to judge the visual acceptability of the weld surface.

Surface porosity also is not a cause for rejection of the weld. Minimal amount of surface porosity may result due to the metallurgical nature of the base metal and welding filler material and methods required by the ASME Code, and as used with qualified welding procedures and welders. This resulting surface porosity is compensated for by the conservative weld metal allowable stresses required by the ASME Code. Welding processes properly qualified and used in fabrication under a controlled quality program as have been implemented at San Onofre Units 2 and 3 will result in minimal porosity and slag in the weld metal.

The construction specification acceptance criteria on porosity and slag should be considered in the context of the overall quality program.

Arc Strikes

Paragraph 5.6.1.11 of CS-P207 states:

"Arc strikes are acceptable, provided that the craters, 1) do not contain cracks (as determined by visual examination), and 2) maximum size does not exceed 3/8-inch plan nor 1/16-inch profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of visual examination."

Even though the ASME Code, Subsection NF does not explicitly discuss arc strikes, the ASME Interpretation in III-80-109, Question (3), states that weldment surface defects are removed without regard to the cause of the surface defect. Arc strikes are of concern only if a crack is produced or the section size is reduced beyond required design section thickness. Arc strikes are not likely to cause cracks in plain carbon steels used for pipe supports. Plain carbon steels are essentially nonhardenable steels. Further, Paragraph 5.6.1.11 of the specification excludes, in particular, crater cracks from acceptability. Minor hardening that might result from arc strikes in plain carbon steel is easily accounted for in the massive surrounding matrix of the ductile material. Arc strikes might be of concern in alloyed steel materials. However, these types of materials are not used in pipe hangers, cable trays supports, or similar items.

Most codes and standards including many AWS standards do not treat arch strikes because of the essentially cosmetic nature of these discontinuities. These codes and standards include:

AWS D14.1 = "Specification for Welding Industrial and Mill Cranes"

AWS D14.2 = "Specification for Metal Cutting Tool Weldments"

AWS D10.5 = Report, "Welding Ferrous Materials for Nuclear Power Piping"

AWS D3.5 = "Hull Welding Manual"

ANSI B31.1 = "Power Piping"

ANSI B31.3 = "Petroleum Refinery Piping"

Grinding of arc strikes is permitted but does not require such grinding provided no crater cracks are present and a gentle or rounded profile exists which does not encroach on the minimum design thickness.

Because the significance of arc strikes in the carbon structural and piping steels is minimal, a "Nondestructive Examination" method which is likely to create arc strikes is widely accepted and in common use throughout manufacturing and construction industries.

The "prod method" of magnetic particle examination may also cause arc strikes on the component surface being examined. The fact is, that on carbon steels arc strikes are so insignificant, that an "NDE" method which induces them is widely used.

Weld Crater Fill Criteria, ASME

Paragraph 5.6.1.9 of specification CS-P207 addresses underfilled groove weld crater. It states:

> "Underfilled groove weld craters shall be accepted provided the depth of underfill is 1/16-inch or less. Underfilled single-pass fillet weld craters shall be accepted provided the crater length is less than 10 percent of the weld length. On multipass fillet welds, crater depth 1/16-inch or less shall be accepted."

ASME Section III, Subsection NF does not specifically address acceptance criteria for underfilled groove craters. In response to a specific inquiry on underfill, the ASME issued Interpretation III-80-109, Question (4). The interpretation states that the ASME Code, NF-5360, addresses weld metal indications only, and not concerned with underrun on fillet weld size or length. The margins inherent in the engineering design of welds account for underrun on fillet size or length defined by the visual inspection criteria. The size of welds shown on engineering drawings accommodate the underfill to the extent specified in the Paragraph 5.6.1.9, and this will not affect the structural integrity of the weld.

11-2-82

AWS D.1.1, WELD CRATER FILL CRITERIA

Reconciliation between San Onofre Units 2 and 3 Construction Specification CS-C16 Paragraph 3.3.3 and AWS D1.1-72 Paragraphs 5.12.1.5(2)(b) and 8.15.1.3 regarding the filling of weld craters is as follows, namely:

AWS 5.12.1.5(2)(b) "All craters filled to the full cross section of the weld."

AWS 8.15.1.3 "All craters are filled to the full cross section of the weld."

CS-C16, 3.3.3 "Underfilled groove weld craters shall be accepted provided the depth of underfill is 1/16 inch or less. Underfilled single-pass fillet weld craters shall be accepted provided the crater length is less than ten percent of the weld length. On multi-pass fillet welds crater depth 1/16 inch or less shall be accepted."

This Section 3.3.3 applies to miscellaneous steel only and not to the main building members. The criteria for acceptance of welds in main building members is addressed in:

CS-C16, 3.1.5 "The weld may have an underfilled crater provided that the underfilled depth does not exceed 1/32", and the crater has a smooth contour blending gradually with the adjacent weld and base metal without acute notches.

Consideration of underfilled craters, grooves, subsize, and concave fillet welds has been based upon conservative evaluation of decreased load carrying effective throat area. The weld metal has substantially higher minimum specified yield strength than does base metal, that is, 50,000 psi versus 36,000 psi.

CS-C16 is included in its entirety in the San Onofre 2 and 3 FSAR as Appendix 3.8A.

11-2-82

Southern California Edison Company

P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

J. M. CURRAN
MANAGER, QUALITY ASSURANCE

TELEPHONE
(213) 572-1695

November 3, 1982

Mr. D. F. Kirsch
U.S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite #210
Walnut Creek, CA 94596

Dear Mr. Kirsch:

SUBJECT: Response to NRC Letter Dated October 29, 1982, on Allegations Regarding Construction Quality at San Onofre Nuclear Generating Station, Units 2 & 3

Per your request at the November 3, 1982 site meeting, enclosed herein is Bechtel's response of October 29, 1982 from R. L. Patterson to J. M. Curran.

Please consider this as reference to our response of November 3, 1982 from Dr. L. T. Papay to Mr. R. H. Engelton.

Very truly yours,

D. Schone for

J. M. Curran
Manager, Quality Assurance

DBSchone:dsg

Enclosure

8212170386
PDR

Bechtel Power Corporation
Engineers – Constructors
12400 East Imperial Highway
Norwalk, California 90650
MAIL ADDRESS
P O BOX 60860 · TERMINAL ANNEX LOS ANGELES, CALIFORNIA 90060
TELEPHONE (213) 864-6011

October 29, 1982

Mr. J. M. Curran
Manager, Quality Assurance
Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770

Subject: San Onofre Nuclear Generating Station, Units 2 & 3
Bechtel Job 10079
Allegations Made by Mr. E. E. Kent

References:
(A) SCE QA Letter, Mr. J. M. Curran to Mr. R. L. Patterson, dated September 11, 1982, Subject: Same as above

(B) BPC Letter, R. L. Patterson to J. M. Curran, dated September 17, 1982, Subject: Same as above

(C) SCE QA Letter, Mr. J. M. Curran to Mr. R. L. Patterson, dated October 15, 1982, Subject: Same as above

(D) E. C. Rodabaugh, et. al , "Review and Assessment of Research Relevant to Design Aspects of Nuclear Power Plant Piping Systems", NUREG-0307, published July 1977, pp. 2-147

Enclosures:
(1) Response to Specific Allegations

(2) ASME Section III, Subsection NF, 1974 Edition, Summer 1974 Addendum, NF-5360

(3) ASME Section III, Subsection NF, 1974 Edition, Summer 1974 Addendum, NF-4427 and Figure NF-4427-1

(4) ASME Boiler and Pressure Vessels, Interpretation, No. 7, III-80-109

(5) ASME Boiler and Pressure Vessels, Interpretation, No. 6, III-1-79-176

(6) Photomicrographs of Vibro-Graved and Scribed Marks

Enclosures: (cont.)

(7) ASME Section III, Subsection NB, 1974 Edition, Summer 1974 Addendum, NB-4232.1, Figure NB-4233-1

(8) ASME Section III, Division I-Subsection NC, 1974 Edition, Summer 1974 Addendum, NC-4711, NC-4720

(9) Supplementary Data - Structural Welding Design and Construction Adequacy

Dear Mr. Curran:

This letter responds to twenty one allegations made by Mr. E. E. Kent pertaining to various aspects of welding, welder qualification and inspection procedures used by Bechtel Power Corporation in the design and construction of the San Onofre Units 2 and 3. Additional allegations made pertaining to a hydrogen line wall thinning and the use of ASTM A-7 steel on Unit 1 will be addressed separately.

The first four allegations were transmitted in Reference (A) and were responded to in Reference (B). The NRC has reviewed this information in NRC Report 82-27 and has closed these items. Additional information on one of these allegations developed as a result of the October 25, 1982 meeting with Mr. Kent is provided as Enclosure (9).

The remaining 17 allegations can be segregated into six categories:

A. Five allegations were made regarding the adequacy of visual acceptance criteria employed in Bechtel's Construction Specification CS-P207 for American Society of Mechanical Engineer Boiler and Pressure Vessel Code (ASME) Section III, Subsection NF, component supports and one allegation was made in relation to B31.1 (non-safety related piping). (Note, although not an allegation, Reference (C) requested that Bechtel review the remaining paragraphs of Section 5.6 of CS-P207 to show conformance with the ASME Code.)

B. Two allegations were made comparing the American Welding Society's (AWS) D.1.1 Structural Welding Code versus CS-C16, "Visual Inspection Criteria for Structural Steel and Miscellaneous Metal Welding to Meet Design Criteria."

C. Three allegations were made relating to field operations. These were pipe damage due to pipe cutter scribe marks, inadequate flare bevel weld details, and inadequate welder qualification requirements.

D. Three allegations were made which question the structural adequacy of welded joints. These were the lack of prototype testing, the lack of precise knowledge of actual weld strengths, and the lack of fillet welds that completely surround the attached member.

E. One allegation related to the question of runoff plates for groove welding not being required either by BPC design or by our suppliers.

F. The final two allegations on Units 2 and 3 were expressed by Mr. Kent after the site tour on October 25, 1982. The first related to the slope requirements at either a valve to pipe joint or pipe to pipe joint where the schedules of the two components are different. The second related to thread engagement requirements on the bonnet of a check valve.

Before addressing each item in particular, Enclosure (1), we wish to state that the design and construction practices employed by BPC were governed by the appropriate code as defined in regulatory documents or as generally accepted as industry practice.

The applicable national standard that deals with welding of safety related pipe supports in nuclear power plants is the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). Only the ASME Code provides definitions for acceptance of pipe support welds by visual examination. The Nuclear Regulatory Commission (NRC) in their Code of Federal Regulations, 10CFR50 (Domestic Licensing of Production and Utilization Facilities) and Regulatory Guide 1.26 (Quality Group Classifications and Standards for Water, Steam, and Radioactive Waste Containing Components of Nuclear Power Plants), specifically approves the use of ASME III for nuclear safety related elements of the plant. The portion of the ASME Code governing pipe supports is Subsection NF. For the San Onofre Units 2 and 3 the 1974 Edition Summer 1974 Addendum is the applicable code. Specifically, San Onofre 2 and 3 construction specifications for pipe supports provide detailed acceptance criteria for welding which comply with the ASME Code and interpretations of the Code written by the ASME.

Outside the NF boundary the American Institute of Steel Construction (AISC) specification and the American Welding Society's (AWS) Structural Welding Code are utilized.

It is important that the detailed wording of particular paragraphs of the construction specification be evaluated in the context of the overall BPC quality program. The quality program used for the design and construction is comprised of documented criteria and guidelines that ensure the adequacy of the end product. These include design guides, National Standards and Codes, developmental work by our Materials and Quality Service (M and QS) Group, qualification of welds and materials, construction welding procedures, qualification of welders, and qualification of weld inspectors. For example, to respond to an NRC request relating to the criteria a welding inspector uses to inspect a weld, the following procedure is employed: (1) The code applicable boundaries are delineated on engineering drawings; (2) there are work plan procedures at the jobsite which precisely define what to do; (3) engineering documents such as construction specifications and Form 84 provide inspection criteria. Based on these documents NF welding (ASME III) would be visually inspected by Pipe Support QCE's in accordance with the acceptance criteria specified in CS-P207. Attachments to pressure boundaries would be inspected by Welding QCE's using visual and NDE procedures prescribed by engineering documents specified on FORM 84. Structural steel, where AWS welding is appropriate, would be inspected by QCE's to the requirements of CS-C16. All cognizant QCE's are certified in accordance with ANSI N45.2.6 or SNT-TC-1A, as applicable.

In general, any statements extracted from the BPC construction specification must be examined in the context of the overall quality program.

Bechtel Power Corporation has reviewed the allegations made by Mr. E. E. Kent and found them to be without substance. The design and construction practices employed by BPC are consistent with normally accepted practices, codes, and regulatory requirements.

Very truly yours,

BECHTEL POWER CORPORATION

R. L. Patterson

R. L. Patterson
Division Quality Assurance Manager

SHF:jv

cc: Mr. D. B. Schone, SCE (Jobsite)

Response to Specific Allegations

A. The first six allegations were that specific sections of CS-P207 are not in accordance with the AWS Code. As previously stated, the applicable code covering inspection of safety related pipe supports is ASME Section III, Subsection NF, not the AWS Code. The following discussion compares specific sections of CS-P207 versus the criteria of the ASME Code [items 1 through 6 and item 11 of Reference (C)].

1. In addressing porosity and slag inclusions in pipe support welds, Paragraph 5.6.1.3 of the specification states:

   "Porosity and slag shall not be cause for rejection."

   From Enclosure (2), ASME Code, Section III, Subarticle NF-5360, porosity and slag are not cited as bases for rejection of pipe support welds by visual examination. The ability to visually examine a pipe support weld is a function of the surface condition of the weld. This surface condition of the weld may be minimally obscured by overlying slag. Surface slag is not of itself a cause for rejection of the weld and does not limit the weld inspector's requirement to accept the weld. Removal of the surface slag then allows the inspector to judge the visual acceptability of the weld surface.

   Surface porosity also is not a cause for rejection of the weld. Minimal amount of surface porosity may result due to the metallurgical nature of the base metal and welding filler material and methods required by the ASME III Code, and as used with qualified welding procedures and welders. This resulting surface porosity is compensated for by the conservative weld metal allowable stresses required by the ASME III Code. Welding processes properly qualified and used in fabrication under a controlled quality program as have been implemented at San Onofre 2 and 3 will result in minimal porosity and slag in the weld metal.

   As stated previously, to take the construction specification acceptance criteria on porosity and slag out of context of the overall quality program is inappropriate.

2. Paragraph 5.6.1.4 of the construction specification for pipe supports discusses weld convexity height acceptance. It states:

   "Convexity height may be accepted without limit. Rollover (overlap) not exceeding 1/8 inch is acceptable provided the toe or fusion line of the weld remains visible for examination."

This paragraph from the specification deals only with fillet welds for pipe supports and not with piping pressure boundary. Paragraph 5.6.1.4 is consistent with the requirements of Subarticle NF-4427 of the ASME III Code, which is shown in Enclosure (3), and states that a weld may vary from concave to convex. Convexity of a fillet weld deals with additional weld metal deposited over what is required by the drawing and may enhance the ability of a weld to sustain greater design loads. Additionally, convexity is self-limiting by the nature and type of weld process used and will not cause significant stress concentration in the pipe support welds. In addition, Code Interpretation III-80-109, Question (1) [Enclosure (4)] confirms that convexity criteria are not addressed by the ASME III Code.

3. Paragraph 5.6.1.9 of the specification addresses underfilled groove weld craters. It states:

> "Underfilled groove weld craters shall be accepted provided the depth of underfill is 1/16 inch or less. Underfilled single-pass fillet weld craters shall be accepted provided the crater length is less than 10 percent of the weld length. On multipass fillet welds, crater depth 1/16 inch or less shall be accepted."

ASME Section III, Subsection NF does not specifically address acceptance criteria for underfilled groove craters. In response to a specific inquiry on underfill, the ASME issued Interpretation III-80-109, Question (4) [Enclosure (4)]. The Interpretation states that the Code, NF-5360, addresses weld metal indications only and is not concerned with underrun on fillet weld size or length. The margins inherent in the engineering design of welds account for underrun on fillet size or length defined by the visual inspection criteria. The size of welds shown on engineering drawings accommodate the underfill to the extent specified in the paragraph 5.6.1.9 and this will not affect the structural integrity of the weld.

4. Paragraph 5.6.1.10 of the specification addresses adherent weld spatter. It states:

> "Adherent weld spatter, not removable by wire brushing, is acceptable unless its complete removal is required for further processing such as coating."

Weld spatter on the surfaces of pipe support welds or base metal has no effect on the structural function or integrity of the support. The ASME III Code, Subsection NF, does not require weld spatter removal. The specific question of weld spatter removal has previously been asked of the ASME. Their written response to the inquiry is contained in Interpretation III-1-79-176 shown in Enclosure (5), and is consistent with the specification.

5. Paragraph 5.6.1.11 of CS-P207 states:

"Arc strikes are acceptable, provided that the craters, (1) do not contain cracks (as determined by visual examination), and (2) maximum size does not exceed 3/8 inch plan nor 1/16 inch profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of visual examination."

Even though the ASME III Code, Subsection NF does not explicitly discuss arc strikes, the ASME Interpretation in III-80-109, Question (3) [Enclosure (4)] states that weldment surface defects are removed without regard to the cause of the surface defect. Arc strikes are of concern only if a crack is produced or the section size is reduced beyond that required design section thickness. Arc strikes are not likely to cause cracks in plain carbon steels used for pipe supports. Plain carbon steels are essentially non-hardenable steels. Further, paragraph 5.6.1.11 of the specification excludes, in particular, crater cracks from acceptability. Minor hardening that might result from arc strikes in plain carbon steel is easily accounted for in the massive surrounding matrix of the ductile material. Arc strikes might be of concern in alloyed steel materials. However, these types of materials are not used in pipe hangers, cable trays supports, or similar items.

Most codes and standards including many AWS standards do not treat arc strikes because of the essentially cosmetic nature of these discontinuities. These codes and standards include:

AWS D14.1 = "Specification for Welding Industrial and Mill Cranes."

AWS D14.2 = "Specification for Metal Cutting Tool Weldments."

AWS D10.5 = Report, "Welding Ferrous Materials for Nuclear Power Piping."

AWS D3.5 = "Hull Welding Manual"

ANSI B31.1 = Power Piping

ANSI B31.3 = Petroleum Refinery Piping

The Bechtel position on arc strikes permits grinding of arc strikes but does not require such grinding provided no crater cracks are present and a gentle or rounded profile exists which does not encroach on the minimum design thickness.

6. The last allegation in this category concerns the substitution of fillet welds for a weldment combining a full penetration groove weld with a fillet weld cover. Paragraph 5.7.2 of the specification states:

   "Pipe support drawings for B31.1 piping that indicate full-penetration groove welds with fillet covers may be welded as just fillet welds. The minimum fillet weld size for B31.1 pipe integral attachments shall be as follows:

   a. Fillet weld size = (0.7) x (the wall thickness of the thinner of the pipe wall or the dummy stub wall).

   b. If the attachment is tension loaded due to a snubber or variable spring hanger, engineering calculations must be performed to justify the strength of the weld."

   Since the reference is to B31.1 piping, the scope of this paragraph in the specification is limited to non-safety related piping systems. These non-safety related areas of the power plant do not affect the safe operation of the nuclear safety related systems or the ability of the nuclear systems to be safely shut down. The original design using all full penetration groove welds with fillet cover welds was found to be very conservative. Therefore, an alternate design using fillet welds was developed. Engineering evaluation has determined that the minimum fillet weld size of (0.7) x (the wall thickness of the thinner of the pipe wall or the dummy stub wall) is adequate for bearing type loads (5.7.2.a). Paragraph 5.7.2.b requires a substantiating calculation to assure the adequacy of the design when tension loads are applied.

   In addition, field procedures require the preparation of an FCR for any modification of the dummy stub to pipe welds. No FCR's were found in a search at the site for cases where this alternate procedure has been applied. It is therefore concluded that all dummy stubs installed with fillet welds have been authorized by engineering and properly sized to carry the imposed loads.

Reference (C), item 11, requested that BPC also review the remaining paragraphs of Section 5.6 for compliance with the ASME Code.

5.6.1.1 "The weld meets or exceeds specified size requirements. Either or both fillet weld legs may exceed design size by 3/16 inch for welds up to and including 5/16 inch fillet, and 1/4 inch for welds larger than 5/16 inch fillet. Welds may be longer than specified. Continuous welds may be accepted in place of intermittent welds."

Subsection NF of the Code is silent on this question. This criteria precludes weld rejection when the welder has provided oversized fillet welds within the bounds stated. It also permits acceptance of fillet welds which are longer than the drawing indicates. Both of these variances result in increased weld material deposition which can not reduce the strength of the weld but may increase its load carrying capability.

5.6.1.2 "The fillet leg dimension may not underrun the nominal fillet size by more than 1/16 inch for more than 10 percent of the weld length. For flange to web joints the undersize may not be within two flange thicknesses of the weld end."

Subsection NF of the Code is silent on this point. However, ASME Interpretation III-80-109 [Enclosure (4)] issued May 12, 1980 is as follows:

Question: Are undersized dimensions greater than 1/16 inch of a weld considered as relevant indications when detected by visual examination in accordance with NF-5360(a)?

Reply: NF-5360 addresses weld metal indications only. It does not address underrun on fillet size or length.

Engineering justification for allowing the fillet leg dimension to underrun the nominal fillet size is based upon the inherent margin in the design. For example, calculations on file demonstrate that when a 3/16 inch fillet weld (the smallest weld specified for use in construction of pipe supports) is undersized by 1/16 inch for 10 percent of its length, it has a usable strength of about 160 percent of the design limit load.

5.6.1.5 "The height of reinforcement of butt welds on each face of the weld shall not exceed the following:"

Nominal Thickness (inch)	Maximum Reinforcement (inch)
Up to 1, incl.	3/32
Over 1 to 2, incl.	1/8
Over 2 to 3, incl.	5/32
Over 3 to 4, incl.	7/32
Over 4 to 5, incl.	1/4
Over 5	5/16

This criteria is identical with the ASME III Code, NF-4426.

5.6.1.6 "There are no cracks or linear indications in the weld exceeding 1/16 inch."

This criteria is in accordance with the ASME III Code, Subsection NF, Subarticle 5360(a) which permits indications up to 1/16 inch. Subarticle 5360(b) precludes the acceptance of any cracks.

5.6.1.7 "Thorough fusion exists between the weld metal and base metal, except as permitted as rollover in paragraph 5.6.1.4."

Fusion is not specifically addressed by the Code. This paragraph gives additional criteria for inspection.

5.6.1.8 "Undercut (underfill) not exceeding 1/16 inch may be accepted for the full length of the weld provided it does not encroach on minimum design thickness. For members welded from both sides, the criteria shall be applied independently except that the cumulative depth shall not encroach on the minimum design thickness."

This criteria is more stringent than the requirements of NF-4424. The latter permits undercutting up to the minimum design thickness of the base metal while this criteria limits undercutting to 1/16 inch or up to the minimum design thickness of the base metal.

B. The next two allegations made concerned specific differences between the AWS D1.1 Code and BPC Construction Specification CS-C16.

The first question was given in Reference (C): "Reconcile the apparent differences between AWS D1.1 1972 paragraph 4.4 and CS-C16 paragraph 3.3.7, regarding arc strikes." This allegation is identical to that responded to previously in our discussion of paragraph 5.6.11 of CS-P207. The major difference is that AWS D1.1-74 paragraph 4.4 refers to arc strikes outside the area of permanent welds.

3.3.7 "Arc strikes are acceptable provided that the craters, (1) do not contain cracks (as determined by visual examination), and (2) maximum size does not exceed 3/8 inch plan nor 1/16 inch profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of proper visual inspection."

It should be noted that the application of Section 3.3.7 is confined only to miscellaneous steel and not the main building members. Arc strikes are harmful only if they produce a crack or diminish the required design thickness. For steels used in the construction of a nuclear power plant, arc strikes are not likely to produce a crack because these mild carbon and austentitic stainless steels are not appreciably hardenable. In addition, the steels used in the building structural framework and the piping system and electrical system supports are not susceptible to cracking resulting from arc strikes.

Because the significance of arc strikes in the carbon structural and piping steels is minimal, a "Nondestructive Examination" method which is likely to ~~detect~~ create arc strikes is widely accepted and in common use throughout manufacturing and construction industries.

The prod method of magnetic particle examination may also cause arc strikes on the component surface being examined. The fact is, that on carbon steels arc strikes are so insignificant that an "NDE" method which induces them is widely used.

The second allegation was presented by Mr. Dennis Kirsch in the October 19, 1982 meeting. He requested a reconciliation between CS-C16 and AWS D1.1-72 paragraphs 5.12.1.5(2)(b) and 8.15.1.3. Both of these sections refer to filling of craters.

5.12.1.5(2)(b) "All craters filled to the full cross section of the weld."

8.15.1.3 "All craters are filled to the full cross section of the weld."

3.3.3 "Underfilled groove weld craters shall be accepted provided the depth of underfill is 1/16 inch or less. Underfilled single-pass fillet weld craters shall be accepted provided the crater length is less than ten percent of the weld length. On multi-pass fillet welds crater depth 1/16 inch or less shall be accepted."

This Section 3.3.3 applies to miscellaneous steel only and not to the main building members.

Consideration of underfilled craters, grooves, subsize and concave fillet welds has been based upon conservative evaluation of decreased load carrying effective throat area. The weld metal has substantially higher minimum specified yield strength than does base metal, that is, 50,000 psi versus 36,000 psi.

Mr. Kirsch also requested SAR references for these and any other exceptions. CS-C16 in its entirety is in the San Onofre 2 and 3 FSAR as Appendix 3.8A.

C. The next three allegations related to field operations:

1. The first of these allegations was that pipe fitters used a pipe cutter to make scribe marks for socket weld fit-up, and these marks would cause stress concentrations. While perhaps not a particularly desirable method to use for scribe marks, any "mechanical damage" would be controlled under our overall quality program.

   Inspection and acceptance criteria are specified in Work Plan Procedure/Quality Control Instruction 400 (WPP/QCI-400). By procedure, minor surface defects not requiring corrective action are defined as, "Defects in pipe having a depth not exceeding 5% of the nominal pipe wall thickness, or 1/16", whichever is less." It should be noted that the 5% limitation is a more stringent requirement for small piping (2 inch and under) than the 1/16 inch requirement.

"Mechanical damage" is defined as scoring, gouges, pits, suspect lap, seams, and similar types of surface damage or defects that may exceed the "minor surface defects" above.

Visual inspections for physical damage on piping material are performed by certified QCE's and include the use of pit gauges to verify the depth of scribe marks.

All scribe marks, including those made by a pipe cutter on socket welded pipe are inspected to these criteria. Remedial action of non-conformances are dispositioned in NCR's.

As a design analogy to the effect of the groove on the integrity of the pipe, reference is made to the misalignment conditions permitted in Section III of the ASME Code. NUREG-0307 [Reference (D)], paragraph 2.9.2.2, "Girth Butt Welds" states in part,

> "It is recognized that thin wall pipe can have relatively high weld reinforcements; producing a significant "notch" at the weld. It is also recognized that misalignment can significantly increase the local stresses in the welds. Both of these aspects were considered in assigning the relatively high C_2 and K_2 indices of 1.4 and 2.5, respectively."

Therefore, the Stress Intensification Factor (SIF) of $(C_2 \times K_2)/2 = (1.4 \times 2.5)/2 = 1.8$ is considered acceptable for this significant notch effect and misalignment. Furthermore, Figure NC-3673.2(b)-1 of ASME Section III requires use of 1.8 SIF for girth butt weld (as welded). This 1.8 SIF requirement is also referenced in NUREG-0307 [Reference (D)]. The applicable SIF for the type of scribe marks under consideration and as shown in photographs of Figures 1 through 4 of Enclosure (6) are judged to be less severe than the misalignment and reinforcement covered in the referenced document and less than 1.8.

In accordance with Figure NC-3673.2(b)-1 of ASME Section III, SIF of 1.8 is applicable for girth butt welds with misalignment greater than 10 percent of the nominal wall thickness. Therefore, for the scribe mark depth limitation of 5 percent of the pipe wall thickness, use of SIF of 1.8 is conservative. The SIF used for socket welded connections is 2.1 (per Figure NC-3673.2(b)-1 of ASME Section III) which also includes the notch effect. The SIF of 2.1 is greater than the SIF of 1.8 developed above. For the San Onofre 2 and 3 project, a SIF of 2.1 is used in design for all socket welds and therefore the socket weld is the governing design factor and not the scribe mark. The moment loadings at the socket weld and the scribe mark (approximately 2 inches away) are essentially identical.

Generally, the pressure design is not the governing condition for small piping. As far as the pressure design is concerned, allowing for the 12.5 percent manufacturing tolerance, the nominal wall thickness provided exceeds the calculated wall thickness by at least 40 percent.

Therefore the 5 percent depth limitation is adequate for pressure design as well.

2. The second allegation in this series related to flare bevel welds. The allegation was unspecific.

   An apparent nonconforming condition was identified during a normal QC inspection of cable tray support installations. The nonconformance related to the underfill of a flare bevel weld associated with a particular support detail. No acceptance criteria existed to disposition a partial penetration flare bevel weld as specified on the engineering design drawings. The problem was determined to be programatical in nature and a Deficiency Evaluation Report was generated (DER No. 69, dated November 4, 1980). The following is a summary of the course of action which transpired to close out the referenced DER:

   a. The associated design disclosure documents (Construction Specification and SAR) were revised to incorporate the applicable acceptance criteria.

   b. All partial penetration flare bevel welds were reinspected to the revised criteria.

   c. Engineering performed a review of the original design and identified the minimum acceptable dimension for the partial penetration flare bevel weld.

   d. All nonconforming conditions were corrected and no further applications of this type of detail were identified.

3. The third allegation in this series related to welder qualification. Mr. Kent stated that sheet 20, note 1 of Welding Qualification document WQ-2 permits weld reinforcement of 1/3 inch contrary to paragraph 3.6.2 of AWS D1.1. Sheet 20 is not part of the welder qualification program used on San Onofre Units 2 and 3. Review of the document, however, concluded that the 1/3 inch was in fact a typographical error and should have been 1/8 inch. This is consistent with detail E also contained on sheet 20.

D. The additional allegations were made concerning the structural adequacy of structural joints. These allegations in particular were: the need for fully welded connection details, prototype testing of weld details, and methods utilized in the selection of actual weld strength.

1. Need for Fully Welded Connections

There are no provisions in any structural design code, nor is it standard design practice, to require fully welded details for use in all structural, pipe support, or cable tray support designs.

All structural design texts, specifications, codes, and technical references permit a broad variety of acceptable design details which have been shown to provide required structural integrity to meet the intended function of the supports. For example, the American Institute of Steel Construction (AISC) Specification is the national specification and design guide utilized by structural engineers for the design of structural steel components. In Section 1.2 of the AISC Specification three basic types of construction and associated design assumptions are permissible, utilizing design details which dictate the member sizes and corresponding strengths. These three types include:

Type 1 - "Rigid-frame" (continuous frame) details which possess sufficient rigidity to minimize angular movement between intersecting members. A fully welded or heavily bolted movement resistant connection is representative of this design type.

- moment

Type 2 - "Simple" frame details which permit unrestrained, free-ended rotation for specified loading conditions, necessitating the design of the connections to resist shear loads only. A lightly welded or lightly bolted connection, or more heavily welded or bolted connection with details which have flexible rotational capability (e.g. double angle connections) are representative of this design type.

Type 3 - "Semi-rigid framing" which permits partial rigidity (partially restrained) for connections of structural components providing the moment resistant capacity can be technically supported through accepted procedural analysis to confirm the degree of restraint. This design type falls between Types 1 and 2.

The selection of the connection type from these three approved types has been made by Bechtel engineering based upon consideration including intended function, required design integrity, types of steel available, constructibility preferences, applicable codes, regulatory requirements, and other relevant aspects. The selection of a particular connection detail is made to assure structural consistency and technical compatibility with the analysis and design of the structural system. Any arbitrary alteration of the connection detail outside the bounds specified in the design drawings or construction specification could invalidate the basic design assumptions. It could also result in the overstress of structural components in excess of specified code allowables. The connections utilized for the San Onofre Units 2 and 3 project have been designed, reviewed and checked by qualified engineers consistent with NRC quality requirements. As such, complete technical consistency and design compatibility have been provided in the San Onofre 2 and 3 design throughout. See Enclosure (9) for additional information.

2. Prototype Testing of Weld Details

The design of weld details and welded connection details are based upon nationally recognized design procedures which are referenced in the project design criteria are specified in the SAR, FSAR and other regulatory documents. Such details utilize recognized analytical techniques which appear in standard textbooks as well as referenced codes. These designs are based upon accepted procedures which have evolved since the founding of the American Institute of Steel Construction in 1921. This organization establishes, through close interaction between industry and university development, extensive research and engineering studies programs to establish acceptable design procedures, economical and efficient design recommendations, and methods to improve and control the quality of structural steel.

The use of the AISC Specification and AWS Code in the selection of relevant weld details precludes the need for prototype testing, providing the material, weld rod and welding procedures conform to the stated code requirements, utilizing basic engineering mechanics principles. M and QS has performed over 800 welding qualification tests to substantiate various welding configurations, materials, and essential welding variables. The AISC Manual states, "The AISC Specification and the Structural Welding Code of the American Welding Society exempt from tests and qualification most of the common welded joints used in steel structures. Such exempt joints are designated as prequalified." The use of prototype testing for weld details is necessary only when unusual non-code weld rod or plate materials are selected, and prior research and testing utilized in code recommendations cannot be directly applied. Such prototype testing can be utilized to justify the use of the proposed design. In the San Onofre 2 and 3 design, no unusual materials or details are utilized. The San Onofre 2 and 3 design utilizes common industry and code accepted structural plate materials, and standard weld rod materials. As such, no prototype testing is required. All materials, procedures, and code applications are described in detail in the project design criteria and the San Onofre 2 and 3 SAR and FSAR.

3. Actual Strength of Welding Materials

The actual strength of welding materials is based specifically upon code allowables for the particular component and its function. The allowable stresses of weld rod material is based upon the specific electrode type (e.g. AWS A5.1 or ASME SA 5.1, E70XX) and the matching base metal comprising the joint detail (e.g. ASTM A-36 or A570). The strength calculations are based upon these allowable stresses, which are a percentage of the minimum specified material properties, and engineering mechanics behavior assumptions specified in code and textbook references. This approach results in significant tensile strength margins over allowable values. To assure that appropriate weld rod and connecting materials are utilized, the design specifications include provisions for material verification, material identification and control, and testing requirements to the minimum specified properties. The allowable stresses specified in the codes are based upon extensive university and industry testing and research, and years of shop and field experience. The selection of AISC and AWS welding materials and prequalified welding details results in a highly conservative welding design basis for the San Onofre 2 and 3 project.

E. The final allegation relates to the use or non-use by BPC and their suppliers of runoff plates for groove welding described in AWS D1.1, paragraph 4.6.1.

The use of runoff tabs or extended backing bars are referred to in the Structural Welding Code, AWS D1.1-74, Article 4.6.1 as follows:

> "Groove welds shall be terminated at the ends of a joint in a manner that will ensure sound welds. Where possible this shall be done by use of extension bars or runoff plates."

The allegation claims that Bechtel and its suppliers do not adhere to this portion of the Code.

The use of runoff tabs is usually restricted to high current density automated welding processes such as submerged arc and gas metal arc machine welding processes where the control of weld end fill is not possible. Since the bulk of the welding at power plant sites is shielded metal arc welding, the control of the weld end fill is of no concern because the process is one of low current density and can be readily controlled by the welder to ensure sound welding including complete filling of the groove weld ends.

As to weldments produced by suppliers of structural steel (fabricated beams, etc.) the same circumstances would control. Where the high current density processes are utilized, extension bars are generally used. Where extension bars are not used, the beam or structural material is cut off at a point where the weld is full section and meets the length requirements of the Purchase Order.

The Structural Welding Code AWS D1.1-77, Revision 2 recognized the fact that the article on groove weld termination should not be inclusive of all welding processes. For this reason Article 4.6.1 has been changed in the 1977 edition and reads as follows:

"Welds shall be terminated at the end of a joint in a manner that will ensure sound welds. Whenever necessary, this shall be done by use of extension bars and runoff plates."

This same wording continues through the latest edition of the AWS Code (D.1.1-82).

F. Mr. Kent alleged in the meeting between SCE, BPC and the NRC after his site tour that there existed cases where BPC did not meet the ASME Code requirements on a 3:1 slope in the body of several Kerotest valves at the valve to pipe joint. He also stated that this was true at the union of two different sized pipes. He stated that NB, NC, and ND-4232 requires this slope and that on the tour they had observed many cases where this slope was obviously steeper, approximately 1:1 or 45°. Our review of this allegation indicates again his superficial knowledge of the ASME III Code. Enclosure (7) extracted from Subsection NB of the ASME III Code specifically states that the 3:1 slope requirements is in the weld prep area and extends only for a distance of 1.5 times the thinner wall thickness. Thereafter the valve body or higher schedule pipe is flared up to a 45° angle. Enclosure (7), page 3, is a copy of a San Onofre Units 2 and 3 drawing showing the required slope details consistent with the ASME Code. Observation of two valves taken from spares and the valves and piping observed during the tour verified that all code requirements were met.

The last allegtion made by Mr. Kent on Units 2 and 3 concerned thread engagement on one of sixteen bonnet to body studs for swing check valve S3-1204-MU-087. The stud was recessed slightly into the upper nut. His allegation was that this indicated short studs were in use and the thread engagement did not meet the ASME Code. The valve in question was supplied by the manufacturer, Anchor Darling, in the same condition as installed. The bonnet has not been removed since the valve was received at the San Onofre site.

Requirements for installation or fabrication of mechanical joints are described in Subarticles NB/NC/ND-4700 [Enclosure (8), page 1] (since NB/NC/ND-4700 are identical, only NC-4700 is shown in the enclosure). Subarticle NC-4711 "Thread Engagement", required all bolts or studs to be engaged in accordance with the design. However, only Code Class 2 and 3 piping flanged joints are required to have bolts extend completely through the nuts, Subarticle NC-3647.6(a) [Enclosure (8), page 2]. In all other bolted connections used for pumps, valves, tanks and vessels, thread engagement is a matter of design.

It is our conclusion that Mr. Kent's allegation is without basis since the Code does not require bolts to be flush with the top of the nut (except for Code Class 2 and 3 piping flanged joints), the vendor did not require it in his maintenance manual, and the valve was designed to be used with the studs and nuts provided.

3 times the width. Rounded indications are indications which are circular or elliptical with the length less than 3 times the width.

NF-5352 Acceptance Standards

(a) Only indications with major dimensions greater than 1/16 in. shall be considered relevant.

(b) Unless otherwise specified in this Subsection, the following relevant indications are unacceptable:

(1) Any cracks or linear indications,

(2) Rounded indications with dimensions greater than 3/16 in.

(3) Four or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in a line and are spearated by 1/16 in. or less edge to edge.

(4) Ten or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in any 6 sq in. of surface with the major dimensions of this area not to exceed 6 in., with the area taken in the most unfavorable location relative to the indications being evaluated.

NF-5360 ACCEPTANCE STANDARDS FOR VISUAL EXAMINATION OF WELDS

(a) Only indications with major dimensions greater than 1/16 in. shall be considered relevant.

(b) Unless otherwise specified in this Subsection, cracks or other linear indications are unacceptable.

NF-5400 EXAMINATION OF SPRINGS FOR CLASS 1 COMPONENT STANDARD SUPPORTS

NF-5410 REQUIRED EXAMINATION AND ACCEPTANCE STANDARDS

Springs for Class 1 component standard supports shall be examined after coiling by either the magnetic particle or liquid pentetrant method. Springs with seams, slits, or quench cracks longer than 3% of the bar diameter shall be rejected.

NF-5500 QUALIFICATIONS OF NONDESTRUCTIVE EXAMINATION PERSONNEL

NF-5510 GENERAL REQUIREMENTS

It shall be the responsibility of the Manufacturer or Installer to assure that all personnel performing nondestructive examination operations under this Subsection are competent and knowledgeable of the applicable examination requirements to the degree specified in NF-5520. All nondestructive examinations required by this Subsection shall be performed and the results evaluated by qualified nondestructive examination personnel. The assignment of responsibilities to individual personnel will be at the discretion of the Manufacturer or Installer.

NF-5520 PERSONNEL QUALIFICATION

NF-5521 Qualification Procedure

(a) Personnel performing nondestructive examination under this Section shall be qualified in accordance with SNT-TC-1A.[1] Supplements and Appendices as applicable for the technique and methods used. For nondestructive examination methods not covered by SNT-TC-1A documents, personnel shall be qualified by the Manufacturer or Installer to comparable levels of competency by subjection to comparable examinations on the particular method involved. The practical portion of the qualification shall be performed using the Manufacturer's or Installer's procedure or part representative of the Manufacturer's products.

(b) The emphasis shall be on the individual's ability to perform the nondestructive examination in accordance with the applicable procedure for the intended application.

(c) For nondestructive examination methods that consist of more than one operation or type, it is permissible to use personnel qualified to perform one or more operations. As an example, one person may be used who is qualified to conduct the examination and another may be used who is qualified to interpret and evaluate the results.

NF-5530 RECORDS

Personnel qualification records shall be retained in accordance with NA-4900.

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[1]SNT-Tc-1A and Supplements is a *Recommended Practice for Nondestructive Testing Personnel Qualification and Certification* published by the American Society for Nondestructive Testing, 914 Chicago Avenue, Evanston, Illinois 60202.

NF-4400 RULES GOVERNING MAKING, EXAMINING, REPAIRING, AND HEAT TREATING WELDS

NF-4410 PRECAUTIONS TO BE TAKEN BEFORE WELDING

NF-4411 Identification, Storage, and Handling of Welding Materials

Each Manufacturer or Installer is responsible for control of the welding electrodes and other materials which are used in the fabrication and installation of components supports (NF-4120). Suitable identification, storage, and handling of electrodes, flux, and other welding materials shall be maintained. Precautions shall be taken to minimize absorption of moisture by electrodes and flux.

NF-4412 Cleanliness and Protection of Weld Surfaces

The method used to prepare the base metal shall leave the weld preparation with reasonably smooth surfaces. The surfaces for welding shall be free of scale, rust, oil, grease, and other deleterious foreign material. The work shall be protected from deleterious contamination and from rain, snow, and wind during welding. Welding shall not be performed on wet surfaces.

NF-4420 RULES FOR MAKING WELDED JOINTS

NF-4421 Backing Strips

The materials for backing strips, when used, shall be compatible with the base metal (NF-4240).

NF-4422 Peening

The weld metal may be peened when it is deemed necessary or helpful to control distortion.

NF-4423 Miscellaneous Welding Requirements

Before applying weld metal on the second side to be welded, the root of double welded joints shall be prepared by suitable methods, such as chipping, grinding, or thermal gouging to sound metal.

NF-4424 Surfaces of Welds

As welded surfaces are permitted. However, the surface of welds shall be sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys to meet the requirements of (a) through (d) below.

(a) The surface condition of the finished weld shall be suitable for the proper interpretation of radiographic and other required nondestructive examinations of the welds. In those cases where there is a question regarding the surface condition on the interpretation of a radiographic film, the film shall be compared to the actual weld surface for interpretation and determination of acceptability.

(b) Reinforcements are permitted in accordance with NF-4426.

(c) Undercuts shall not encroach on the required section thickness.

(d) If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the required thickness.

NF-4426 Reinforcement of Butt Welds

The surface of the reinforcement of all butt welded joints may be flush with the base material or may have uniform crowns. The height of reinforcement on each face of the weld shall not exceed the following thickness:

Nominal Thickness, in.	Maximum Reinforcement, in.
Up to 1, incl.	$^3/_{32}$
Over 1 to 2, incl.	$^1/_8$
Over 2 to 3, incl.	$^5/_{32}$
Over 3 to 4, incl.	$^7/_{32}$
Over 4 to 5, incl.	$^1/_4$
Over 5	$^5/_{16}$

NF-4427 Shape and Size of Fillet Welds

Fillet welds may vary from convex to concave. The size of the fillet weld shall be determined in accordance with Figure NF-4427-1.

NF-4429 Plug Welds

When plug welds are used on component supports, a fillet weld shall first be deposited around the circumference at the bottom of the hole.

NF-4440 EXAMINATION OF WELDS

All welds shall be examined in accordance with the requirements of NF-5000.

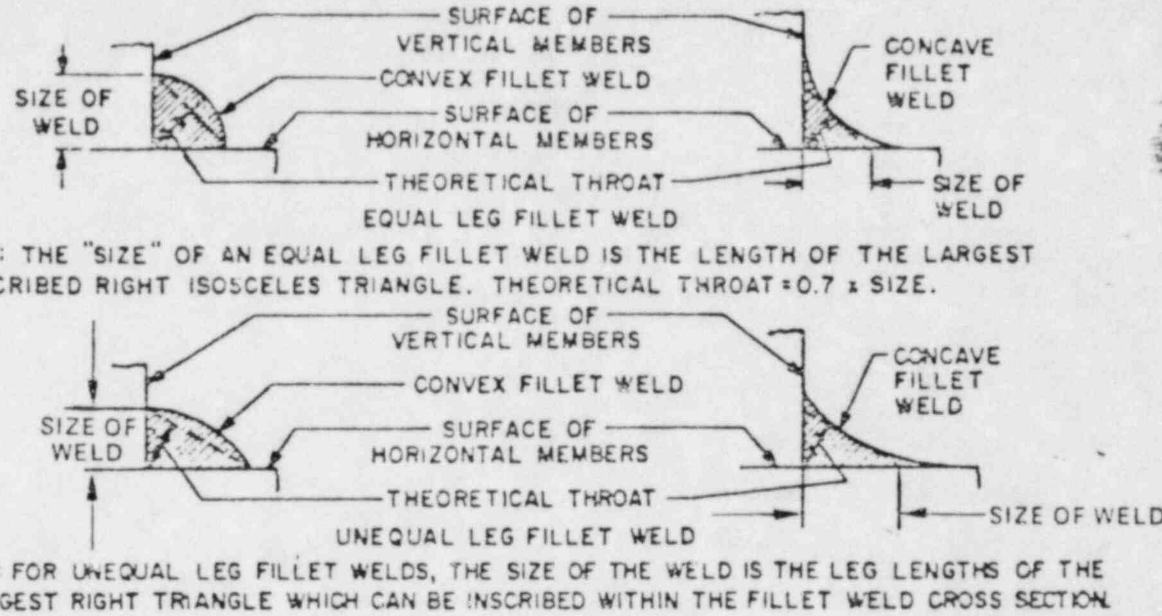


FIG. NF-4427-1 SIZE OF FILLET WELDS

NF-4450 REPAIR OF WELD METAL DEFECTS

NF-4451 General Requirements

Unacceptable defects in weld metal detected by examinations required by NF-5000 shall be eliminated and, when necessary, repaired in accordance with the requirements of this subsubarticle.

NF-4452 Elimination of Surface Defects

Weld metal surface defects may be removed by grinding or machining and need not be repaired by welding, provided that the requirements of (a), (b), and (c) are met.

(a) The remaining thickness of the section is not reduced below that required by NF-3000.

(b) The depression, after defect elimination, is blended uniformly into the surrounding surface.

(c) The area is examined by a magnetic particle or liquid penetrant method after blending to ensure that the defect has been removed or in indication reduced to an acceptable limit.

NF-4453 Requirements for Making Repairs to Welds

Excavated cavities in weld metal, whose depths reduce the section thickness below the requirements of NF-3000, shall be repaired in accordance with the following subparagraphs.

NF-4453.1 Defect Removal. Unacceptable defects detected by the examination or test required by NF-5000 shall be removed by mechanical means or by thermal gouging processes.

NF-4453.2 Requirements for Welding Materials, Procedures, and Welders. The weld repair shall be made using welding materials, welders, and welding procedures in accordance with NF-4125 and NF-4300.

NF-4453.3 Blending of Repaired Areas. After repair, the surface shall be blended uniformly into the surrounding surface.

NF-4453.4 Examination of Repair Welds. The examination of weld repairs shall be repeated as required for the original weld.

NF-4453.5 Heat Treatment of Repaired Areas. The repaired area shall be heat treated when required by NF-4640.

NF-4600 HEAT TREATMENT

NF-4610 WELDING PREHEAT AND INTERPASS REQUIREMENTS

NF-4611 When Preheat Is Necessary

The need for and temperature of preheat are dependent on a number of factors, such as the chemical analysis, degree of restraint of the parts being joined, elevated temperature, physical prop-

Interpretation: III-80-109

Subject: Section III, Division 1, NF-4427 Shape and Size of Fillet Welds, NF-4452 Elimination of Surface Defects, NF-5360 Acceptance Standards for Visual Examination, Appendix XVII-2454 Butt and Groove Welds

Date Issued: May 12, 1980

File: NI-80-12

Question (1): Does Section III, Subsection NF provide requirements for the maximum convexity of fillet welds?

Reply (1): No.

Question (2): Is the theoretical throat of a fillet weld the minimum effective throat?

Reply (2): Yes.

Question (3): Do weld metal surface defects (NF-4452) include arc strikes?

Reply (3): NF-4452 provides for elimination of weld metal surface defects without reference to the cause of the surface defect.

Question (4): Are undersize dimensions, greater than 1/16 in., of a weld considered as relevant indications when detected by visual examination in accordance with NF-5360(a)?

Reply (4): NF-5360 addresses weld metal indications only. It does not address underrun on fillet size or length.

Question (5): Does XVII-2454(c) of the 1977 Edition mean that a ½ in. double partial penetration groove weld joining 3 in. thick material together is unacceptable?

Reply (5): Yes.

Question (6): Is it permissible to use a single-bevel full penetration weld without the use of backing strips or back gouging in the fabrication of welded tee joints in linear type component supports?

Reply (6): Yes.

Interpretation: III-1-79-176

Subject: Section III, Division 1 Division 2 Weld Spatter

Date Issued: October 23, 1979

File: NI-79-202

Question: Is it required by Section III, Division 1 and/or Division 2, that weld spatter be removed for cosmetic purposes if it does not interfere with ...ther processing or the use of the item in service, or if it does not interfere with subsequent NDE, or if paint or other protective coating is not required?

Reply: It is not required by Section III, Division 1 and/or Division 2 that weld spatter be removed provided it does not interfere or limit subsequent Code required activities.

Interpretation: III-1-79-177

Subject: Section III, Division 1, Appendix V, N-2 Data Report Form

Date Issued: October 23, 1979

File: NI-79-223

Question: When a Certificate of Authorization is extended to a field site, what data report form should be used for field fabricated parts and appurtenances such as containment vessel equipment hatches?

Reply: When a Certificate of Authorization is extended to a field site for field fabrication of parts or appurtenances, the N-2 Data Report Form shall be used for those parts and appurtenances intended to receive an NPT stamp. The Authorized Inspector at the field site who has the responsibility for assuring that Code requirements have been met shall so signify by completing the "Certification of Shop Inspection" portion of the N-2 Data Report Form. (Note: The text of the "Certification of Shop Inspection" box does not address the issue of where the inspection was made, i.e., shop or field. It does address the issues that inspection was performed by a duly authorized person at a point in time.)

Interpretation: III-1-79-178

Subject: Section III, Division 1, Case N-71 Additional Materials for Component Supports

Date Issued: October 23, 1979

File: NI-79-247

Question: How are the maximum allowable stresses to be calculated for SB-150 Grade 642 material used in accordance with Section III, Case N-71-8 for Class 1, 2, 3, and MC component supports?

Reply: The allowable stresses and stress intensities for Plate and Shell Type Component Supports are provided in Tables 1 and 2 of Code Case N-71-8. For Linear Type Component Supports for bars made from this material, Table 3 provides the S_y values needed for the applicable formulas of XVII-2200, and for bolting made to this specification and grade, the Ultimate Tensile Strength Values of Table 5 may be used with the equations applicable to austenitic steels from XVII-2460 of Appendix XVII.

Scribe Lines for Socket Welds

The attached photographs show four samples of 3/8 inch O.D. x 0.065 inch wall stainless steel tubing. Two of the samples were circumferentially marked with a scribing tool and the other two were circumferentially marked and numbered with a vibro-graving tool.

The depth of each type of mark was measured at 100x (magnifications) and the depth is reported below. The depth measurement represents the depression below the original surface.

Sample No.	Marked By	Depth of Circ. Mark (in.)	Depth of Numerals (in.)	Wall Thickness At Circ. Mark (in.)	Wall Thickness At Numbers (in.)
1	Vibro-Graving	0.0005 to 0.003	0.001 to 0.002	0.070	0.072
2	Vibro-Graving	Up to 0.003	Up to 0.003	0.068	0.067
3	Scribe	Up to 0.0015	---	0.070	---
4	Scribe	Up to 0.003	---	0.068	---

Figure 1 shows the as received smaples. Figure 2 shows the vibro-graving surface numbers at 10x and the cross section at 100x. Figure 3 shows the vibro-graved circumferential mark at 10x and the cross section at 100x. Figure 4 shows the scribed circumferential mark at 10x and the cross section at 100x. Although both of the marking techniques produced marks of approximately equal depth, (Samples 1, 2 and 4) the scribed surface marks are more uniform and not as sharp as those made with the vibro-graving tool.

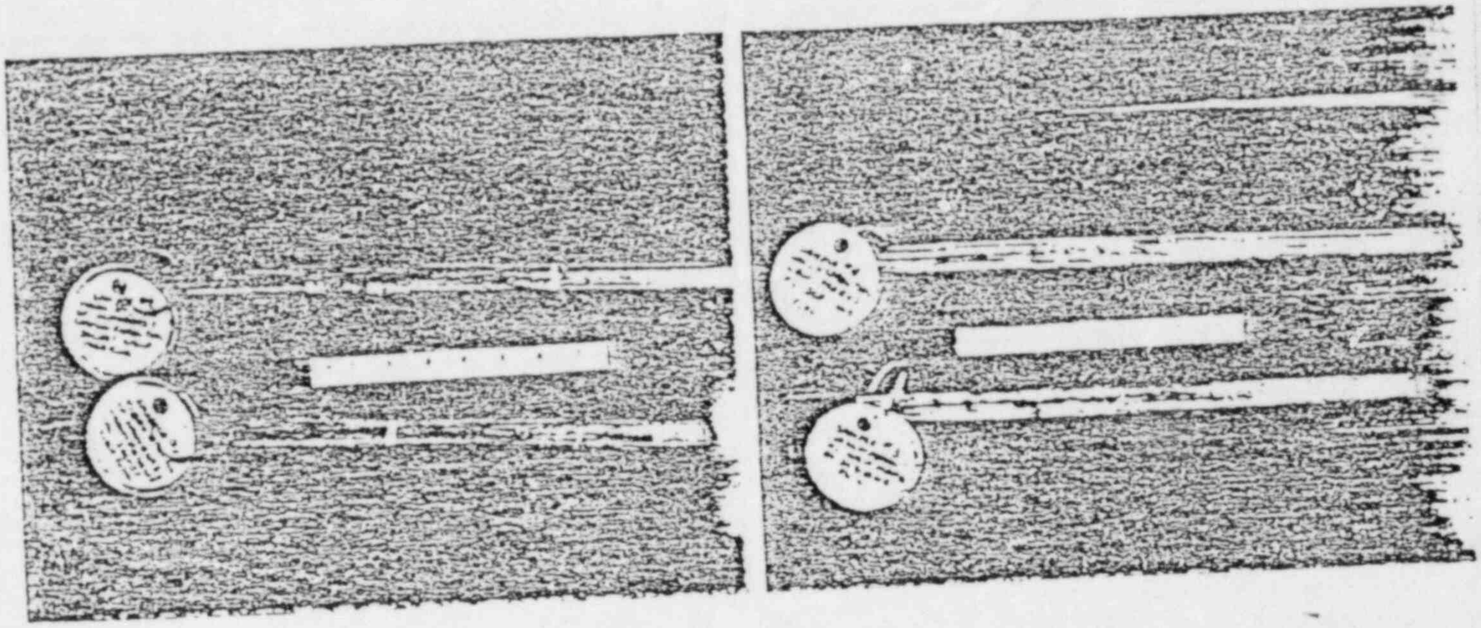
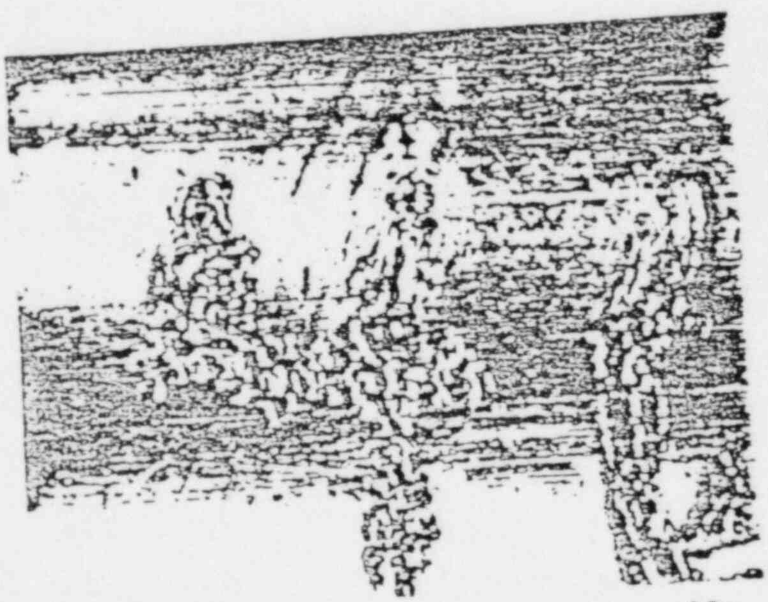
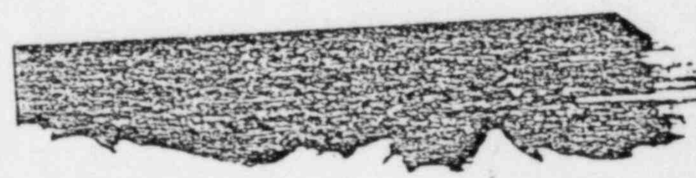


Figure 1 - As Received Samples



10x

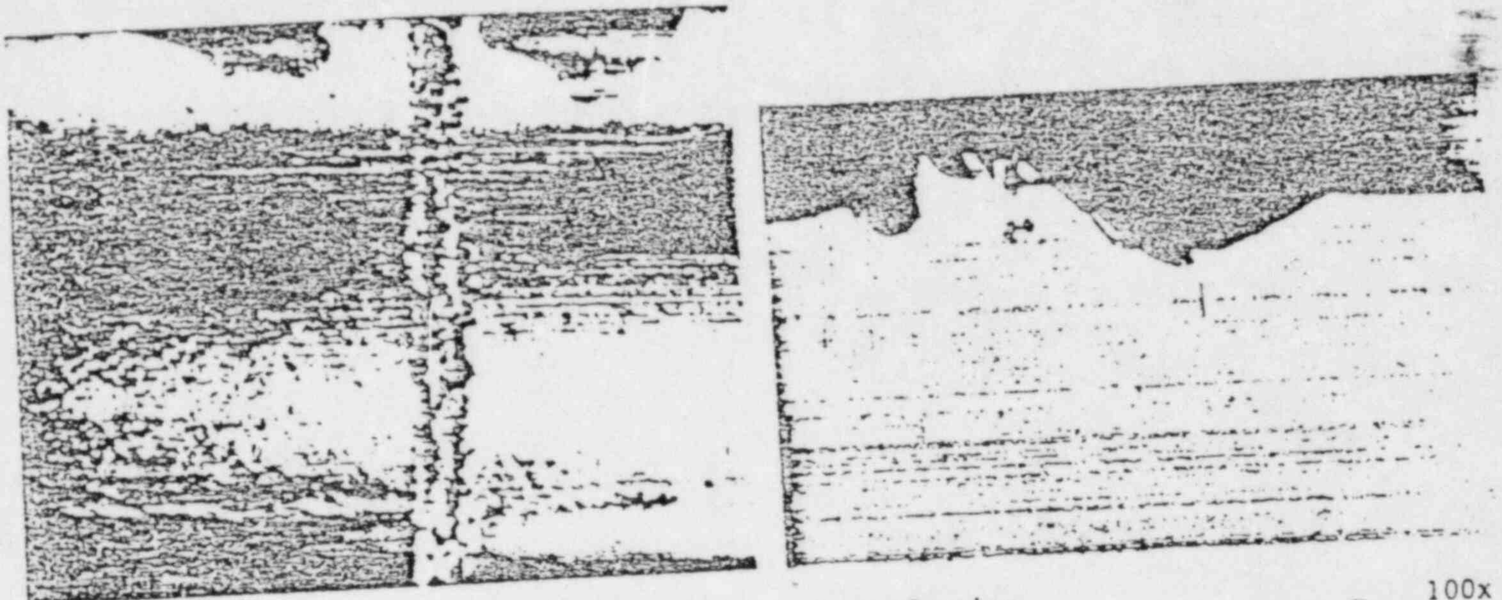
Surface



100x

Cross Section

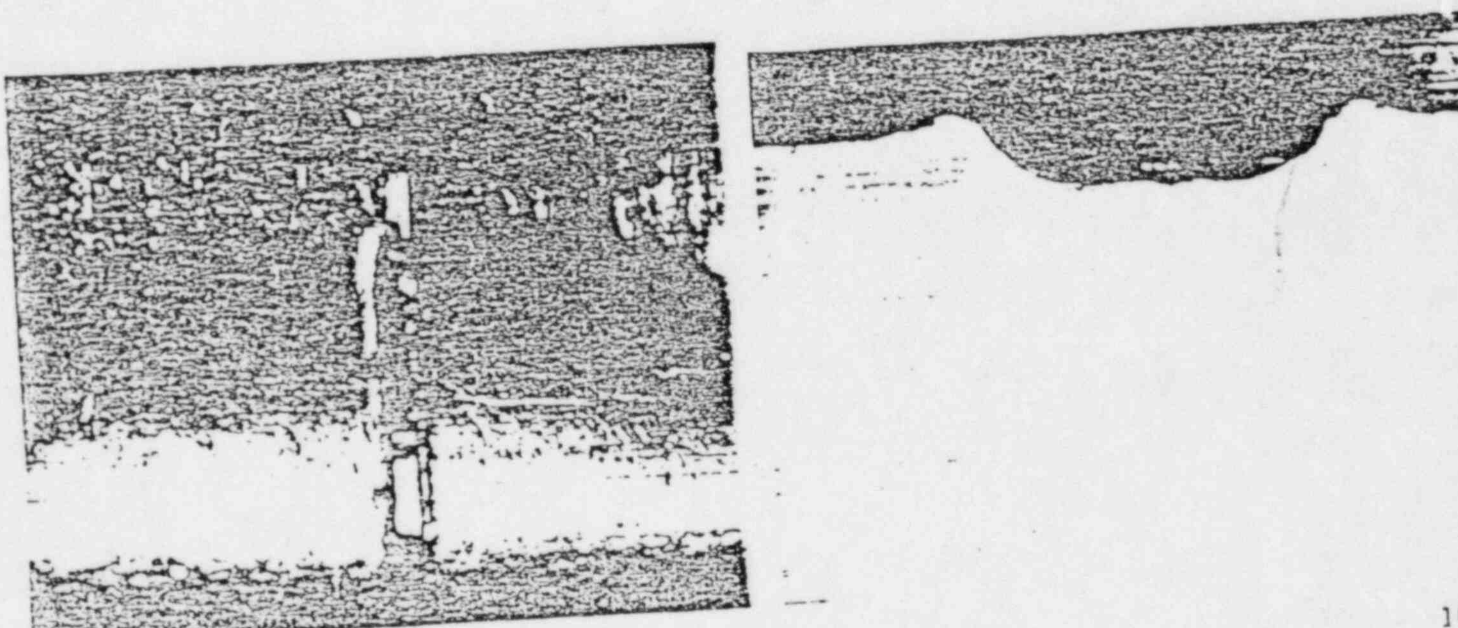
Figure 2 - Vibro-Graved Numerals



Surface 10x

Cross Section 100x

Figure 3 - Vibro-Graved Circumferential Mark



Surface 10x

Cross Section 100x

Figure 4 - Scribed Circumferential Mark

NB-4230 FITTING AND ALIGNING

NB-4231 Fitting and Aligning Methods

Parts that are to be joined by welding may be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, tack welds, or temporary attachments.

NB-4231.1 Tack Welds. Tack welds used to secure alignment shall either be removed completely, when they have served their purpose, or their stopping and starting ends shall be properly prepared by grinding or other suitable means so that they may be satisfactorily incorporated into the final weld. Tack welds shall be made by qualified welders using qualified welding procedures. When tack welds are to become part of the finished weld, they shall be visually examined and defective tack welds removed.

NB-4231.2 Temporary Attachments and Their Removal. Attachments which are welded to the component during construction but which are not incorporated into the final component, such as alignment lugs or straps, tie straps, braces, preheat equipment, postweld heat treatment equipment, are permitted, provided the requirements of (a) through (h) below are met.

(a) The material is identified and is suitable for welding but need not be certified material.

(b) The material is compatible for welding to the component material to which it is attached.

(c) The welding material is compatible with the base material and is certified in accordance with NB-2130;

(d) The welder and welding procedure are qualified in accordance with Section IX and the additional requirements of NB-4320.

(e) The immediate area around the temporary attachment is marked in a suitable manner so that after removal the area can be identified until after it has been examined in accordance with (g) below.

(f) The temporary attachment is completely removed in accordance with the procedures of NB-4211.

(g) After the temporary attachment has been removed, the marked area is examined by a magnetic particle or liquid penetrant method in accordance with the requirements of Articles 6 and 7 of Section V and meets the acceptance standards of NB-5340 or NB-5350, as applicable.

(h) The attachment weld or the area after removal of the attachment is postweld heat treated in accordance with NB-4600.

NB-4232 Maximum Offset of Aligned Sections

(a) Alignment of sections shall be such that the maximum offset of the finished weld will not be greater than the applicable amount listed in Table NB-4232-1, where t is the nominal thickness of the thinner section at the joint.

(b) Joints in spherical vessels, joints within heads, and joints between cylindrical shells and hemispherical heads shall meet the requirements in Table NB-4232-1 for longitudinal joints.

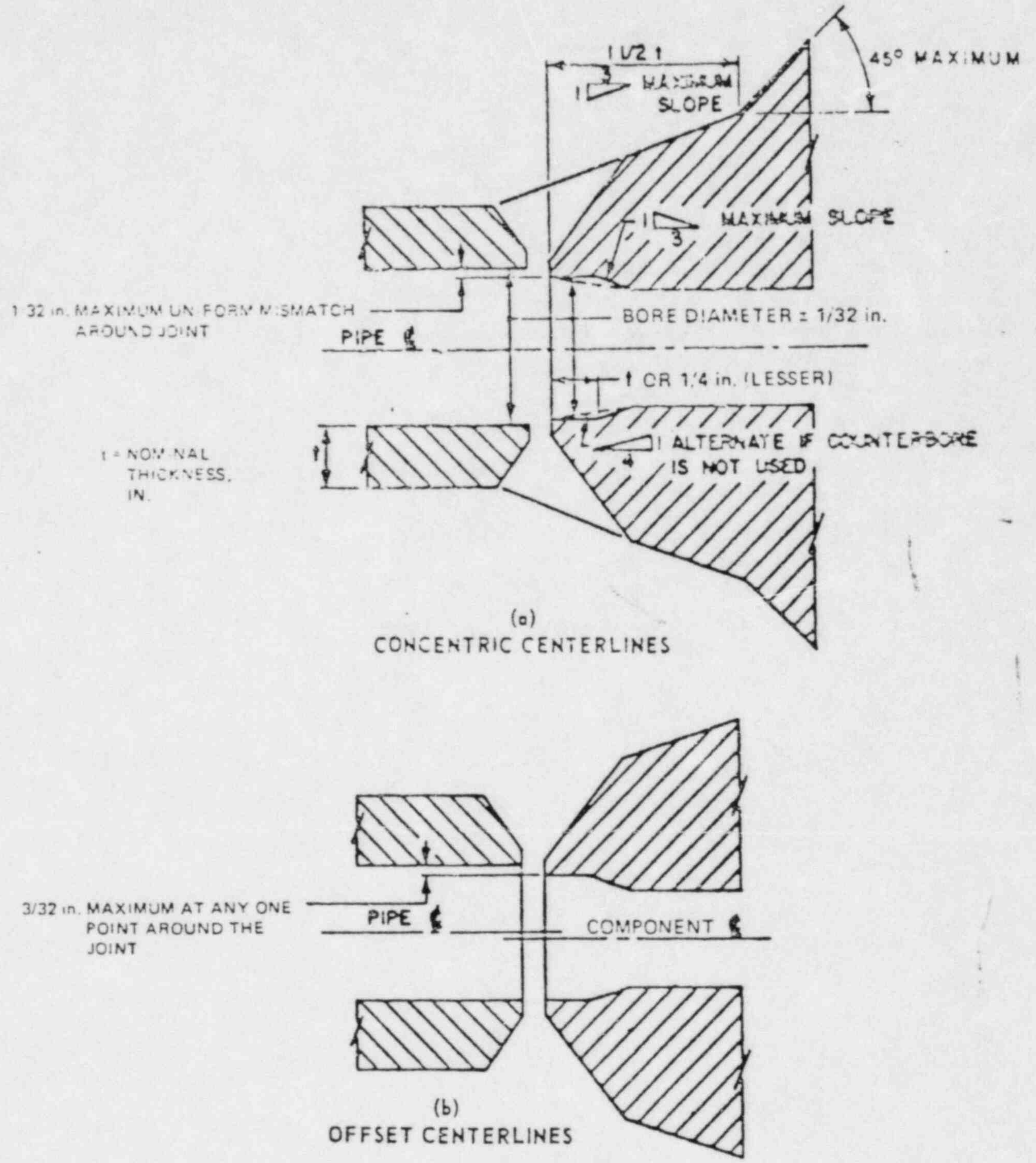
NB-4232.1 Fairing of Offsets. Any offset within the allowable tolerance provided above shall be faired to at least a 3 to 1 taper over the width of the finished weld or, if necessary, by adding additional weld metal beyond what would otherwise be the edge of the weld. In addition, offsets greater than those stated in Table NB-4232-1 are acceptable provided the requirements of NB-3200 are met.

NB-4233 Alignment Requirements When Component Inside Surfaces Are Inaccessible

When the inside surfaces of components are inaccessible for welding or fairing in accordance with NB-4232.1, the inside diameters shall match each other within $^1/_{16}$ in. When the components are aligned concentrically, a uniform mismatch of $^1/_{32}$ in. around the joint can result as shown in Fig. NB-4233-1 sk. (a). However, other variables not associated with the diameter of the component often result in alignments that are offset rather than concentric. In these cases, the maximum misalignment at any one point around the joint shall not exceed $^1/_{32}$ in., as shown in Fig. NB-4233-1 sk. (b). Should component tolerances such as diameter, wall thickness, out of roundness, result in inside diameter variations which do not meet these limits, the inside diameters shall be counterbored, sized, or ground to produce a bore within these limits.

TABLE NB-4232-1
MAXIMUM ALLOWABLE OFFSET IN FINAL WELDED JOINTS

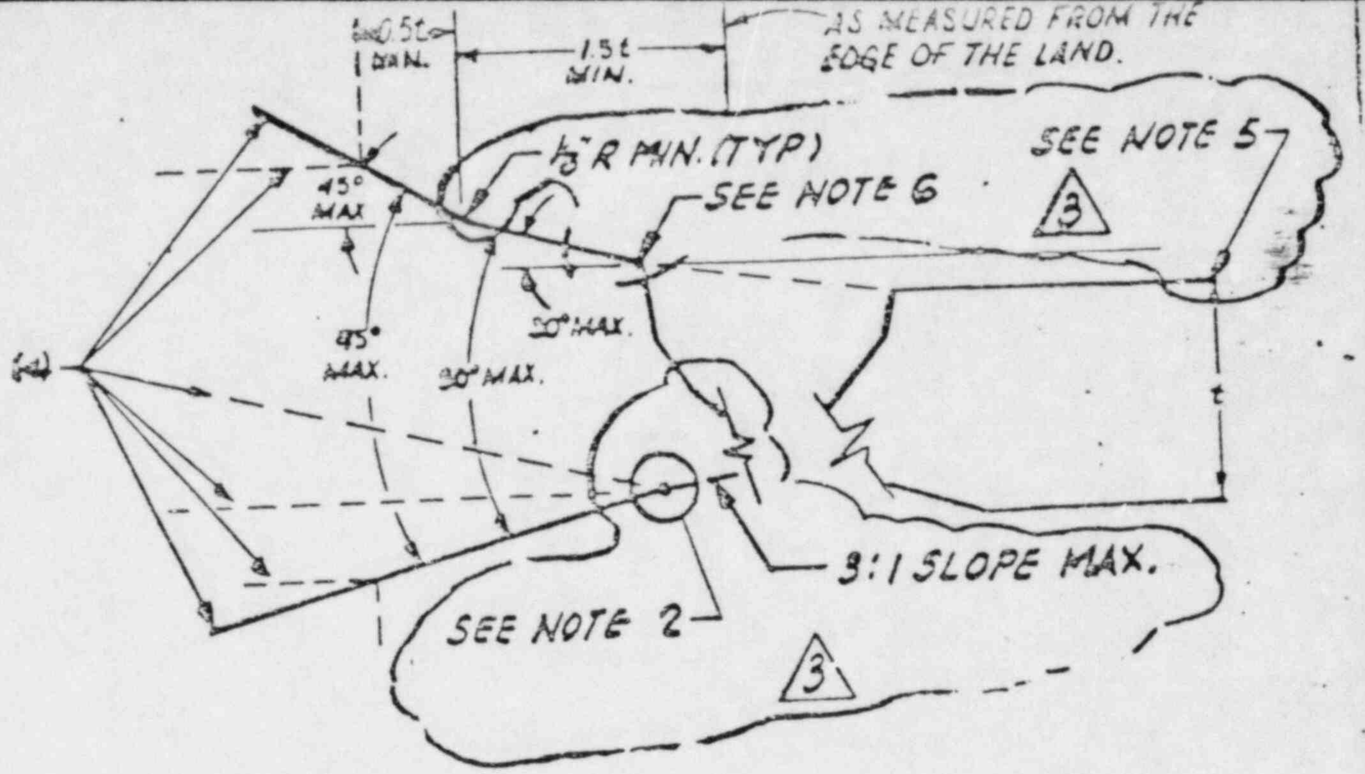
Section Thickness in In.	Direction of Joints	
	Longitudinal	Circumferential
Up to 1/2, incl.	1/4 t	1/4 t
Over 1/2 to 3/4, incl.	1/8 in.	1/4 t
Over 3/4 to 1-1/2, incl.	1/8 in.	3/16 in.
Over 1 1/2 to 2, incl.	1/8 in.	1/8 t
Over 2	Lesser of 1/16 t or 3/8 in.	Lesser of 1/8 t or 3/4 in.



NOTE

THE COMBINED INTERNAL AND EXTERNAL TRANSITION OF THICKNESS SHALL NOT EXCEED AN INCLUDED ANGLE OF 30° AT ANY POINT WITHIN 1½ t OF THE LAND.

FIG. NB-4233-1 BUTTWELD ALIGNMENT TOLERANCES AND ACCEPTABLE SLOPES FOR UNEQUAL I.D. AND O.D. WHEN INSIDE SURFACE IS INACCESSIBLE FOR WELDING OR FAIRING



1. TRANSITIONS ARE FOR VALVES, FITTINGS, AND EQUIPMENT.
2. FOR WELD END PREPS SEE DRAWING 40048 OR 40049.
3. t = NOMINAL WALL THICKNESS.
4. INTERIOR AND EXTERIOR TRANSITION ANGLES SHALL NOT BE COMBINED SO AS TO DECREASE MINIMUM REQUIRED WALL THICKNESS.
5. THE VALUE OF t MIN. IS WHICHEVER OF THE FOLLOWING IS APPLICABLE
   (a) THE MIN. ORDERED WALL THICKNESS OF THE PIPE
   (b) 0.875 TIMES NOM. WALL THICKNESS OF PIPE ORDERED TO A PIPE SCHEDULE WALL THICKNESS WHICH HAS AN UNDER TOLERANCE OF 12.5%.
   (c) THE MIN. ORDERED WALL THICKNESS OF THE CYLINDRICAL WELDING END OF A COMPONENT OR FITTING (OR THE THINNER OF THE TWO) WHEN THE JOINT IS BETWEEN TWO COMPONENT.
6. THE MAX. THICKNESS AT THE END OF THE COMPONENT IS
   (a) THE GREATER OF (t MIN. + 0.15 IN.) OR 1.15 t MIN WHEN ORDERED ON A MIN. WALL BASIS.
   (b) THE GREATER OF (t MIN + 0.15 IN.) OR 1.10 t NOM. WHEN ORDERED ON A NOM. WALL BASIS.

△3

PROFESSIONAL ... No. 4462 ... 3/31/75 ... MECHANICAL

QC I/II

NO.	REVISIONS	DATE	DR.	CHK.	E.G.S.	CHF. E.	P.E.
3	ADDED NOTES 5,6 AND ADDITIONAL INFO	6-27-78	RM	JRH			JDH
2	5t MIN. REVISED TO .5t MIN.	6-12-75	LM	JRH			JDH
1	REDRAWN FROM DWG. 40050 REV. "O"	4-2-75	LOMELI	JRH			

BECHTEL POWER CORPORATION NORWALK, CALIFORNIA	J.O. NO.	SAN ONOFRE NUCLEAR GENERATING STATION
	FILE	WELDED END TRANSITIONS FOR VALVES, FITTINGS AND EQUIPMENT
JOB NO 10079-003 / DATE / APPROVED		SOUTHERN CALIFORNIA EDISON COMPANY LOS ANGELES, CAL.
		SCALE / 40050-3

PE-488 (1304) 8/73

NC-4650 HEAT TREATMENT AFTER BENDING OR FORMING FOR PIPE, PUMPS AND VALVES

NC-4651 Conditions Requiring Heat Treatment After Bending or Forming

(a) Ferritic alloy steel pipe or formed portions of pumps or valves that have been heated for bending or other forming operations shall receive a heat treatment in accordance with NC-4620 or a full anneal, a normalizing and tempering treatment or a quenching and tempering treatment.

(b) Carbon steel pipe or formed portions of pumps or valves with a wall thickness greater than ¾ in. included in group P-Number 1 in Section IX that have been cold bent or formed shall receive heat treatment in accordance with NC-4620.

(c) Ferritic alloy pipe or formed portions of pumps or valves with an outside diameter greater than 4 in. and a wall thickness greater than ½ in. included in groups P-Number 3 through P-Number 5 in Section IX that have been cold bent or formed shall require a heat treatment in accordance with NC-4620.

NC-4652 Exemptions From Heat Treatment After Bending or Forming

If the conditions described in (a) through (d) are met, heat treatment after bending or forming is not required.

(a) Carbon steel pipe or portions of pumps and valves that have been bent or formed at a temperature of 1650 F or higher shall require no subsequent heat treatment, providing the requirements of NC-4213 have been met.

(b) Austenitic stainless steel pipe, or portions of pumps or valves that have been heated for bending or other forming operations may be used in the absent condition unless the Design Specifications require a heat treatment following bending or forming.

(c) All austenitic stainless steel pipe, or portions of pumps or valves that have been cold bent or formed may be used in the as-bent condition unless the Design Specifications require a heat treatment following bending or forming.

(d) Carbon steel and ferritic alloy-steel pipe or portions of pumps or valves with size and wall thicknesses less than specified in NC-4651(b) and (c) may be cold bent or formed without a heat treatment following bending.

NC-4700 MECHANICAL JOINTS

NC-4710 BOLTING AND THREADING

NC-4711 Thread Engagement

All bolts or studs shall be engaged in accordance with the design.

NC-4712 Thread Lubricants

Any lubricant or compound used in threaded joints shall be suitable for the service conditions and shall not react unfavorably with either the service fluid or any component material in the system.

NC-4713 Removal of Thread Lubricants

All threading lubricants or compounds shall be removed from surfaces which are to be seal-welded.

NC-4720 BOLTING FLANGED JOINTS

In bolting gasketed flanged joints, the contact faces of the flanges shall bear uniformly on the gasket and the gasket shall be properly compressed in accordance with the design principles applicable to the type of gasket used. All flanged joints shall be made up with relatively uniform bolt stress.

NC-4730 ELECTRICAL AND MECHANICAL PENETRATION ASSEMBLIES

Electrical and mechanical penetration assemblies shall be constructed in accordance with the rules for components, except that the design and the materials performing the electrical conducting and insulating function of electrical penetrations need not meet the requirements of this Subsection. Tubes or pipes of 2 in. nominal pipe size and less may be joined to a penetration assembly in accordance with the rules of NC-4350.

NC-4800 EXPANSION JOINTS

NC-4820 FABRICATION AND INSTALLATION RULES FOR BELLOWS EXPANSION JOINTS

The requirements of (a) through (f) below shall be met.

(a) All welded joints shall comply with the requirements of NC-4000.

A = the sum of the mechanical allowances, in. (NC-3613)

$$t = d_6 \left(\frac{3P}{16S}\right)^{1/2} \quad (8)$$

where

d_6 = the inside diameter of the gasket for raised or flat face flanges or the pitch diameter of the gasket for retained gasketed flanges, in.
P = design pressure, psi
S = the allowable stress

NC-3647.3 Temporary Blanks. Blanks to be used for test purposes only shall have a minimum thickness not less than the pressure design thickness, t, calculated from Equation 8 above, except that P shall not be less than the test pressure and the allowable stress, S, may be taken as 95% of the specified minimum yield strength of the blank material (Tables I-2.0).

NC-3647.4 Flanges. Flanges shall be integral or be attached to pipe by welding, brazing, threading, or other means within the applicable standards specified in Table NC-3691-1.

NC-3647.5 Gaskets

(a) Gaskets shall be made of materials which are not injuriously affected by the fluid or by temperatures within the design temperature range.

(b) Only metallic or asbestos metallic gaskets may be used on flat or raised face flanges if the expected normal operating pressure exceeds 720 psi or the temperature exceeds 750 F. However, compressed sheet asbestos confined gaskets are not limited as to pressures provided the gasket material is suitable for the temperatures.

(c) The use of metal or metal asbestos gaskets is not limited as to pressure provided the gasket materials are suitable for the fluid design temperature.

NC-3647.6 Bolting

(a) Bolts, nuts and washers shall comply with applicable standards and specifications listed in Table NC-3691-1. Unless otherwise specified, bolting shall be in accordance with ANSI B16.5. Bolts shall extend completely through the nuts.

(b) Carbon steel bolts or bolt studs may be used if expected normal operating pressure does not exceed 300 psi for water or 250 psi for steam and the expected normal operating temperature does not exceed 450 F. Carbon steel bolts shall be ANSI Standard square or heavy hexagon head bolts and shall have ANSI Standard heavy semi-finished hexagon nuts.

(c) Alloy steel bolt studs shall be threaded full length or, if desired, may have reduced shanks of a diameter not less than that at the root of the threads. They shall have ANSI Standard heavy hexagonal nuts. Headed alloy bolts are not recommended.

(d) All alloy bolts or bolt studs and accompanying nuts are recommended to be threaded in accordance with ANSI B1.1 Class 2A external threads and Class 2B internal threads.

NC-3648 Reducers

Reducer fittings manufactured in accordance with the standards listed in Table NC-3691-1 shall be considered suitable for use. Where butt welding reducers are made to a nominal pipe thickness, the reducers shall be considered suitable for use with pipe of the same nominal thickness.

NC-3649 Pressure Design of Other Pressure Retaining Piping Products

Other pressure retaining piping products manufactured in accordance with the standards listed in Table NC-3691-1 shall be considered suitable for use in piping systems at the specified pressure-temperature ratings. Pressure retaining piping products not covered by the standards listed in Table NC-3691-1 and for which design formulas or procedures are not given in this Subsection may be used where the design of similarly shaped, proportioned, and sized components has been proved satisfactory by successful performance under comparable service conditions. Where such satisfactory service experience exists, interpolation may be made to other sized piping products with a geometrically similar shape. In the absence of such service experience, the pressure design shall be based on an analysis consistent with the general design philosophy of this Subsection and substantiated by at least one of the following:

(a) Proof tests as described in ANSI B16.9;

(b) Experimental stress analysis (Appendix II).

NC-3649.1 Expansion Joints—General Requirements. Expansion joints of the bellows, sliding, ball or swivel types may be used to provide flexibility for piping systems. The design of the piping systems and the design, material, fabrication, examination, and testing of the expansion joints shall conform to

Supplementary Data
Structural Welding Design and Construction Adequacy

Allegations:

In the walkdown of SONGS 2 and 3 conducted by Bechtel, Edison, and NRC representatives with Mr. E. Kent on October 25, 1982, several allegations were made concerning the subject of weld end returns, structural connections, and structural design adequacy in general. While the subjects addressed in Bechtel's original response to the NRC remain unchanged, this supplementary information is provided to address, to the fullest extent, these issues of concern to Mr. E. E. Kent which were identified in the walkdown on October 25, 1982.

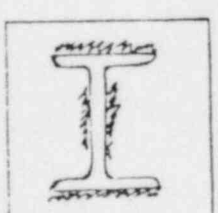
These include:

I. The weld return requirements of AISC, Specification §1.17.10 and AWS Code §8.8.6. Mr. Kent alleges that these requirements are not followed by Bechtel Po· Corporation according to his interpretations.

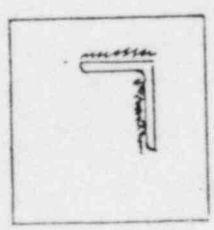
II. The need for fully welded or fully bolted standard structural connections or box sections which can develop the full shear and bending capacity of the section. Mr. Kent alleges that connections used to resist seismic stress conditions should develop the full capacity of the section irrespective of load magnitude, direction, or other design considerations.

I. Weld End Returns

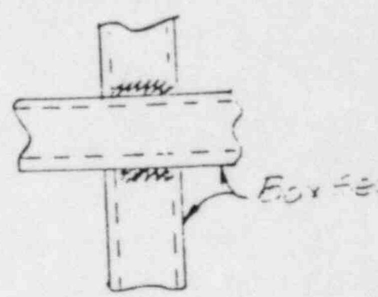
Mr. Kent interprets AISC §1.7.10 and AWS Code §8.8.6 as applicable to all structural details irrespective of load magnitude, direction, type of load (e.g. tension, compression, shear, bending), or actual stress condition. In particular, he has various concerns over the validity of not specifying weld end returns for three types of connection details as follows:



TYPE A



TYPE B



TYPE C

Bechtel Engineering Position

The design of all welded connections utilized on the SONGS 2 and 3 project are made in accordance with the relevant code for which the structure or component is classified, consistent with the design criteria and SAR requirements. The allegation concerning weld end requirements is incorrect and is based upon an inappropriate interpretation of the AISC Specification and the AWS Code. The AWS Code in its forward specifies the following:

"This Code does not concern itself with such design considerations as arrangement of parts, loading and the computation of stresses for proportioning the load-carrying members of structure and their connection. Such considerations, it is assumed, are elsewhere covered in a general code or specifications such as a Building Code, AISC Specification for the Design, Fabrication an Erection of Structural Steel for Buildings, ..., or other specifications prescribed by the owner."

It is Bechtel's position that the AWS excludes from its jurisdiction the design responsibility of the weld details, and further directs the design function to the designing professional engineer who is required to adopt and interpret other appropriate design specifications including the AISC Specifications. In this regard, AISC §1.17.10 is considered in the Bechtel design and utilized accordingly. This AISC provision states as follows:

"Side or end fillet welds terminating at ends or sides, respectively, of parts or members shall, whenever practicable, be returned continuously around the corners for a distance not less than twice the nominal size of the weld. This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connections, on the plane about which bending moments are computed. End returns shall be indicated on the design and detail drawings."

The provisions of this requirement are clearly specified to apply to structural components subject to bending where high stress concentrations due to high local weld stresses may exist in extreme edges of weld details. These include selected connection details subject to high stresses which warrant such consideration. The purpose of this provision is elaborated upon and discussed in considerable detail in technical references and textbooks used by practicing professional engineers internationally. For greater insight into this provision, several references are included in this response. The purpose of weld end returns are to assist in the redistribution of high local stresses when the following conditions apply:

1. Where vertical welds are subject to high stresses which are calculated to exist at extreme tips of a weld group, generally from large bending moments which have a tendency to "pry" the weld apart.

2. Where the weld stress is required to perform to its maximum allowable stress value, and further, where maximum loading conditions can readily carry the local weld stress intensity into yield conditions.

3. In applications for which the local tensile stress from extreme bending effects are required to be resisted by small, narrow weld details.

In the design of all structures and components in the SONGS 2 and 3 project, AISC §1.7.10 has been considered. Where the provisions of this section are appropriate, Bechtel has provided weld details, including weld end returns, which meet the provisions and intent of the AISC Specifications. As a whole, Bechtel has specified weld end returns for appropriate design applications when calculated weld stresses approach code allowable values. These weld end returns have been provided conservatively even though the San Onofre 2 and 3 design criteria limits the Design Basis Earthquake (DBE) combines stresses to 90% of yield. Typical types of details where weld ends have been specified include to enhance local stress conditions include:

1. Welded double angle structural connections with high weld stresses (e.g. weld stresses near code allowables) which are field welded to intersecting beams and columns and for which "prying" is a credible failure mechanism.

2. Special beam connections where beam brackets or seats are required designed for high stresses (e.g. weld stresses near code allowables) whose behavior has a tendency to "pry" the weld detail.

3. Special highly stressed design connections which are not resisted in tension by a large weld segment whose behavior could result in "prying" action.

As such, the San Onofre 2 and 3 structural design appropriately accounts for the provisions of AISC §1.7.10 and utilizes this provision for those specific conditions for which it is intended to apply.

Mr. Kent, however, has refused to recognize the clarification specified in the second sentence of AISC §1.7.10 which states ......"This provision shall apply to side and top fillet welds connecting brackets, beam seats, and similar connections, on the plane upon which bending moments are computed." His criticism extends not only Bechtel's interpretation of the provision, but also with the AISC with whom he apparently disagrees. He contends that full welding all-around is "optimum" and should be adopted for all details which are subject to seismic considerations. This feeling obviously extends his interpretation of weld end returns to conditions for which it is neither recommended by the code, nor required by the specific structural design conditions by the designing professional engineer.

Mr. Kent contends that weld end returns should be specified for Type A and B connection details. Bechtel disagrees for the following reasons:

1. The details are not appropriate for the types of connections for which AISC §1.7.10 is intended to apply.

2. The top and bottom welds (for Detail A) are designed to take the tension and compression loading components from bending with a weld sized to take the full load accordingly. The vertical welds are designed to take the full shear load. In essence, the top and bottom welds behave in a tension and compression mode, not one of "prying". If the weld is sized

to withstand the full design load at allowable stress levels the weld end return would be located below the extreme weld fiber and would have limited value. The weld end return, if provided according to his interpretation, would remain below the stresses at the top fiber until the section reached yield levels. Since this design condition is prohibited by the DBE criteria, the weld end return, if installed, would have no meaning provided that the top weld is sized to resist the full design force.

3. The full "2t" weld may not be constructible orthogonal to the top weld since the curvature of the weld at the tip of the structural member may prohibit its installation. This condition is prevalent for angle member extreme ends and certain structural shapes. In addition, the high stress concentration caused by the non-orthogonal weld end return may increase stress concentrations.

4. The entire weld detail must be proportioned in such a manner that adequate weld exists to withstand the loads. Beam sizing is often made utilizing stock size member selection which provides some uniformity in ordering steel and some consistency in field erection. It is, therefore, not unusual to see a member with oversize beam section properties connected by a weld detail which does not develop its full section. The important and relevant design consideration is that the weld detail should be sized to withstand all design loads imposed upon it. The arbitrary selection of weld details which develop all beam sections would lead to excessive costs for the plant, while adding nothing to the structural integrity of the design.

5. The detail utilized for tension and compression members (e.g. axial struts) do not require the same attention to weld end returns since "prying" is not, in general, a credible failure mechanism. In conversations held with Mr. Kent in the walkdown, it was evident that he did not comprehend the behavior of such members, and was unable to make such a determination.

In Detail C, Mr. Kent contends that the weld detail is inadequate and should be welded all around. This interpretation is not only highly subjective but in clear violation of the AWS Code §8.8.5. This section clearly prohibits an orthogonal weld detail fillet welded, which is welded from two independent directional planes, from being welded continuously. This section requires that the weld be broken at the junction of the two welding planes. This shows the lack of understanding of specific and relevant code provisions by Mr. Kent. In the application of the detail, the weld has been conservatively sized to maintain weld stresses considerably below allowables and the design meets the design criteria for the project. Here again the weld end interpretation by Mr. Kent is in error and clearly violates the specific provision of the AWS Code.

II. The Need for Fully Welded or Bolted Connections to Develop the Full Shear and Bending Capacity of Structural Sections

This contention by Mr. Kent addresses in a more direct manner his disagreement with the governing AISC Specification. He contends that all connections should be designed and constructed to develop the full shear and bending capacity of every beam section utilized in the plant. In essence, it is his contention that AISC §1.2 should not be applicable for structures in seismic zones.

Bechtel Engineering Position

It is Bechtel Engineering's position that this contention contradicts over 60 years of experience in the preparation of the AISC Specification and equivalent experience and design practice by practicing registered engineers throughout the industry internationally. AISC Specification §1.2 clearly permits the utilization of three primary design types which have been discussed in the previous response to the NRC. Some additional comments are warranted. Mr. Kent has thrust himself in a position of engineering decision-making, a position for which he is neither qualified academically, nor licensed professionally.

Bechtel has utilized highly qualified licensed professionals in the selection of weld details and such professionals have interpreted code requirements under the close scrutiny of the NRC. Mr. Kent's unqualified, subjective approach to design would have the following impact:

- o Welding of all connections would result in a highly complex, highly indeterminate design which would be prohibitive to analyze and design. The use of full moment-resistant connections arbitrarily would invalidate all detailed analysis and design performed over 10 years.
- o The project design and construction schedule would be increased several years.
- o The use of full moment-resistant connections would add significant and prohibitive costs to the project, and not necessarily add to the safety or structural integrity of the plant. This design concept, if selected, is not optimum.

For these reasons, Mr. Kent's position is inappropriate and Bechtel disagrees with his contention emphatically.

In summary, Mr. Kent's contentions in the structural design and construction of the San Onofre 2 and 3 project are inaccurate and unjustified, and Bechtel rejects all of his unqualified allegations without reservation.

References

The following are technical and professional references which support the position taken by Bechtel in the applicability of Code provisions of AISC Specification §1.7.10 with respect to weld end returns and the need for welding all-around.

(A) AISC Steel Construction Manual, 7th Edition, 1970, pp. 4-43, 4-50, 4-51, 4-53, 4-101, 4-102, 4-103, 4-104, 4-105, 5-113

(B) Structural Steel Design by Jack C. McCormac, International Textbook Company, Scranton, Pennsylvania, pp. 214-216, 253-267

(C) Steel Structures - Design and Behavior, 2nd Edition by Charles G. Salmon and John E. Johnson, Harper & Row Publishers, New York, pp. 213-242

(D) Design of Welded Structures by Omer W. Blodgett, James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, pp. 3.3-1 to 3.3-18, 5.2-1 to 5.4-14

(E) Structural Steel Detailing, American Institute of Steel Construction, New York, pp. 6-27 to 6-30