U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
REGION IV

Report No. 99900521/80-01 Program No. 51200

Company: Bechtel Power Corporation
Los Angeles Power Division
P. O. Box 60860 Terminal Annex
Los Angeles, California 90060

Inspection Conducted: January 7-10, 1980

Inspectors: R. H. Brickley 2/7/80
R. H. Brickley, Principal Inspector Date
Program Evaluation Section
Vendor Inspection Branch

Other accompaning Personnel: D. G. Breaux, Intern Inspector 2/8/80 Date
Vendor Inspection Branch

Approved by: C. J. Hale 2-8-80
C. J. Hale, Chief Date
Program Evaluation Section
Vendor Inspection Branch

Summary

Inspection on January 7-10, 1980 (99900521/80-01)

Areas Inspected: Follow up on 10 CFR 50.55(e) reports involving splicing of electrical cable, a pin failure on a valve disc, and documentation of calculations for pipe support design; and action on previous inspection findings. The inspection involved twenty-eight (28) inspector-hours on site by one NRC inspector.

Results: The inspection resulted in the identification of one infraction of 10 CFR 21 requirements in that deviations in the design of installed safety related components were not evaluated.

DETAILS SECTION

A. Persons Contacted

C. F. Albertalli, Deputy Engineering Group Supervisor (EGS) Electrical
*A. G. Coutoumanos, QA Supervisor
D. K. Dreyfus, Management Auditor
R. P. Ellis, Engineering Group Leader (EGL)
J. E. Geiger, Project QA Supervisor
*L. G. Hersh, Assistant Project Engineer
*J. Hosmer, Assistant Project Engineer
P. Kabre, EGL
S. A. Mohamed, EGS
A. Pressman, Engineering Manager
J. L. Quinnelly, Project Quality Engineer
R. L. Rogers, Project Engineer
J. Woo, Electrical Engineer
C. E. Zimmerman, QA Supervisor

*Denotes those present at the exit interview.

B. Action on Previous Inspection Findings

1. (Closed) Deviation (Report No. 79-02) Five (5) examples of failure to follow procedures in the area of internal audits. The inspector verified the actions taken as committed in the Bechtel response dated July 25, 1979.

2. (Closed) Deviation (Report No. 79-02) Two (2) examples of failure to follow procedures in the area of QA records. The inspector verified the actions taken as committed in the Bechtel response dated July 25, 1979.

3. (Closed) Deviation (Report No. 79-02) The QA record procedure did not fully implement the requirements of ANSI N45.2.9 as committed in the Topical Report. The inspector verified the actions taken as committed in the Bechtel response dated October 26, 1979.

4. (Open) Follow-Up Item (Report No. 79-02) Errors were found in three (3) safety related engineering design calculations. The inspector verified the actions taken as committed in the Bechtel response dated July 25, 1979, and found that the revision to the engineering procedure for design calculations did not specify

that the checker document any errors that he identified. Management representatives stated that they would issue instructions to the staff to document these errors. A review of the instructions on documentation of calculational errors will be conducted during a future inspection.

C. Splicing of Electrical Cable

1. Objectives

The objectives of this area of inspection were to examine and evaluate the results of Bechtel's investigation of the spliced electrical cable supplied to San Onofre Nuclear Generating Station (SONGS), Units 2 and 3.

2. Method of Accomplishment

The preceding objectives were accomplished by an examination of:

a. Specification No. SO23-304-11 (600 Volt Power Cable for the SONGS Units 2 and 3) and its addendums 1 through 5.

b. Deficiency Evaluation Report No. 35, dated October 18,1979 reporting that 600 V Power Cable, supplied by G.E., was found in a repaired condition, i.e. conductor (consisting of 19 strands) of single conductor cable was spliced (jointed), the conductor insulation and cable jacket was repaired.

c. Bechtel IOM (trip report of visit to General Electric, Bridgeport, Ct. and Rockbestos Company, New Haven and East Granby, Ct. October 30, 1979 through November 1, 1979) dated November 16, 1979.

3. Findings

a. General

(1) The specification identified in paragraph C.2.a. above requires that the cables be fabricated to meet the requirements of ASTM B8-72 and B33-72 which permit joints (welded or brazed) in cables under specified conditions. Addendum No. 5 to this specification requires that when cable splicing and repair are a normal part of the manufacturing process, the LOCA survival test cable specimen shall include such cable splice and repair.

(2) It is GE's position that the qualification testing conducted by Franklin Institute (Reports No. F-C 3913-1A, F-C 3913-2A, and FC 3913-3A) substaintiates the qualification status. GE felt that since the test cables were produced under factory conditions using factory equipment and processes, the qualification tests were representative of the supplied cable. However, no evidence existed to prove that the test cable contained splices and repairs, therefore Addendum No. 5 to the speciation was issued.

(3) GE and Rockbestos (suppliers of cable to SONGS) are to conduct LOCA qualification and hot spot testing of cables with splices and repairs. The Rockbestos tests are presently underway with an estimated completion date of March 1980. The GE tests should be complete by May 1980.

b. Deviations and Unresolved Items

None identified

c. Follow-Up Items

An examination of the results of the GE and Rockbestos tests will be conducted during a future inspection.

D. Pin Failure on Valve Disc

The failure of a pin in the disc of a ten (10) inch check valve in the turbine exhaust line at the Hatch plant was reported to NRC Region II via LER No. 50-366/1979-46. A follow-up inspection (99900118/79-02) at the supplier (Walworth Corp.) revealed that the cause of the failure may have been that the purchaser's specification did not contain sufficient information on anticipated operating conditions. As part of the follow-up on this item the inspector examined specification SO23-408-1 (Quality Class I, II, III Specification for Nuclear Service Valves) and its addena.

Specification SO23-408-1 provided conservative simplifications of transient conditions for use in the design of valves meeting the requirements of sub paragraph NB-3512.1 of the code and qualified by the procedures of paragraphs NB-3520 thru NB-3550. The specification further stated that if the procedures of subparagraph NB-3512.2 are to be used, the purchaser will supply transient data to the vendor upon request. An additional follow-up inspection will be conducted during a future Bechtel-Gaithersburg inspection; however, from the inspection results thus far this does not appear to be a generic problem.

E. Lack of Documented Calculations for Pipe Support Design

This item is a follow-up to a 50.55(e) report made by SONGS to NRC Region V that the stress analysis and design verification were not formally documented for the design of 2½ inch and larger pipe supports. The report further stated that the stress calculations were made and checked but were not formally documented nor were records kept.

1. Objectives

The objectives of this area of the inspection were to:

a. Verify Bechtel's implementation of the corrective actions stated in the report.

b. Review and evaluate the Bechtel analysis that concluded that this item would not have adversely affected the safety of operations of the plant.

c. Review and evaluate the Bechtel analysis that concluded that this item was not reportable under 10 CFR 21.

2. Method of Accomplishment

The preceding objectives were accomplished by an examination of:

a. Section 15.1 (Identification and Evaluation of Reportable Deficiencies) Revision 4, dated 8/6/79 of the SONGS Project Quality Program Manual.

b. Section Nos. 14 (Calculations) Revision 8, dated 8/20/79 and 36 (Substantial Safety Hazard and Significant Deficiency Reporting) Revision 0, dated 7/31/78 of the SONGS Project Internal Procedures Manual.

c. Deficiency Evaluation Report (DER) No. 21 Revisions 0 (3/2/79), 1 (4/5/79), and 3 (5/31/79).

d. Minutes of a meeting held on 3/19/79 between the licensee and Bechtel regarding DER No. 21.

e. Start-up System Stress Review Package for the Emergency Chilled Water System consisting of Pipe Support Description List, Consideration of Design Conditions, Isometric Pipe Support List, Isometric Sketches, Pipe Support Assembly Drawings, Field Change Requests, Calculation Sheets, and the Pipe Support Checklist Summary.

f. Calculation binder for the Salt Water Cooling system.

3. Findings

a. General

(1) The examination of DER No. 21 revealed that there were eight (8) deficiencies that had been identified that were, in general, not considered significant by Bechtel because of the point in the design process that the deficiencies were identified. Bechtel further believed that there would not have been a chance of the deficiencies not being identified through project review, chief engineer staff review, or final engineering design verification prior to turnover for startup. These deficiencies were identified by Bechtel audits on drawings issued for construction. These deficiencies and Bechtel's position resulting from their evaluation (DER No. 21) are as follows:

(a) Insufficient pipe bearing surface

A maximum of 500 large pipe supports (thin wall piping, 8 inches in diameter and larger) do not meet design requirements for pipe bearing surface. In these cases, loading conditions could result in pipe stress allowables being exceeded.

Bechtel's position is that insufficient pipe bearing surface, even within thin wall piping, is not generally a problem on plants with low seismic design criteria. The structural steel framing sizes selected by the engineer would normally result in an adequate design.

(b) Frictional loading on pipe support framing

The effect of loads imposed by thermal expansion movement of piping on pipe support framing was not adequately considered in the design of certain 8 inch and larger pipe supports. The number of supports affected is included in (a), above.

Bechtel's position is that extensive use of steel framing and the need for numerous axial restraints has been necessary to meet project seismic criteria, as opposed to simpler rod hanger configurations which are more standard pipe support design components. These framing systems are more susceptible to loads from piping thermal expansion. Rod hangers are comparatively free of the need for a detailed analysis of the effects of thermal movement.

Bechtel representatives stated that the problem was that the Dead Weight Load and Coefficient of Friction were not considered in the direction of thermal expansion which would have increased the stress. About 50% of the total supports involved (500) have been evaluated. About 5% of these were found that exceeded the allowable stress requiring modification.

(c) Lack of reinforced branch connections

Piping has been fabricated with non-reinforced branch connections in lieu or reinforced tees. This condition was not apparent until receipt of the fabricator's spool sheets. The condition is limited to thinner wall piping.

Bechtel's position is that a normal review of vendor spool sheets identified the problem of use of non-reinforced branch connections in lieu of reinforced tees. This is considered to be the type of problem that can occur from time to time and the review of spool sheets is conducted to identify such problems.

Bechtel representatives stated that thus far they had found four (4) cases where the branch connections required reinforcement to bring the stress intensification factor down. The original Bechtel stress analysis was based on isometrics that indicated a tee connection; however, the specification used by the designer (Vendor) gave him the option of using either a tee or a branch connection.

(d) Use of Dissimilar Metal Attachments

Carbon steel integral attachment material (dummy stubs) had been used on stainless steel lines with design temperatures between 150 F and 300 F. In certain configurations (about 100 pipe supports) the use of carbon steel may result in failure of welds between the attachment and pipe.

Bechtel's position is that because of material availability, substitution of carbon steel attachments for stainless steel was necessary to meet roject schedule. BPC Engineering Staff review of this substitution indicated that the project should use more conservatism in the design than originally specified when using carbon steel attachments on lines with design temperatures

between 150 F and 300 F. Another aspect of the situation is that piping design temperatures are often quite conservative with respect to normal operating and even transient conditions. Substantial margin usually exists between the design temperature and realistic operating conditions. Thus, detailed evaluation of process operating conditions may result in the acceptability of a particular attachment's configuration.

Bechtel representatives stated that up to a temperature of 150 F the carbon steel to stainless steel weld does not present a problem; however, at higher temperatures the difference in the coefficient of thermal expansion of the two materials could result in weld failure. This problem involves approximately 100 pipe supports.

(e) Fillet Welds not in Accordance with AISC Minimum Size Criteria

Approximately 10 percent of large pipe supports may have fillet welds that do not meet the minimum weld size requirements of AISC Section 1.17.5. This problem is particularly applicable to embed-to-support fillet welds. The problems are generally 1/16 inch undersize on 1/4 inch nominal welds.

Bechtel's position is that relatively thick embeds and building structural steel have been used on the project as required by seismic considerations. In so doing, the normal pipe support procedure of designing weld sizes for strength alone did not consider these heavier steel configurations, and did not meet AISC requirements.

Bechtel representatives stated that the stress analysis performed on these welds indicates that they can withstand the applied loads.

It should be noted that the inspector had identified a similar problem in 1978 (Report No. 99900521/78-02) with respect to fillet welds not meeting the minimum size requirements of the Code. At that time Bechtel conducted a review of the drawings on all projects to identify those welds that were undersize with respect to Code requirements (Report No. 99900521/78-03). On the

SONGS project eight thousand eight hunderd twenty (8820) drawings were reviewed with three hundred sixty-two (362) found containing undersized welds. It does not appear that these type welds were considered during Bechtel's earlier review.

(f) Lack of Formal Civil/Structural Calculation

Certain pipe support drawings were issued without formal calculations justifying the design. The supports were designed by civil engineers, but because of a misunderstanding of the need for formal calculations, design justification was not documented.

The Bechtel position is that some of the pipe supports are relatively simple beam undersupports or cantilevers. The design loadings can be small compared to project generic steel member sizes and minimum weld sizes. Other supports are indeed more complex and do not lend themselves to judgemental design by an experienced structural engineer. Since the civil portion of all pipe support designs was approved by structural engineers, as documented on pipe support drawings, the lack of formal calculations is not expected to result in significant deficiencies. It should be noted that this item was selected for reporting to NRC Region V under 10 CFR 50.55(e).

(g) Embed Plate Stiffness

Supports attached to cinch anchor embed plates may have been designed without adequate consideration of plate stiffness. Additionally, certain plates may not have adequately considered biaxial bending. These problems may effect 500 pipe supports. This problem has been highlighted on Hatch 1 and 2.

Bechtel's position is that in most applications, the project's loading conditions would be compatible with the standard assumption of infinite embed stiffness. However, because of this project's high seismic criteria, this assumption may not always be conservative.

(h) Use of Structural Tees Instead of Dummy Stubs

Under certain loading conditions, the specified structural tee may have insufficient strength. Additionally, the bearing surface may be inadequate. Dummy stubs should have been specified. This problem may effect 50 pipe supports. This item is similar to (g) above since horizontal seismic loading relates to structural tee adequacy.

(2) In summary it is Bechtel's position that except for the lack of documented civil structural calculations to back up pipe supports issued for construction, the deficiencies identified in pipe supports were not considered significant with respect to 10 CFR 50.55(e) reporting requirements based on the following:

(a) Design evolution has resulted in some iterative evaluations of pipe supports, with the effect of high seismic criteria being the major contributor to criteria modifications.

(b) Vendor interface problems have arisen as must be expected.

(c) Final design reviews, prior to system turnover for startup, have been established to ensure problems are identified and corrective action initiated on a system basis. This will include evaluation of supports based on criteria evolution and vendor interface problems.

(3) The lack of civil structural calculations is reportable based on a break down in the quality assurance program.

The preceding Bechtel positions are as stated in the evaluation attached to DER No. 21; however, they did not appear to address whether these items by themselves, or in total, could have created a substantial safety hazard as defined under part 21. Management representatives agreed that the following conclusions reached by the NRC inspector were correct:

(a) There have been pipe supports installed in safety related systems that have had to be modified to provide sufficient bearing surface (Item 3.a.(1). (a) above).

(b) In the above cases no analysis was performed to determine what would happen if this condition had gone undetected.

(4) The corrective actions taken by Bechtel to date include: the addition of several senior supervisors with strong civil structural background to the pipe support group; combining the pipe support and stress groups under one chief engineer; revision of Section 14 of the PIPM; and

institution of a Start-Up System Stress Review program. This program, to be completed on each system prior to turnover for start-up, consists of a pipe support design review (by checklist), pipe support walkdown inspection, and an analysis performed to support the design. All identified deficiencies are to be corrected prior to turning the system over for start-up.

(5) Bechtel representatives stated that they had conducted, but not documented, reviews of their other projects (Palo Verde and Vogtle) and found that similar items do not exist. They did not check any of their operating plants for these items.

b. Noncompliances

In this area of the inspection one infraction was identified (see Notice of Violation, Enclosure)

The inspector concluded from his examination of the documents listed in E.2.c,d,e, and f, above that deviations existed in basic components, as defined in Section 21.3(a) of Part 21, that have been installed (21.3(d)(2)) in safety related systems. Management representatives confirmed this conclusion (See paragraph E.3.a.(2)(a) above). The inspector further concluded that the planned design process for the above items had been completed at the time that the deviations were discovered and that these deviations related to the originally applicable design requirements rather than to any changes in the basic design criteria which may have been imposed at a later time. Management representatives confirmed the inspector's conclusion that no analysis (evaluation) had been performed to determine what would happen if the identified conditions had gone undetected.

c. Deviations and Unresolved Items

None identified

E. Exit Interview

An exit interview was held with management representatives on January 10, 1980. In addition to those individuals indicated by an asterisk in paragraph A those in attendance were:

J. E. Bashore, Division QA Manager
I. R. Caraco, Vice President and General Manager
L. G. Hinkelman, Manager, Domestic Operations
W. A. Homer, Manager, Division Engineering
B. L. Lex, Project Manager, Vogtle
D. E. Nunn, QA Manager, Southern California Edison Co.
W. H. Wilson, Project Manager, Palo Verde
A. W. Stenersen, Project QA Engineer

The inspector summarized the scope and findings of the inspection. In addition the inspector reminded them that a response to the inspection should contain, as a minimum, the following:

1. Corrective Actions

   A description of the steps that have been or will be taken to correct the item, the steps that have been or will be taken to assure that similar items do not exist, and the date these actions were or will be completed.

2. Preventive Measures

   A description of the steps that have been or will be taken to prevent recurrence of this type deviation and the date these preventive measures were or will be completed.

In both cases the corrective and preventive actions must be capable of being verified by the NRC inspector during a subsequent inspection. Management comments were generally for clarification only, or acknowledgement of the statements by the inspector.