UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 0 1 1983

MEMORANDUM FOR: Olan Parr, Chief
Auxiliary Systems Branch
Division of Systems Integration

FROM: B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

SUBJECT: FOLLOW UP ACTIONS FOR THE CALLAWAY INTEGRATED DESIGN INSPECTION

As a result of the Integrated Design Inspection (IDI) performed at the Callaway Plant there are two follow up items which require an evaluation and close out by NRR. By memorandum dated November 16, 1983, Region III requested that NRR provide the follow up and close out actions necessary to resolve these items. Since the review responsibility for these IDI items rests with the Auxiliary Systems Branch (ASB), the purpose of this memorandum is to request that ASB review these items along with the applicant's response and provide a written input to the Division of Licensing by December 31, 1983.

These IDI items have been discussed with Mr. Bill LeFave of your staff and are attached. If you have any questions or require additional assistance, please contact the Callaway Project Manager, Mr. Joe Holonich, at extension 27793.

B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Attachment: As stated

cc: J. Partlow, IE
D. Allison, IE
C. Hale, Region IV
C. Norelius, Region III
R. Spessard, Region III
J. Neisler, Callaway SRI
R. Knop, Region III
R. Bosnak, MEB
G. Lear, GSEB
W. LaFave, ASB
R. Lobel, ASB

FINDING 2-1

This finding questions the design adequacy of the auxiliary feedwater pump turbine exhaust line which is non seismic category I beyond the boundary of the auxiliary building. The finding states that the design provisions for the line are shown on Figure 10.4-10; however, it contends that the design is improper in that it violates FSAR commitments related to the seismic design capability of the active AFW Turbine driven pump.

RESPONSE

The response to this finding is divided into three parts which address 1) the design adequacy of the exhaust line 2) the compliance with the FSAR, and 3) the content of the FSAR.

1. Design Provisions

The design of the AFP turbine exhaust line was established during the early phases of the project and it was shown in the PSAR and the FSAR as being non-seismic Category I beyond the boundary of the auxiliary building.

The design was based on current licensing requirements for system operation following a single failure. The design flow rate is delivered by the system for all credible initiating events and has been accepted by the NRC during both the PSAR and FSAR review phases.

The following exhaust line failure mode considerations were evaluated in establishing the design:

(a) The auxiliary boiler building is designed to UBC seismic considerations and is not expected to fail during a seismic event.

(b) If the auxiliary boiler building were to catostrophically fail and the exhaust line were sheared off completely, the AFP turbine would operate properly.

(c) Even if the exhaust line were to crimp significantly, the AFP turbine driven pump would still deliver design flow rates. The back pressure on the turbine may be increased significantly before the required flow rates will not be available. A local constriction of 90% of the free area of the exhaust line is required before the design flow will not be delivered. This type of failure is not considered to be credible.

Breaks in seismic Category I piping are not postulated during a seismic event. Thus a MSLB or MFLB inside containment or in the steam tunnel are not postulated following a seismic event and the design of the exhaust line does not enter into the evaluation of these breaks.

FINDING 2-7

This finding identified an apparent instance where a statement in the FSAR had not been implemented in the design. The statement was that there is no water drainage to lower elevations of the auxiliary building following a nonmechanistic break of a main feedwater line. The main issue is whether the effects of nonmechanistic breaks in the steam tunnel should be considered in the design basis of the rooms below the steam tunnel.

RESPONSE:

In 1977 the NRC advised the SNUPPS utilities that the SNUPPS main steam tunnel room would have to be designed to withstand the pressure effects of a nonmechanistic break in a main steam or main feed line. The NRC also stated that any equipment required for safe shutdown located within the room should be qualified to the resultant environment. On March 9, 1978, the NRC accepted the design modifications and analyses provided by SNUPPS which allowed the venting of the structure and provided the parameters required for qualification of items within the room.

Flooding within main steam tunnel room from this nonmechanistic break was calculated. In order to ensure the integrity of the walls and to preclude the need for equipment qualification in a submerged condition, two twenty-inch drain lines were provided to drain the water to the turbine building. During preparation of the licensing submittal, note was taken of these large drain lines as well as certain sealed penetrations through the floor of the steam tunnel. It was erroneously assumed that there would be no drainage to the lower elevations of the plant even though the small drain lines were shown on the drainage system P&IDs. The FSAR will be revised to eliminate this error.

Although it was never SNUPPS' intent to extend the effects of this improbable, nonmechanistic break outside the steam tunnel, water drainage and steam escape through the small drain lines have been considered. Water drainage to lower elevations will not adversely affect safety-related equipment because the water goes to the auxiliary building basement which has a 7-foot design flood depth. Similarly steam escape is not likely to affect safety-related equipment due to the small driving force (steam tunnel pressure) and because fire dampers in the ventilation ducts close when the room temperature exceeds that normally anticipated. When the dampers close, the driving force equalizes, and passive heat sinks take effect to reduce room temperature.

For a seismically induced MSLB in the turbine building, various single failures can be postulated, none of which result in adverse conditions even if the AFP Turbine is inoperable. If an MSLIV fails to close, one steam generator will blow down; however, 2 motor driven AFW Pumps are available to feed 3 intact steam generators. If one motor driven pump train fails for any reason, the other motor driven pump will feed 2 steam generators as required. In this case the break has been isolated by the MSLIV and all 4 steam generators are intact.

The turbine driven pump subsystem is designed to be independent of AC power as required by the NRC for defense-in-depth to reduce the consequences of a total loss of all AC power. Loss of all AC power is not a design basis condition of SNUPPS since it would require failure of both of the diesel generators to start concurrent with a loss of offsite power. However, the design capabilities of the SNUPPS plants for this condition were evaluated by the NRC staff and the ACRS and were found to be acceptable.

The possibility of both a seismic event and a total loss of AC power occurring simultaneously is remote. Even if this combination were to occur, the auxiliary boiler building would have to fail in a manner which would result in the nearly perfect sealing of the entire flow area of the exhaust line before the turbine driven pump would fail to deliver the required flow.

To summarize the design provisions of the AFW system, the system design meets all current requirements and will function for events beyond current design bases established by the NRC.

2. Compliance With The FSAR

The design of the AFP turbine exhaust pipe is in accordance with the original design intent and the FSAR requirements. The declassification of the exhaust line to non seismic and B31.1 was shown in the PSAR and the FSAR. The design of the AFW pump and turbine meet the FSAR requirements stated in Section 3.9(B).3.2.2.1: the pump is designed and qualified to operate during a safe shutdown earthquake. This section makes no commitment for the design of the exhaust line nor does it address the exhaust line.

The regulatory requirements for the seismic design of systems are addressed in Regulatory Guide 1.29. The SNUPPS response to this regulatory guide is provided in Table 3.2-3. As noted therein, the SNUPPS implementation of seismic requirements is shown on Table 3.2-1. The text of Section 3.2 states the following:

> "For identification of system and subsystem boundaries, Table 3.2-1 is supplemented (i.e., referenced to applicable figures) by piping and instrument diagrams which have been marked to clearly show the limits of the seismic category I and the various quality group classifications on a system."

Section 5.4 of Table 3.2-1 describes the AFW system pumps and provides a reference to Figure 10.4-9. Figure 10.4-9 clearly indicates the limits of the seismic Category 1 piping. Section 10.4.9 also references this table for the definition of seismic design limits.

In summary, it is SNUPPS position that there is no violation of FSAR commitments.

3. Content of the FSAR

This finding implies that the SNUPPS FSAR did not fully describe the design of the exhaust line. We believe that the FSAR content is appropriate.

The SNUPPS FSAR is written in accordance with Regulatory Guide 1.70. This regulatory guide and the Standard Review Plans (SRPS) do not require descriptions of design provisions which have not been provided nor do they require justification for not providing certain features. The SNUPPS FSAR does clearly identify the design of the exhaust line and references the specific location in which the exhaust line provisions can be reviewed.

Krep Konklin ~~[illegible]~~ -Ces (M) J Keppler, RIII

Open Question - Response from UE

Docket No. 50-483

APR 4 1983

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Union Electric Company
ATTN: Mr. Donald F. Schnell
Vice President, Nuclear
P.O. Box 149
Mail Code 400
St. Louis, Missouri 63166

Gentlemen:

SUBJECT: Integrated Design Inspection 50-483/82-22

This refers to the integrated design inspection conducted by the Office of Inspection and Enforcement on November 10 - November 19, 1982 and November 29 - December 14, 1982 at the Callaway Plant, your St. Louis corporate office, Nuclear Projects Incorporated, Bechtel Power Corporation and Westinghouse Electric Corporation. The inspection team was composed of personnel from the NRC's Office of Inspection and Enforcement, Office of Nuclear Reactor Regulation, the Region IV Office and consultants. This inspection covered activities authorized by NRC Construction Permit CPPR-139.

This inspection is the first of a series of integrated design inspections that the Office of Inspection and Enforcement plans to conduct with assistance from other NRC offices and consultants. The results of these inspections will be used to evaluate control of the design process and quality of design activities at nuclear plants.

The enclosed report identifies the areas examined during the inspection, which focused on the auxiliary feedwater system as a selected sample. Activities included examination of procedures, records, training and inspection of the system as installed at the plant. Emphasis was placed upon reviewing the adequacy of design details as a means of measuring how well the design process had functioned for the selected sample.

Findings regarding errors, procedural violations and inconsistencies are identified in the report. Unresolved items are identified where insufficient information was developed to allow final determinations on the adequacy of specific features or practices. Other observations are identified where it was considered appropriate to call attention to a matter that was not a specific finding or unresolved item. They include items recommended for your consideration but for which there are no specific regulatory requirements.

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APR 6 1983

Section 1 of the report provides a summary of the results of the inspection and the conclusions reached by the inspection team. No pervasive breakdown in the design process was identified; however, your prompt attention is needed for resolution of the specific deficiencies identified.

The most significant negative findings or deficiencies are summarized as follows:

(1) There was a lack of formal control over Bechtel's use of plant design newsletters. Thus, these newsletters, which described acceptable modeling and stress analysis techniques, were not being applied uniformly to project design work (Section 3.1.2).

(2) The auxiliary feedwater pump turbine exhaust pipe was not classified as Seismic Category I and safety grade throughout its entire length. No justification was available. This represented incomplete detailed analysis to support pump operability requirements. A similar classification was identified in two other systems (Section 2.4).

(3) The ability of motor controllers to withstand fault currents had not been considered or assured. This represented an instance of improper detailed design (Section 5.2).

(4) The team identified needs for improvement in control of the design process at Bechtel in certain areas such as those related to high energy line break analyses (Section 2.4), guidance for two design groups (Sections 3.1.4 and 3.2.4), interface definitions (Section 4.4) and baseplate design (Section 4.5).

(5) Three instances were identified where specific FSAR commitments were not met, one of which involved the turbine exhaust pipe discussed above (Sections 2.3, 2.4, and 6.2).

With the exception of the matters identified in the findings and one observation concerning delay in resolving a design issue, the team considered the general project management to be a strength. Nearly all the detailed design information reviewed was adequate and consistent, indicating a controlled design process.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosures will be placed in the NRC Public Document Room unless you notify this office, by telephone, within 15 days of the date of this letter and submit written application to withhold information contained herein within 30 days of the date of this letter. Such applications must be consistent with the requirements of 10 CFR 2.790(b)(1).

You are requested to respond in writing to the findings and unresolved items within 45 days after receipt of this letter. With respect to the deficiencies identified in findings, the response should address the cause, extent, corrective actions and any other information you consider relevant. For unresolved items, the response should provide information concerning acceptability of the specific feature or practice involved. The response should be addressed to the NRC Region III Office, with copies to the NRC Region IV Office and this office.

As discussed in the report, the NRC's followup efforts will be managed by the Region III Office with assistance from other NRC offices as needed. Some of the items identified in the report may provide bases for enforcement actions. The Regional Office will initiate any enforcement actions considered appropriate.

Should you have any questions concerning this inspection, please contact us or James E. Konklin, Chief, Reactor Projects Section 1A, in the Region III Office.

Sincerely,

"Original Signed By
R. C. DeYoung"

Richard C. DeYoung, Director
Office of Inspection and Enforcement

Enclosure:
Inspection Report 50-483/82-22

cc: See Page 4

SEE PREVIOUS CONCURRENCES

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OFFICE OF INSPECTION AND ENFORCEMENT

DIVISION OF QUALITY ASSURANCE, SAFEGUARDS, AND INSPECTION PROGRAMS
QUALITY ASSURANCE BRANCH

UNDER REVIEW FOR PROPRIETARY INFORMATION

Report No. 50-483/82-22

Docket No. 50-483

Licensee: Union Electric Company
P. O. Box 149
St. Louis, Missouri 63166

Facility Name: Callaway Plant, Unit 1

Inspection at: Callaway Plant, Fulton, Missouri; Union Electric Company, St. Louis, Missouri; Nuclear Projects Incorporated, Gaithersburg, Maryland; Bechtel Power Corporation, Gaithersburg; Maryland, and Westinghouse Electric Corporation, Monroeville, Pennsylvania

Inspection Conducted: November 10-November 19, and November 29-December 14, 1982

Inspection Team Members:

Mechanical Systems	D.P. Allison, Technical Assistant, OIE (Team Leader)	3/29/83 Date
	D.P. Norkin, Reactor Construction Engineer, OIE	3/29/83 Date
Mechanical Components	J.R. Fair, Senior Mechanical Engineer, OIE	3/29/83 Date
	D.K. Morton, Consultant, INEL-EG&G Idaho (D P Allison for)	3/29/83 Date
Civil and Structural	R.E. Shewmaker, Senior Civil Engineer, OIE	3/29/83 Date
	J.S. Ma, Structural Engineer, NRR (D P Allison for)	3/29/83 Date

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Electrical Power

D P Allison for 3/29/83
I. Ahmed, Electrical Engineer, NRR Date

D P Allison for 3/29/83
R.L. Sprague, Consultant, INEL-EG&G Idaho Date

Instrumentation and Control

D P Allison for 3/29/83
D.D. Chamberlain, Reactor Engineer, Region IV Date

D P Allison for 3/29/83
R.O. Karsch, Reactor Engineer, NRR Date

Accompanying Personnel:

*E.L. Jordan, OIE
*T.L. Harpster, OIE
*G.E. Edison, NRR (Project Manager)
*J.H. Neisler, Region III (Resident Inspector)
*J.E. Konklin, Region III
*H.M. Wescott, Region III

Approved By: Brian Grimes 3/31/8
Brian K. Grimes, Deputy Director Date
Division of Quality Assurance,
Safeguards, and Inspection Programs, OIE

*Present part-time at certain meetings as described in report.

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List of Findings, Unresolved Items, and Observations

1. INTRODUCTION AND SUMMARY

1.1 Objectives

In August 1982 the NRC staff undertook a number of initiatives to improve assurance of quality in design and construction of nuclear projects. One of those initiatives was to develop and implement an integrated design inspection program to assess the quality of design activities, including examination of as-built configuration. The objective was to expand the NRC examination of quality assurance into the design process. The approach would provide a comprehensive examination of the design development and implementation for a selected system. (Reference 1.56).

Since this was both the first inspection in that program and a trial inspection, it had a dual objective - evaluating the design process for the Callaway Plant and developing the methodology for conducting future inspections. This report covers only the first objective, evaluating the design process based on examination of the auxiliary feedwater system.

1.2 Definitions

Findings

In our evaluation we found many design actions that were being well executed. Some of these positive findings are described in the text of the following sections. They are not flagged and numbered in the text nor listed at the front of this report since follow-up is not required.

Negative findings include such items as procedure violations, errors and inconsistencies. They are described in the text of the following sections. The negative findings are flagged and numbered in the text since followup action is required for licensee resolution and NRC evaluation of the resolutions.

This interoffice NRC effort was structured as an inspection of the Callaway Plant, for which the NRC's Region III Office is responsible. Accordingly, NRC follow-up on these items will be managed and tracked by the Region III Office with assistance as required from the Region IV Office which manages the vendor inspection program and the Office of Inspection and Enforcement which managed this inspection.

Some of the items identified may form the bases for enforcement action. The Regional Offices will review them and initiate enforcement action as appropriate.

Unresolved Items

Unresolved items are questions for which the inspection team did not develop enough information to reach a conclusion. These items could become findings, depending upon the nature of further information. Unresolved items are described in the text of the following sections. They are flagged and numbered since licensee response and NRC evaluation are required. As with the findings, the NRC follow-up will be managed by the Region III Office with assistance as required from other offices.

Observations

The report contains a number of other observations that are flagged and numbered. These represent cases where it is considered appropriate to call attention to matters that are not specific findings or unresolved items. They include items recommended for licensee consideration but for which there was no specific regulatory requirement.

1.3 Callaway Project Organization

The Callaway Plant, Unit 1 (Union Electric Company) and the Wolf Creek Generating Station (Kansas Gas and Electric Company and Kansas City Power and Light Company) are two standard plants being constructed under the Standardized Nuclear Unit Power Plant System concept (SNUPPS). This concept has included other units and other utilities but, currently, only Callaway 1 and Wolf Creek remain under active construction. Our inspection was conducted for the Callaway Plant, Unit 1. Since the designs are standard, some of our findings and conclusions apply equally to the Wolf Creek Generating Station. A copy of this report will be forwarded to the Wolf Creek licensee for information. However, separate responses with respect to Wolf Creek will not be needed.

Union Electric Company holds the construction permit for the Callaway plant and is responsible for assuring proper design. Union Electric and the other utilities participating in SNUPPS have contracted with Nuclear Projects Incorporated (NPI) to assist them in carrying out this responsibility. Basically, NPI takes an item such as a proposed design, a decision to be made, or a problem to be resolved, obtains comments from the utilities' engineers, facilitates resolution of the comments until a single position has been agreed upon and then promulgates that position. Utility decisions affecting design are reached in this manner primarily through the operation of a Technical Committee, although other committees such as a Management Committee and a Quality Assurance Committee are also important. NPI is also sometimes called the SNUPPS Project Office. However, we will refer to it as NPI in this report to avoid confusion with the SNUPPS project organization at Bechtel Power Corporation.

The power block is that part of the plant encompassed in the SNUPPS concept. It includes the reactor building, auxiliary building, turbine building, diesel building, control building, fuel building, radwaste building and hot machine shop. Bechtel Power Corporation is the architect-engineer responsible for design of the power block. In addition, Bechtel is responsible for designing the ultimate heat sink and the associated cooling water systems. The Bechtel scope of design includes all the areas relevant to our inspection of the auxiliary feedwater system. Accordingly, we did not conduct any inspections of Sverdrup and Parcel which is the architect-engineering firm responsible for designing items such as administration buildings, warehouses, shops and switchyard facilities.

Bechtel Power Corporation, which is organized by projects, executed the design of the SNUPPS units (Callaway and Wolf Creek) as a single project known as the SNUPPS project. The two units have the same design within the power block. The ultimate heat sinks, although not the same at the two units, are designed by the same SNUPPS project organization. The utilities provide guidance and exchange information with Bechtel via the NPI organization as discussed above. In turn, Bechtel manages the contract with the reactor manufacturer, Westinghouse Electric Company, so that interchange of information with Westinghouse is via Bechtel.

Daniel International Corporation is the constructor responsible for building the Callaway Plant and conducting the quality control portion of the quality assurance program for construction. Daniel does not perform design work. However, Daniel does develop and exchange information related to design with Bechtel such as Field Change Requests to resolve design and construction problems.

There is, in essence, no field engineering function; design work is performed at the Bechtel Gaithersburg office. Bechtel does have a site liaison engineering group at the construction site which processes documents such as Field Change Requests. However, it functions as a liaison group - not as a design organization.

1.4 Inspection Effort

We selected the auxiliary feedwater system for this inspection. This is a system important to nuclear safety. The components, functions and interfaces involved are typical of those found in a number of other safety systems.

The inspection was an interoffice NRC effort conducted with contractor assistance. Team selections were made to provide technical expertise and design experience in the disciplines listed. Half the team members had previous experience as employees with architect-engineering firms working on large commercial nuclear power plants. The others had related design experience such as working elsewhere on commercial nuclear facilities, test reactors or naval reactors.

Beginning on October 20, 1982 the inspection team devoted 3 weeks to the study of background information and preparation of inspection plans. Then 4 weeks of direct inspection activities were conducted at Union Electric Company, Nuclear Projects Incorporated, Bechtel Power Corporation, Westinghouse Electric Company and the Callaway Plant, concluding on December 14, 1982. A more detailed chronology of inspection activities is provided in Section 7 of this report.

The inspection team reviewed the organizations' staffing and procedures and interviewed personnel to determine the responsibilities of and the relationships among the entities involved in the design process. The general levels of personnel qualification and the guidance provided were also noted. Primary emphasis was placed upon reviewing the adequacy of design details (or products) as a means of measuring how well the design process had functioned in the selected sample area. In reviewing the design details the team focused on the following items:

(1) Validity of design inputs and assumptions.

(2) Validity of design specifications.

(3) Validity of analyses.

(4) Identification of system interface requirements.

(5) Potential indirect effects of changes.

(6) Proper component classification.

(7) Revision control.

(8) Documentation control.

(9) Verification of as-built condition.

In some areas, such as the review of piping stress analyses, the sample was narrowed to include only a part of the auxiliary feedwater system. In other areas, such as electrical power, the sample was broadened into areas that were not related solely to the auxiliary feedwater system. More detailed descriptions of the review are provided in following sections of this report.

1.5 Conclusions

Although the inspection sampled a very small part of the design effort, the team did review hundreds of specific items. The most significant deficiencies are summarized as follows:

(1) There was a lack of formal control over Bechtel's use of plant design newsletters. Thus, these newsletters, which described acceptable modeling and stress analysis techniques, were not being applied uniformly to project design work (Section 3.1.2).

(2) The auxiliary feedwater pump turbine exhaust pipe was not classified as Seismic Category I and safety grade throughout its entire length. No justification available. This represented incomplete detailed analysis to support pump operability requirements. A similar classification was identified in two other systems (Section 2.4).

(3) The ability of motor controllers to withstand fault currents had not been considered or assured. This represented an instance of improper detailed design (Section 5.2).

(4) The team identified needs for improvement in control of the design process at Bechtel in certain areas such as those related to high energy line break analyses (Section 2.4), guidance for two design groups (Sections 3.1.4 and 3.2.4), interface definitions (Section 4.4) and baseplate design (Section 4.5).

(5) Three instances were identified where specific FSAR commitments were not met, one of which involved the turbine exhaust pipe discussed above (Sections 2.3, 2.4, and 6.2).

Prompt attention is needed for the resolution of these specific deficiencies and others identified in the following sections. However, the team concludes that these items are not indicative of any pervasive breakdown in the design process.

With the exception of the matters identified in the findings and an instance of delay in resolving a design issue (Observation 4-1), the team considered the general project management to be a strength. Several utilities' staffs were involved in the development of design criteria and guidance. Effective follow-up and project management assistance were provided by NPI. Bechtel utilized a competent project organization to execute the detailed design work. Interfaces, including those with Westinghouse, were generally well controlled as evidenced by the consistency of design documents. Nearly all the detailed design information reviewed was adequate and consistent, indicating a controlled design process.

Sections 2 through 6 below provide more detailed descriptions of our evaluations in the five discipline areas that we reviewed. Section 7 provides a chronology, lists of documents reviewed or referenced and lists of personnel interviewed.

2.0 Mechanical Systems

The objective of this portion of the inspection was to evaluate the mechanical systems aspects of the design with emphasis on the exchange and control of interface information. The team reviewed the system design and a number of sample areas of work which focused primarily upon the Bechtel Mechanical/Nuclear Group.

2.1 Design Information

This section summarizes the basic mechanical systems design information reviewed.

Design commitments to the NRC are contained in the FSAR and related correspondence submitted in support of the operating license application. The basic system design, design bases, functional requirements, failure analyses and component data are described in these documents along with more general information such as relevant accident analyses, high energy line break analyses and seismic requirements. These licensing commitments were prepared and submitted by NPI acting on the behalf of Union Electric Company and other SNUPPS utilities, with considerable assistance from Bechtel Power Corporation and Westinghouse Electric Company. An area of emphasis in our inspection was to determine whether or not the actual design met the licensing commitments.

The reactor manufacturer's basic design recommendations and interface information are contained in the Westinghouse Steam System Design Manual. This information has been augmented considerably by correspondence between Bechtel and Westinghouse over the life of the project. A great deal of the correspondence that we reviewed was related to exchange of information about the plant safety analyses described in the FSAR, which were performed by Westinghouse. One aim of our inspection was to determine whether or not this information had been properly considered and whether the actual design was consistent with the interface needs of the nuclear steam supply system.

The Mechanical/Nuclear Group at Bechtel is a central focus for system design and for coordination with other entities such as NPI, Westinghouse, and Bechtel's Stress Analysis Group. The Mechanical/Nuclear Group produces a number of documents describing the auxiliary feedwater system design, including the following principal documents:

(1) A system description which describes such items as design bases, system functions and operation, component data, instrumentation requirements, and single failure analysis.

(2) A flow diagram which describes flow paths and calculated flows, temperatures and pressures for various conditions of operation.

(3) A piping and instrumentation diagram which describes the schematic arrangement of the piping, pumps, valves and instruments.

(4) Numerous other documents such as general mechanical/nuclear design criteria, the auxiliary feedwater pump specification, and specific calculations.

The Mechanical/Nuclear Group at Bechtel also takes a lead and coordinating role in the performance of high energy line break analyses.

The results of our review of the mechanical systems aspects are described in the following sections.

2.2 Personnel and Guidance

This section summarizes the basic staffing and guidance information reviewed in the mechanical systems area.

The supervising engineer at Union Electric responsible for the mechanical and electrical areas on the SNUPPS project had held that position for more than 6 years and had 26 years professional experience with Union Electric. The mechanical engineer responsible for the auxiliary feedwater system (among other systems) had held that position for 1½ years and had 14 years professional experience with Union Electric. In addition, the NPI staff contained a number of individuals with considerable experience in regulatory matters and nuclear plant systems design.

The team briefly reviewed the organization for the Mechanical/Nuclear Group at Bechtel. The group supervisor had been in that position for the SNUPPS project for 1.5 years. The three supervisors reporting to him had each been working on the SNUPPS project for at least five years. The Mechanical/Nuclear Group had a total of 21 engineers (including the above supervisors). Five had masters degrees and 6 were registered professional engineers. The average experience included 8.8 years of engineering, 5.5 years on nuclear applications, and 2.6 years on the SNUPPS project.

Prior to October 1981 new engineers in the group had attended lectures on the basic quality procedures involved, Bechtel Engineering Department Procedures (EDP) and Engineering Department Project Instructions (EDPI). Attendance sheets for these lectures were retained by the project quality engineer. For those assigned to the group since October 1981 (8 individuals) the instructions were assigned and read on a self-study basis. A training record was maintained indicating the instructions assigned for reading and the date they were read. Engineers also attended technical training courses, which were voluntary. Subject courses included (1) nuclear plant design overview, (2) fossil plant design overview, (3) technical seminars on components (e.g., feedwater pumps), and (4) Engineer-In-Training and Professional Engineer in-house review courses.

Our interviews indicated that engineers in the Mechanical/Nuclear Group generally were familiar with the instructions and followed them. The supervisors reflected substantial knowledge of nuclear plant design and regulatory requirements in the mechanical/nuclear area.

The results of our review of design details in the mechanical systems area are described in the following sections.

2.3 System Design

The objective of this portion of the inspection was to evaluate the adequacy and the control of basic auxiliary feedwater system design information.

The team reviewed the basic auxiliary feedwater system design information contained in the FSAR, the system description (Reference 2.27) the piping and instrumentation diagram (Reference 2.36) and the system flow diagram (References 2.23 and 2.24). In addition, the applicant had submitted the results of an auxiliary feedwater system reliability study (Reference 2.37) and had discussed the system design extensively at a meeting with the NRC staff (Reference 2.38).

The auxiliary feedwater system included two motor driven pump trains powered and controlled from separate Class IE alternating current power supplies. Each motor driven train fed two of the plant's four steam generators. The system also included a steam turbine driven pump train controlled from direct current electrical power supplies. The turbine driven pump train fed all four of the plant's steam generators and had about twice the pumping capacity of a single motor driven train. Modulating control valves were employed in the motor driven pump discharge lines to each steam generator to avoid excessive flow to postulated broken lines. Fixed orifices were employed in the turbine driven pump discharge lines to avoid excessive flow. The system was not intended to be employed for normal startup and shutdown operations since an electric driven feedwater pump had been provided for this purpose in the main feedwater system. Appropriate automatic starting signals and indications were provided. The auxiliary feedwater system would start and run without operator action when needed due to pipe breaks, loss of offsite power or loss of the main feedwater system. The turbine driven train was capable of operating for at least two hours during a loss of alternating current power supplies (including the diesel generators). The normal supply of auxiliary feedwater was from a non-safety grade condensate storage tank. Automatic transfer functions were provided to switch the pumps' suction to the safety-grade essential service water system in the event of low suction pressure from the condensate storage tank. The switchover function did depend upon alternating current electrical power supplies.

The basic system design as documented in the licensing submittals, had been previously reviewed and found acceptable by the NRC staff (References 2.44 and 2.45). In the areas reviewed during this inspection, acceptability of the basic design in accordance with regulatory guidance was generally confirmed. In addition, further details were reviewed as described below to determine their adequacy and consistency.

The team reviewed the auxiliary feedwater pump specification (Reference 2.33) and found it to be consistent with other design documents and the system design. A few examples are discussed below to illustrate the nature of this review. Two turbine overspeed trip devices were specified, set at 110% and 115% of rated speed. These setpoints were consistent with assumptions used in system flow and pressure calculations (Reference 2.22). The trip and throttle valve was specified to open within 10 seconds and the pump was specified to come up to rated flow and head within 20 seconds which was consistent with Westinghouse recommendations and the plant safety analyses. Although no minimum closing time was specified, we found that Bechtel's files contained documentation of a telephone conversation with the vendor which indicated that testing had shown the valve to close in a range of 0.5 to 0.9 seconds. This supported the assumptions used by Bechtel's Stress Analysis Group in evaluating the effects of a turbine trip on the steam supply line. The environmental qualification conditions were the same as given in the FSAR for the pump rooms. Flow, temperatures, pressures, water quality and functional requirements were all generally consistent with values contained in numerous other documents that we reviewed.

During the team's mechanical components review, an instance of improper classification was found on a portion of the system. For the turbine exhaust line a boundary anchor had been provided at the auxiliary building penetration where the pipe changed to non-seismic and non-safety and ran through the non-Category I auxiliary boiler room. The anchor was designed for piping collapse loads from the downstream pipe. However, we considered the non-Category I sections of pipe to be contrary to FSAR Section 3.9(b).3.2.2.1 which classified the auxiliary feedwater pumps as active components and stated that active components were qualified for operability during safe shutdown earthquake conditions. As was indicated in the Westinghouse design recommendations for this system, the turbine vent piping should normally be safety grade since, if it were blocked, turbine operations would be affected. We did note that Figure 10.4-10 of the FSAR showed the class change on the turbine exhaust line. Nevertheless, no justification was available to demonstrate that the auxiliary feed pump turbine met the requirements for an active component since the exhaust path was not completely qualified. Also, a brief review of the piping and instrumentation diagrams indicated similar class changes for the diesel generator exhaust pipes and the atmospheric steam dump exhaust pipes. This appeared to represent incomplete detailed support for pump operability requirements. It was one of three examples of failure to meet FSAR commitments. Findings 2-7 and 6-3 provide discussions of the other examples. (Finding No. 2-1)

The team reviewed the environmental qualification temperature specified for the turbine driven pump room. The maximum room temperature specified in the FSAR Tables 3.11(B)-1 and 3.11(b)-2, for both accident and normal conditions, was 150 F. The turbine driven pump was being qualified for conditions at least that severe. Since the room did not have safety grade ventilation or cooling, room temperature would be assumed to be controlled by heat transfer to adjacent spaces when the turbine pump was operating. The two worst cases to be considered were (1) operating after a main steam line break when the space above would be heated by escaping steam and (2) operating for at least two hours following a loss of alternating current electrical power.

We found that the available air conditioning calculations did not support the specified temperature of 150F; however, on a judgment basis it appeared that the specified temperature could be supported. A series of calculations had addressed temperatures in the turbine driven pump room. The first calculation, GF 175, was performed in 1975, approved in 1977 as a final calculation and superceded in 1978 (Ref. 2.39). The result was a calculated long term (steady state) temperature of 170 F based on heat transfer to adjacent spaces at 122 F. This answer was too high for the purpose of this discussion and heating of adjacent spaces had not been assumed. However, since the analysis was conservative and the actual accident conditions would be transitory rather than steady state, this did not indicate that the room would actually exceed 150 F. The superceding calculation, GF 274, had been voided prior to approval. The third calculation HV 319 (Ref. 2.40), was performed in 1981. It addressed room temperature based on normal ventilation system flow with outside air at various temperatures, which was not a worst case condition. A fourth calculation, GF-415, was in progress during our inspection. This calculation was intended to address the worst case conditions and, thus, the validity of the environmental qualification temperature specified. It appeared from the heat loads and heat transfer paths involved that the validity could be demonstrated. These efforts should be completed to determine whether this question might have any effect on design (Unresolved Item No. 2-1).

The system description, system flow diagram and some of the underlying calculations were changed during our inspection. We reviewed both the latest revision and the previous versions of these documents. The changes consisted of updating information to reflect such items as design changes that had been made and actual pump performance data. In general, we found the details contained in these documents to be technically sound and consistent with the other documents we reviewed.

The team reviewed the Calculation AL-22 (Ref. 2.22) concerning system pressure. Five conditions were evaluated, representing various operating modes. The maximum pressure was calculated for a condition where suction was taken from the alternate source (the essential service water system) since this provided water at a higher pressure than the condensate storage tank. The electric driven pumps were assumed to be running with no flow to the steam generators - essentially placing them at their maximum shutoff head based on actual pump capabilities. All pressures were within the design pressure of the piping.

There was an erroneous assumption in the maximum pressure case. Flow had been assumed in the pump discharge line with attendant pressure drops taken from calculations for other cases. This was inconsistent with the assumption of no flow to the steam generators and resulted in an underprediction of pressure for three points in the discharge piping by 4, 10, and 35 psi, respectively. Since the team found no similar errors, this did not appear to be a systematic error. It had no effect on the design. The corrected pressure result for the three points would be 1814 psia, the same as at the pump discharge. The design pressure for the piping at these points was 1815 psia, the same as at the pump discharge. (Finding No. 2-2).

The team reviewed Calculation AL-20 (Reference 2.4) related to total pump head requirements for the turbine driven pump and Calculation AL-16 (Reference 2.19) concerning suction head available for the pumps. No significant problems were found with either calculation. The assumptions and results were generally consistent with system functional requirements. They supported the values used in containment pressure analyses, assuring that auxiliary feedwater flow through the steam generator to a ruptured main steam line would not add excessively to the containment pressure. Appropriate interface information had been exchanged with Bechtel's Nuclear Staff Group on this matter and care had been taken to assure that revisions did not void the consistency of the two efforts.

There was an error in Calculation AL-20. A value for head loss in the flow restriction orifices that appeared on page 2 of the calculation had been changed from 350 feet to 425 feet in Revision A. The same value had not been changed where it also appeared on page 8. This did not appear to be a systematic error. It had no effect on the results since more than enough margin had been allowed in subsequent steps. (Finding No. 2-3).

The team also noted that Bechtel and Westinghouse had exchanged information several times concerning maximum flow under accident conditions. This appeared to have been properly considered and it resulted in design changes to assure that the pumps would be protected from conditions of inadequate suction head at high flow rates.

As discussed above, Findings 2-2 and 2-3 involved detailed calculational deficiencies that had no apparent adverse effect on the design and did not appear to indicate systematic weaknesses. Finding 2-1 concerning classification of the turbine exhaust pipe appeared to be more significant. It represented incomplete detailed support for pump operability requirements and similar classifications appeared to exist for exhaust pipes in other systems. The other system design features reviewed were adequate and consistent, indicating a controlled design process.

2.4 High Energy and Moderate Energy Line Breaks

The objective of this portion of the inspection was to evaluate the adequacy and control of high and moderate energy line break analyses related to the auxiliary feedwater system.

Bechtel procedures for inter-discipline coordination and documentation of high energy line break analyses on the SNUPPS project were detailed in a memorandum from the Project Engineering Manager (Reference 2.31). The Bechtel Stress Group performed the stress analyses necessary to determine postulated pipe break locations and produced pipe-break isometric drawings indicating the locations and type of breaks to be considered. The Mechanical/Nuclear Group calculated thrust and jet forces, determined what targets might be affected by pipe whip or jet impingement and determined whether any damage would be acceptable for a particular break. Where damage to targets would not be acceptable the Mechanical/Nuclear

Group prepared action plans and provided instructions to other groups to obtain corrective action. For example, the Civil Group might design a whip restraint to preclude pipe whip.

Potential targets for the postulated breaks were determined primarily by reference to the scale model of the plant. After a particular room had been reviewed it was flagged and any changes to the model (and thus to design locations) were controlled by routing through the Mechanical/Nuclear Group. Here they were checked for effects on the high energy line break analyses before being implemented. If necessary, the analyses would be updated. This appeared to be a sound procedure for maintaining the high energy line break analyses as reasonably current working files and for controlling design changes so as to minimize the inadvertent introduction of pipe break vulnerabilities that might require correction later.

The team reviewed six postulated breaks in the steam supply line to the auxiliary feedwater pump turbine, including field inspection of the locations involved, review of the analysis of effects, and review of one associated thrust force calculation. The auxiliary feedwater system was the only safety related system of interest in proximity to these breaks. The system was generally well protected by compartmentalization. For instance, a break in the turbine driven auxiliary feedwater pump room might damage equipment associated with that pump (which also would be lost because of the break) but no equipment associated with the other pumps was located in the compartment. Generally, we found the protection to be adequate and the analyses to be soundly based. However, we did have some concerns about procedures, traceability and control as discussed below.

We found that zone of influence drawings were not being prepared for the high energy line break analyses. This was contrary to the instructions in the Project Engineering Manager's memorandum (Reference 2.31) which required preparation of such drawings. Bechtel personnel indicated that zone of influence drawings were not cost effective. We would agree that the scale model and other documents that were being prepared in accordance with the instructions appeared to be effective and adequate tools for determining the influence of breaks. However, the procedure and actual practice should be consistent. (Finding No. 2-4)

We found that the Dynamic Effects Analysis (target sheet) for high energy break number FC 01-01 erroneously stated that there would be no pipe whip for a postulated break in the steam supply line near the auxiliary feedwater pump turbine. Field inspection indicated that, since there were no anchors close enough to the postulated break to preclude pipe motion, the correct statement would have been that the pipe could whip and the effect on potential targets should have been evaluated. This item had no adverse effect on the design. The conclusions would remain the same because there were no unacceptable targets in that area. We noted that the target sheets for other breaks generally indicated that there would be no pipe whip. However, they did not indicate any basis for the determination, i.e., a comparison to indicate that the moment (thrust times distance to the nearest anchor) was less than the pipe's moment resisting capability. We also had general concerns about traceability and checking as discussed below. Accordingly, based on our work, we could not make a firm determination that this was an isolated error. This matter should be addressed in resolving the item. (Finding No. 2-5)

The break by break Dynamic Effects Analyses (target sheets) were being treated quite informally. For each break these target sheets listed the calculated thrust forces, jet cone characteristics and determinations on pipe whip. They also listed the potential targets and evaluations of the effects on those targets. Our concern was that the sheets were not signed, dated, checked or approved. It was not possible to tell when an analysis had been performed or even what revision of the jet force calculations or the piping isometric drawing they had been based upon. Bechtel personnel stated that they did not consider these analyses to be like design calculations (which would be subject to formal controls for checking, approval and revision). Further, they indicated that, near the end of the project the sheets would be reviewed along with other related calculations before being finalized. It was not intended, however, to bring them under formal control at that time. We concluded that the documents should be better controlled, at least before they are finalized. These analyses provide part of the basis for design documents and they provide back-up for information supplied to regulatory agencies - two of the objectives that define project design calculations in Bechtel Procedure EDPI 4.37-01. (Reference 1.16) (Finding No. 2-6)

In addition to the six breaks discussed above, the team also reviewed protection arrangements and related correspondence for a postulated main steam line break or main feedwater line break in the space above the auxiliary feedwater pump rooms. In the original design, breaks had not been postulated in that area due to the low stress levels and high quality requirements for the piping. In response to developing NRC staff positions, design changes had been initiated to provide protection for such breaks in 1977. The breaks postulated were defined as non-mechanistic breaks. This meant that a single ended guillotine break would be assumed. Structural integrity of walls and floors and environmental qualification of electrical equipment located in the space were required. However, pipe whip and jet impingement protection were not required.

Generally, the protection features described in the licensing commitments had been incorporated into the design. However, we found that, in one instance, the design did not meet a licensing commitment. A letter to the NRC in 1977 (Reference 2.41) and FSAR Section 3.B.4.2 had stated that there would be no drainage (from the break area above the auxiliary feedwater pump rooms) to lower levels of the auxiliary building and that penetrations through the floor would be waterproof. Large drain lines had been installed to shunt drainage from the break areas to the turbine building. Waterproof seals had been provided where piping penetrated the floor. We reviewed the seal designs and found them adequate. However, field inspection indicated that several small drain lines through the floor had remained in place. The appropriate drawings (References 2.42 and 2.43) indicated that these lines had remained in the design, were interconnected with drains from the auxiliary feedwater pump rooms and did drain to lower levels of the auxiliary building. There were no isolation provisions to prevent steam from entering various critical areas via these drains. We did not determine the potential effects on design, which would depend upon how much steam might enter critical areas through the small drain lines. This flow path should be blocked or the safety significance should be addressed and, if justified, the FSAR should be changed. Since the other protection features had been incorporated in the design, this specific item did not appear to indicate a systematic weakness in providing high energy line break protection. It was one of three examples of failure to meet FSAR commitments. Findings 2-1 and 6-3 provide discussions of the other examples. (Finding 2-7)

In general, the moderate energy line hazards analyses had not yet been completed in the area of our inspection. However, several flooding protection calculations related to these analyses had been completed. The team reviewed two sample calculations, FL-01 and FL-13, related to flooding levels in the auxiliary building basement and the auxiliary feedwater pump rooms (References 2.34 and 2.35). Both calculations demonstrated adequate protection for safety related equipment on a conservative basis and indicated compliance with the appropriate FSAR commitments.

As discussed above, we found a need for improved control of certain analyses (break by break dynamic effects analyses) and found an error in one of those analyses. There was one specific failure to meet a licensing commitment that did not appear to be a systematic error. The procedural violation concerning zone of influence drawings had no apparent effect since the actual practices appeared adequate. In other respects, we generally found the protection adequate and the analyses soundly based, indicating adequate control.

2.5 Westinghouse Information

The objective of this portion of the inspection was to evaluate design interfaces with the nuclear steam supply system.

We reviewed the Westinghouse design recommendations and interface information in the Steam Systems Design Manual. We also reviewed about 12 letters between Bechtel and Westinghouse which served to amplify and, in some cases, to modify this information. Westinghouse recommendations were not necessarily requirements that must be met. The team's object was to determine that either the system design was consistent with Westinghouse recommendations or, where this was not the case, to determine that the differences in design features had been evaluated and were known to be adequate.

We found a number of minor differences which Bechtel personnel were readily able to justify on sound technical bases. For example, Westinghouse Steam Systems Design Manual had literally recommended use of automatically closing valves to prevent other systems from depleting the water in condensate storage tank below the required minimum when the auxiliary feedwater system was needed. In the SNUPPS design, the other systems' suction lines were located high in the tank so they were incapable of depleting the condensate storage tank below the required level. This was clearly acceptable.

We reviewed correspondence related to the standard Westinghouse recommendation to employ a safety grade source of condensate quality water as the primary suction source. The SNUPPS design employed, as the primary source, a non-safety grade condensate storage tank. Automatic provisions were provided to switch the system's suction to a safety grade source (the essential service water system) in the event of low suction pressure from the condensate storage tank. This alternate safety grade source was not of condensate quality, being essentially Missouri River concentrated by a factor of four as a result of cooling tower evaporation. From the initial exchanges of correspondence it appeared that Westinghouse had preferred a safety grade condensate quality source (or an equivalent source based on heat exchangers). However, Westinghouse had in the end provided Bechtel a letter stating that the SNUPPS practice was not a safety problem.

Westinghouse personnel demonstrated the basis for this determination. Their calculations indicated that using ultimate heat sink water for one cooldown cycle of about 24 hours would result in a chemical environment far less severe than that which experimental data had indicated might cause steam generator tube failure or tube support sheet failure, even for steam generator designs that were considerably more susceptible to damage than the SNUPPS steam generators.

The team reviewed interface information related to accident analyses involving the auxiliary feedwater system to determine that the values provided by Bechtel to Westinghouse were current and correct. The accident analyses we reviewed were those for main feedwater line rupture, main steam line rupture and main feedwater system failure. Bechtel had provided auxiliary feedwater system flow rates, temperature limits, purge volumes and startup times which were consistent with the actual system design. One of the important considerations was the maintanance of a sustained flow rate of 470 gallons per minute from the turbine driven pump following a main feedwater line break accident. The team checked Bechtel Calculation AL-26 (Reference 2.11) and found that pump flow had been calculated, based on pump and turbine characteristics, for eight conditions corresponding to points after the accident This demonstrated that the necessary flow would be maintained during the course of the accident with the various values of steam pressure and temperature that would be available for the turbine driven pump.

With one exception (classification of the turbine exhaust pipe discussed in Section 2.3 of this report) we found that the design features we reviewed were consistent with Westinghouse recommendations or that the differences had been evaluated and justified, indicating exchange and control of interface information.

2.6 Conclusion

As discussed in the preceeding sections, nearly all of the design information we reviewed was adequate and consistent indicating a controlled design process. We found a need for improved control in certain parts of the high energy line break analyses and we found one instance where the high energy line break protection features did not meet a licensing commitment which did not appear to be a systematic error. Nevertheless, we generally found the high energy break protection adequate and the analyses soundly based. Accordingly, the design process appeared to be controlled.

3.0 Mechanical Components

The objective of this portion of the inspection was to evaluate the mechanical components aspects of the design with emphasis on the control of design information and assumptions used in the evaluations. This review included sample areas of work in the Stress Analysis Group and the Pipe Support Group at Bechtel Power Corporation and sample items of mechanical equipment.

3.1 Stress Analysis Group

3.1.1 - Design Information

This section summarizes the basic design information reviewed in relation to the Stress Analysis Group.

Design information used by the Stress Analysis Group is generally provided by other Becntel internal design groups. The design data include project specifications for piping, piping isometric drawings and vendor component allowable loads. Drawings and specifications are formally controlled documents containing coordination sign off stamps and are referenced in the stress analysis cover sheets. Valve weight data are contained on the piping isometric drawings. Information on component allowable loads and system operating conditions is transmitted from the Mechanical/Nuclear Group by memoranda and retained in the stress analysis problem file. Seismic response spectra are maintained in Bechtel Computer Program ME 909 (Reference 3.26) and are obtained by specifying the building and elevation data point shown in the civil mathematical models. The stress group leader maintains a notebook containing the civil mathematical models and corresponding spectra. Also contained in the notebook are ME 909 printouts of the spectra. One data point was checked (Data Point No. 11 in the Auxiliary Building). The ME 909 spectra printout for this data point matched the envelope spectra obtained from the civil specification. Spectra enveloping between different buildings and elevations is performed by the computer program.

Loads and pipe movements at pipe support locations are transmitted from the Stress Analysis Group to the Pipe Support Group by memoranda. Movements at small pipe branch connections are maintained in the stress analysis problem file. Since the Pipe Support Group performs the design of small diameter piping, the stress analysis package is checked by that group to obtain the correct movements at attachment points.

Feedback from the field on "as-built" conditions is largely in the form of Field Change Requests (FCR) which must be approved by Bechtel. The design philosophy for the SNUPPS project is intended to limit Field Change Requests by requiring the system to be fabricated within the tolerances contained in Bechtel Specification M-204 (Reference 1.24). As a result, no field change requests for piping were available in the Stress Analysis Group for inspection team review. In addition to limiting the field changes on piping, Bechtel plans to conduct final "as-built" walkdowns when construction is complete. Since support fabrication on the sample system was not complete at the time of the inspection, no assessment could be made of the implementation of "as-built" controls for piping.

The results of our review of sample work areas are described in Section 3.1.3.

3.1.2 - Personnel and Guidance

This section describes our review of training and guidance information related to the Stress Analysis Group.

Inexperienced engineers were first assigned to the Bechtel staff rather than a specific project. There, they received classroom training (approximately 150 hours) which gave them an overview of analysis techniques and procedures for various loading conditions. Once the training was completed, the engineers were assigned to a specific project. There, the first assignments for new personnel were checking and reviewing completed (and previously checked) problems to become further acquainted with the group's work. Then typical work was assigned. No formal training class notes were available to review for class effectiveness. The training program had only been available within the past two or three years.

The Stress Analysis Group uses centralized guidance documents such as computer manuals and stress newsletters. The inspection team studied the stress newsletters and the user's manual for Bechtel computer program ME 101 (Reference 3.27) which was the computer program used for piping analysis. The stress newsletters are a collection of letters issued from time to time by the stress groups of various Bechtel offices indicating acceptable analysis techniques, analysis clarifications, and suggested analytical procedures. We noted that the newsletters had not been evaluated for use on the SNUPPS project. They were being used in some cases but, on the whole, there was no system in place to determine what should be used where. This was in violation of Bechtel Procedure EDPI 4.1-01 (Reference 1.11) which states that "Design criteria on the SNUPPS project are detailed in discipline design criteria documents which shall be revised and documented in accordance with this instruction." (Finding No. 3-1)

Finding 3-2 (Section 3.1.3) concerned an error that might have been avoided by use of the appropriate newsletter. Based on the nature of the newsletters and the lack of controls, there appeared to be a potential for other such errors. In addition, Finding 3-5 (Section 3.1.3) concerned assumptions made at a piping class boundary. This appeared to indicate a need for more formal guidance in other areas as well. These matters should be addressed in resolving the above finding.

One newsletter that the team reviewed dealt with welded attachments to ASME Class 2 and 3 piping systems. During this review, Bechtel personnel indicated that if the loads on the attachment produced a stress less than 8 ksi, the attachment was considered adequate. If the welded attachment resulted in a stress greater than 8 ksi, a more detailed analysis procedure would be utilized. The initial welded attachment stress analysis would be performed by the Pipe Support Group using Bechtel Computer program ME 210 (Reference 3.28). If the results indicated stresses greater than 8 ksi, Class 1 allowable stress limits would be used for comparison of lug stresses combined with the piping stresses for primary upset, primary plus secondary, and faulted load combinations.

Sections NC-3645 and ND-3645 of the 1974 Edition of the ASME Code require the consideration of local stresses in the pipe resulting from attachments but do not define explicit stress allowable criteria. The NRC staff is currently reviewing criteria for piping attachments on a generic basis. However, at present, the Bechtel procedure appears to meet the requirements of the above sections of the ASME Code.

From the team's review of a user's manual for the ME 101 program, it was noted that there might be a non-conservatism in the calculation of seismic anchor movements for skewed restraints. The ME 101 Program Users Manual discussed the method used by the program to compute loads due to seismic anchor movements. For skewed supports (which did not align with east-west, north-south or vertical directions), the anchor movement applied to the support was the global movement multiplied by the cosine vector. This might yield non-conservative results for some cases. This question should be addressed by further study and, if needed, appropriate corrective action should be taken. (Unresolved Item No. 3-1)

For seismic analysis of piping systems, the FSAR referenced Revision 3 of Bechtel Topical Report BP-TOP-1 (Reference 3.5). The Stress Analysis Group Leader had a copy of Revision 2 for reference and there was no documented evidence that the group members had formally reviewed Revision 3. This indicated a lack of awareness of what was specified in the FSAR. However, a brief comparison indicated that Revision 3 incorporated a discussion of closely spaced modes and Class 1 piping cyclic criteria, and specified that three simultaneous directions of earthquake input be utilized. No evidence was found that Stress Analysis Group personnel had violated these criteria.

The Stress Analysis Group Leader also maintained a copy of Bechtel Specification M-200 (Reference 3.3) dealing with design of ASME Section III piping. Stress allowable limits and load combinations were contained on Gaithersburg Power Division standardized forms used by the Stress Analysis Group. For support loads, only maximum design loads were summed. This provided the most conservative load combination to the Pipe Support Group.

A number of general questions arose during the inspection concerning the analytical procedures utilized for the piping system analyses for the SNUPPS project. One question dealt with the analytical procedure for incorporating "missing mass" or zero period acceleration effects. For the SNUPPS project, the Stress Analysis Group was using a 33 Hz frequency cutoff. No zero period acceleration loads were being incorporated into the support load tables. However, Bechtel personnel indicated that SNUPPS Project criteria required that (1) minimum stiffnesses be used, (2) worst case loads (typically faulted) be used to design supports to normal and upset allowable stress levels, and (3) that a minimum design load of 100 lb/inch diameter of pipe be used. The team believes that sufficient conservation exists in the calculation of support loads to cover zero period acceleration effects in these particular circumstances.

Another question concerned checking to see if response spectra peaks were straddled. This would result in an analysis that was sensitive to small changes in input parameters and modeling assumptions. Bechtel did not conduct formalized checks. However, typically the first mode for the piping systems reviewed was greater than the fundamental spectra peaks and, therefore, peak straddling was not observed.

Finally, the stiffness values used in the piping analyses were explored. Bechtel personnel indicated that very high stiffnesses were used in the weight and thermal expansion analyses while realistic minimum stiffnesses were used for the seismic analyses. This meant that thermal expansion results should be conservative, seismic results adequate, and that weight results can be non-conservative. However, the non-conservatism in the weight results would not be of engineering significance.

In summary, the Stress Analysis Group used standardized forms and the ME 101 computer program which provided good assurance of consistent application of the ASME Code requirements specified in the FSAR. In the more judgemental areas of analysis and modeling assumptions, improvements in the guidance were needed as discussed above in relation to Finding 3-1.

The results of our review of specific analyses are described in the following section.

3.1.3 - Analysis Review

The objective of this portion of the inspection was to evaluate the adequacy and control of specific Stress Analysis Group products.

Two stress analysis packages were selected for detailed review: (1) the auxiliary feedwater turbine driven pump discharge line, Problem No. 70, (Reference 3.9) and (2) the steam supply line to the turbine, Problem No. 60, (Reference 3.7). The team reviewed the input information referenced, the assumptions used in the analysis, and the stress and load summary sheets for compliance with FSAR criteria.

Problem No. 60 referred to Revision 13 of Specification MS-1, the Piping Class Summary, whereas Revision 14 (Reference 1.23) had been issued by the time the analysis was finally approved and Revision 15 had been issued by the time of our inspection. A similar situation existed with Problem No. 70. However, the team's review indicated that the later revisions did not affect these analyses. In addition, to demonstrate the procedure for controlling such information, Bechtel personnel provided a memorandum (Reference 3.39) that documented the piping analyses affected by the latest revision (Rev 15) to the Piping Class Summary.

The analyses indicated that 3% damped SSE response spectra had been used as input whereas 2% should be used for small piping. However, we found notes indicating that the 3% spectra analysis results had been multiplied by a factor of 1.25 to conservatively bound the 2% spectra acceleration values. This was a valid practice.

The analysis packages indicated that the main run piping did not have stress intensification factors greater than 1.0 at points where branch piping was located. The plant design staff stated this was a standard procedure for the SNUPPS project. (This applied to cases where the branch pipe was smaller than the run pipe as defined by footnote (6) to Figure NC-3673.2(b)-1 of the ASME Code.) Since the 1974 Edition of the ASME Code was ambiguous in this area, Bechtel's interpretation was that the run piping need not be stress intensified. We believe this approach is not conservative; however the significance is not expected to be major. The Code ambiguity was clarified in the Summer 1979 Addenda where a minimum stress intensification factor of 1.5 was required. However, the licensee is not required to meet the later versions of the ASME Code.

We found that Problem No. 60 had not employed the correct enveloped seismic response spectrum. FSAR Section 3.7(B)3.7 stated that "The seismic design of the piping and equipment included the effect of the seismic response of the supports, equipment, structures, and components." The enveloped response spectra used on Problem No. 60 were not conservative in that they did not include the effects of the main steam lines to which the supply lines in question were attached. A correct response spectrum should have been obtained if the appropriate plant design stress analysis newsletter, as discussed in Finding 3-1 above, had been employed. Since no formal design requirements existed to addresss response spectra input for branch lines, this problem may apply to other analyses where branch lines have been decoupled from larger piping systems. (Finding No. 3-2)

We found that Drawing M-03AB01 (Reference 3.29) did not reflect the correct "as-built" condition at the connection between the steam supply to the auxiliary feedwater pump turbine and the main steam loop 3 header. The pipe fabricator (Dravo) had supplied a different configuration than described in the Bechtel drawing. Revision 5A to the Dravo drawing (Reference 3.30), which had been received at site with the spool shipment, showed the correct "as-built" condition. However, the Bechtel site records maintained by the Bechtel Site Liaison Engineering Group contained the earlier Revision 5, (Reference 3.31), which did not reflect the "as-built" condition. This appeared to be a paperwork error by either Bechtel or Dravo. (Finding No. 3-3)

With respect to the same connection, we found that Problem No. 60 did not contain documentation for the calculation of the stress intensification factor used. This was contrary to Bechtel Procedure EDPI 4.37-01 (Reference 1.16), which required a statement of how design data were developed if detailed calculations were not performed. This was a procedural item which we would not expect to adversely affect the analysis. (Finding No. 3-4)

One additional piping run was reviewed to determine the adequacy of the assumptions used at Seismic Category I boundaries. This was the auxiliary feedwater suction piping from the condensate storage tank Problem No. 44A (Reference 3.8). Review of Problem No. 44A indicated that no anchor was designed at the Seismic Category I boundary where the buried pipe entered the auxiliary building. The effects of the Non-Category I pipe had been considered by modeling approximately ten feet of massless pipe with three directional soil springs located at two foot intervals. It was noted that building settlement was considered in the analysis in accordance with Bechtel Specification M-200 requirements.

We found that Problem No. 44A did not contain an evaluation of the imposed loads and movements due to the thermal expansion of the attached buried piping outside the building. This is contrary to Section ND-3651 of the 1974 Edition of the ASME Boiler and Pressure Vessel Code which states that the design of the complete piping system shall be analyzed between anchors for the effects of thermal expansion. This appeared to be a unique situation involving an interface, without an anchor, between Non-Category I buried pipe and Category I pipe inside a building. (Finding No. 3-5)

In addition, we found that the same problem did not contain an analysis of piping from the condensate storage tank inside the building for the cold condition. This is contrary to Section ND-3624 of the 1974 Edition of the ASME Boiler and Pressure Vessel Code which requires that the design of piping systems take into account forces and moments resulting from thermal expansion and contraction. This specific error in Problem 44A did not appear to be a systematic error since a check of the suction from the Essential Service Water System and the Auxiliary Feedwater discharge piping confirmed they had been analyzed for the low temperature condition. (Finding No. 3-6)

In a meeting with the NRC staff on June 9-10, 1981, the SNUPPS applicants committted to meet the staff's position on functional capability for ASME Class 2 and 3 piping systems (Reference 3.32). At the time of the inspection of the auxiliary feedwater piping system, the analyses had not been checked for compliance with the technical position. Our review of the stress analysis packages indicated that stresses at some points in the piping systems exceeded the minimum limits given in the technical position. Further evaluation is necessary to assure functional capability of these piping systems in accordance with the technical position. (Unresolved Item No. 3-2)

The piping systems required to meet the functional capability criteria in the technical position were identified by marked-up P&ID's that were transmitted from the Mechanical/Nuclear Group. However, no list was available to identify which analysis problems required evaluation for the functional capability criteria. In order to check the implementation of the functional capability criteria on current work, the team checked Stress Analysis Problem No. 12, (Reference 3.33). Review of the stress summary verified that the functional capability criteria had been considered in the analysis.

3.1.4 - Summary

This section summarizes the results of our review concerning the Stress Analysis Group.

As discussed above, three findings related to Stress Analysis Group guidance for analysis techniques and modeling assumptions. The most significant (No. 3-1) involved a lack of control over the use of stress newsletters. The second (No. 3-2) concerned seismic response spectra input for branch lines. The third (No. 3-5) involved the assumptions made at a piping class boundary. Although the majority of assumptions used appeared adequate, the negative findings indicated that more formal guidance was needed for consistent and correct application of design assumptions. (Observation 3-1)

There was one finding (No. 3-3) concerning control of design input information. This involved feedback of "as-built" information from the vendor drawing of the steam supply connection to the main steam line. The overall control over feedback of "as-built" information could not be assessed because system construction had not been completed and "as-built" walk downs had not been performed.

The review of design input information supplied by other Bechtel design groups included system operating parameters, component allowable loads, seismic input and piping class specifications. Based on the inspection sample, design input information appeared to be controlled.

The review of sample calculations indicated that the basic criteria specified in the FSAR for ASME Code allowable stresses and design load combinations were followed. Two findings did not appear to be systematic errors. One (No. 3-4) concerned a lack of documentation for a stress intensification factor and the other (No. 3-6) concerned failure to analyze suction piping for the cold condition. Accordingly, based on the inspection sample, adequate control was indicated.

3.2 Pipe Support Group

3.2.1 - Design Information

This section summarizes the basic design information reviewed in relation to the Pipe Support Group.

The basic input information comes from the Stress Analysis Group in the form of memoranda transmitting the support load summary sheets and piping isometrics showing the location of the supports. Data containing pipe thermal and seismic movements at the support locations are listed on the support load sheets.

Coordination with the Civil Group for structural attachments was achieved by sending the Civil Group the working drawing of the support which, in all samples examined, contained the imposed loads and the location of the support. The Civil Group then stamps the working drawing "Approved" prior to the Pipe Support Group issuing the hanger drawing. Working drawings had been retained for reference, although there was no evidence that this was required by Bechtel procedures. The most recent procedure implemented by Revision 17 to Bechtel Procedure EDPI 4.46-01 (Reference 1.17), requires an index sheet to be maintained for each isometric drawing. The index sheet contains a list of all supports on the piping isometric along with the revisions of the support design. When supports are revised, the index sheet along with all new support revisions are sent to the Civil Group which signs the coordination sheet.

In our review of the sample calculations as discussed in the following sections, we found the original procedure had been followed and the documentation had been retained. Implementation of the current procedure should improve the coordination between groups and the retrievability of the records in the Pipe Support Group.

The majority of the supports on the system selected had not been completed and had not received the field QC check at the time of the inspection. Feedback from the field on "as-built" conditions was similar to that discussed in Section 3.1.1 for piping. The major difference with supports was that the Daniel procedure for field change requests (Reference 3.38) allowed construction to proceed on the basis of the proposed change prior to Bechtel approval of the FCR. This was called a "Red Line Procedure" and it required a "Red Line Tag" be attached to the support until the FCR was dispositioned by Bechtel.

The results of our review of sample work areas are described in Section 3.2.3.

3.2.2 - Personnel and Guidance

This section describes our review of training and guidance information related to the Pipe Support Group.

Interviews with Bechtel personnel indicated the Pipe Support Group conducted a training course for new personnel. The training course consisted of approximately 60 hours of classwork. As with the Stress Analysis Group, it was noted that the training program had only recently been available.

A key document used by the Pipe Support Group was Bechtel Specification M-217 concerning pipe supports (Reference 3.16). This specification listed general design requirements such as required stiffness of supports. Another document used by the Pipe Support Group was Bechtel's Plant Design Hanger Engineering Standards (Reference 3.17). This document contained guidance for items such as evaluation of standard details for welds and attachments.

Standard components such as clamps, snubbers and sway struts were selected based on manufacturers' catalogue load ratings. Supplementary steel framing was generally evaluated using the computer program STRUDL to obtain member stresses and attachment loads. Evaluation of welded attachments to piping was performed by the Pipe Support Group as previously discussed in Section 3.1.2.

The basic design criteria involved evaluation of supports for the maximum loads transmitted by the Stress Analysis Group and maintaining the stresses within the ASME Code upset limits. This was more conservative than the FSAR criteria. Bechtel personnel indicated that more detailed evaluations using FSAR load combinations and stress limits might be used to evaluate the adequacy of existing supports or for evaluation of welded attachment stresses if needed.

The results of our review of specific analyses are described in the following section.

3.2.3 - Analysis Review

The objective of this portion of the inspection was to evaluate the adequacy and control of specific Pipe Support Group products.

Several pipe support calculation sheets were reviewed. Support AL02-C009/135Q was chosen for review because it contained welded attachments to the pipe. The loads matched the loads calculated by the Stress Analysis Group. The welded attachment analysis appeared adequate.

Support AL04-C009/135Q (incorporating two rigid struts) was reviewed. No stiffness calculations had been made. Bechtel personnel indicated that it was standard procedure not to calculate stiffness of struts when Hanger Engineering Standard (HES) number 16, Revision 1 was utilized. This standard limited the angle between two struts (analytically modeled as orthogonal) to be between 30° and 150°. It also illustrated a "cookbook" method for calculating the imposed axial loads. No evaluation was available at the time of the inspection to verify that the strut stiffnesses met the requirements of Specification M-217 for the entire range of allowed angles. Since the piping analysis used the stiffness given in Specification M-217, this question should be addressed to determine whether it has any affect on the design. (Unresolved Item No. 3-3)

In general, lateral vibrations of struts and rods were not considered for the SNUPPS project and no criteria were available for evaluating the frequency of supports in the unrestrained direction. FSAR Section 3.7(B).3.7 stated that the seismic design of piping included the effects of the seismic response of supports. Significant lateral vibration of the support would reduce its buckling capacity and could affect the response of the piping system. This question should be addressed to determine whether it has any effect on the design. (Unresolved Item No. 3-4)

Support AL01-R005/135Q was a box frame on the suction piping providing lateral support in one direction. Attached to the bottom of the frame was spring hanger AL01-H001/135Q. The loads used to analyze the support frame did not match the loads from the piping analysis. However, the loads used in the frame analysis were much higher than the loads from the piping analysis. The frame dimensions used in the STRUDL analysis did not match the dimensions on the support drawing. The STRUDL analysis was dated 10/04/76 and Rev 2 of the support drawing was dated 6/23/78. Apparently, the STRUDL analysis for this case was based on a preliminary design or a similar design of another frame support and was not updated with current loads and "as-built" dimensions because of the conservatism in the loads used in the analysis. Because the loads used in the analysis were much greater than the current piping loads, the frame design should be satisfactory and the apparent assumption was justified. The support design contained an evaluation of the frame stiffness which demonstrated that Specification M-217 requirements had been met.

Field inspection of support AL01-R005/135Q indicated that the frame provided no vertical clearance at the bottom of the pipe. This frame was not intended to provide vertical support. The cause was that the length of the vertical members specified in the bill of materials did not match the dimensions shown on the hanger sketch. This appeared to be a non-systematic error that was not detected in the design checks or the initial field quality control check of the hanger. It is expected that this error would be detected by a system walkdown performed in accordance with the NRC's IE Bulletin 79-14. The support will require rework to obtain the proper vertical clearance. (Finding No. 3-7)

Spring hanger AL01-H001/135Q was attached to the box frame discussed above. The analysis package contained correct loads and movements from the piping analysis. The design of the members was based on a load from a previous analysis revision which was less than the current load. A note in the hanger calculation stated that the new load and movements would not affect the member sizes. This design appeared to be satisfactory.

Support FC01-R020/135Q consisted of two lateral snubbers on the steam supply line to the turbine. The loads and movements used in the support evaluation were the same as those contained in the pipe stress analysis. The evaluation of support stiffness considered only the structural steel elements of the support which, in essence, assumes that the snubbers involved were rigid. We found that this did not meet the requirements of Bechtel Specification M-217 (Reference 3.16). Section 4.2(b.) of the specification required that either the stiffness requirements of Table 1 in that specification be met, the frequency equation be satisfied or the stress problem reanalyzed using the actual stiffness of the support. Test data from Pacific Scientific showed that the snubber stiffness for this snubber (type R/2-.65) was less than the minimum stiffness required by Table 1 of Specification M-217. However, the piping stress analysis, Problem No. 60 had used the stiffness value from the table. (Finding No. 3-8)

Since it appeared that snubber stiffnesses were not generally being checked for compliance with Specification M-217 requirements, similar situations may exist for other supports using snubbers. In addition, unresolved Items 3-3 and 3-6 concerned lack of evidence that support stiffness requirements had been checked for specific struts and I-beam attachments. Apparently, it was generally being assumed that standard components would be satisfactory rather than checking to determine that the project interface requirements in Specification M-217 had been met. In addition, Unresolved Item 3-4 concerned an apparent assumption that standard struts and rods would automatically be satisfactory from a standpoint of lateral vibrations. Based on these considerations it appeared that improved guidance and procedures were needed to assure that project requirements were met for standard pipe support components and structural details. These matters should be addressed in resolution of the above finding.

Anchor AL01-A002/125Q on the auxiliary feedwater suction piping was reviewed to verify the method used to evaluate welded attachment stresses. The evaluation used the ME 210 computer program to evaluate welded attachment stresses at the pipe attachment point. Since the stresses exceeded 8 ksi, an evaluation was performed using ASME Class 1 allowable stress limits for the following load cases: (1) primary upset limits for weight + OBE (2) primary faulted limits for weight + SSE and (3) primary plus secondary limits for weight, thermal, OBE and seismic anchor movements. The items reviewed, which focused on the methods for handling attachment stresses, appeared acceptable.

Anchor FC01-A002/135 was designed by the Civil Group. This anchor was a boundary anchor between the Seismic Category I steam supply line and the non-seismic supply line from the auxiliary boiler. The design loads from the Stress Analysis Group considered piping collapse loads from the non-Category I section of the piping. It was noted during the team's civil engineering review that these moments were reduced by the ASME Code stress intensification factor at the nearby elbow. The Bechtel Civil Group provided procedure TB-011 (Reference 3.21), which had been provided by the Stress Analysis Group. This procedure allowed reduction of collapse moments by the ASME Code stress intensification factor at any fitting located within three piping diameters of a restraint. While this procedure may produce acceptable results for elbows, we considered its general validity questionable since the Code stress intensification factors would not generally correlate with section collapse properties. This matter should be addressed to determine its potential effects on design. (Unresolved Item No. 3-5)

Field Change Request 2FC-1191-MH was reviewed as an example of field feedback. The FCR involved relocation of the structural steel attachment of a sway strut approximately six inches to avoid interference with existing conduit. The relocation was accepted and the Civil Group had signed off on the coordination sign off sheet. The change involved a support which placed an existing structural I-beam in torsion; the change increased the torsional moment on the I-beam. I-beams generally have low torsional stiffness, especially for the case where the load is applied locally through the flange. No evidence existed at the time of our inspection to verify that Specification M-217 stiffness requirements had been considered when this change was approved. This should be addressed to determine whether or not it would have any effect on the design. (Unresolved Item No. 3-6)

3.2.4 - Summary

This section summarizes the results of our review concerning the Pipe Support Group.

As discussed above, there was one finding (No. 3-8) concerning the failure to meet the support stiffness requirements of Specification M-217 with respect to snubbers. In addition there were two unresolved items (Numbers 3-3 and 3-6) regarding a lack of evidence that support stiffness requirements had been met for specific struts and I-beam attachments. The specification provides interface requirements to assure the consistency of piping analyses with support stiffness. Apparently, it was assumed that standard components would automatically be satisfactory rather than checking to stresses present in the angles. The angle supports should be checked using appropriate analytical methods. (Unresolved Item No. 3-7)

The inlet nozzle loads used in the qualification report were the same as the loads used by the Stress Analysis Group for Problem No. 60. The stiffness of the nozzle could not be determined from the review of the report. Therefore, it could not be verified that the assumption of the nozzle as a rigid anchor in the piping analysis was valid. It was noted that dynamic testing results presented on page 52 of the turbine report listed frequencies ranging from 2.5 to 6.7 Hz, indicating that the turbine was not a rigid component. This item should be addressed to determine whether or not there is any effect on the piping analysis. (Unresolved Item No. 3-8)

There was no indication that the Stress Analysis Group reviewed the above vendor design reports and we had some concern about whether the stress analysis assumptions in those reports were being checked for consistency with Bechtel pipe stress analyses. However, since we found no violations of regulatory requirements, this matter is mentioned as a recommended area for licensee consideration. (Observation No. 3-3)

The team reviewed the qualification report for valve HV12 (Reference 3.36) as well as the valve data sheet supplied by Masoneilan, dated 8/19/77 which provided the actual weight of the valve. The weight given on the data sheet was approximately 6% greater than the weight used in the piping analysis (Problem No. 70). When questioned about this difference, Bechtel personnel produced the current revision of isometric drawing M-04AL04 (Reference 3.37), which contained the correct valve weight. They also produced the Bechtel criterion for reanalysis of piping problems due to changes in valve weights. This criterion stated that reanalysis was not required if the valve weight change was less than 17%. This was based on generic calculations performed by the Plant Design Staff. We did not review the documentation supporting the 17% criteria; however, the weight difference for valve HV-12 in Problem No. 70 was not considered significant.

The seismic input that Bechtel had provided for valve qualification consisted of generic envelope spectra for the plant. These spectra enveloped the output accelerations from the piping analysis and were conservative.

As discussed above, our review in this area resulted in two unresolved items and one recommendation for licensee consideration. Based on the limited review of equipment, it appeared that adequate controls existed to ensure basic design inputs such as nozzle allowable loads, seismic inputs and valve weights were properly transmitted between the Stress Analysis Group and the component suppliers.

3.4 Conclusion

On the basis of the sample included in the inspection, the design process appeared to be controlled in the mechanical components area. As discussed in the preceeding sections, weaknesses were identified, the most significant involving guidance concerning design assumptions and standard components. Nevertheless, the inspection sample in this area appeared to indicate adequate control.

4.0 Civil and Structural Engineering

The objective of this portion of the inspection was to evaluate civil and structural engineering design details and practices with emphasis upon control and exchange of information as well as the technical execution of the design. The team reviewed the involvement of Union Electric Company and Nuclear Projects Incorporated and the execution of design by the Bechtel Power Corporation. Areas of review included personnel qualifications, guidance provided, and a number of technical and procedural areas as described below.

4.1 Involvement of Union Electric Company and Nuclear Projects Inc.

The objective of this portion of the inspection was to determine, on the basis of a limited sample of technical items, the manner and depth of involvement of the licensee, Union Electric Company and the SNUPPS Utilities' contractor, Nuclear Projects Inc. (NPI), in the design of the Callaway facility in the civil-structural discipline area.

The Union Electric Company Nuclear Engineering Department responsible for the Callaway facility consisted of 26 engineers at the time of the inspection. Two of those engineers were civil-structural. Union Electric personnel indicated that the group had been formed about May of 1976. At that time a supervisory engineer in the civil-structural area and another civil-structural engineer were assigned to the Nuclear Engineering Department. Prior to that time these two engineers had been involved along with a third civil-structural engineer on assignment to the Callaway project from the Union Electric Engineering and Construction Department.

FSAR Section 1.4.1.3 describes the technical qualifications of Union Electric and provides the company philosophy with respect to engineering, design and construction of the nuclear facility. That section states that "UE does not maintain engineering and construction staffs for the design and construction of power plants, but rather engages reputable engineering and construction firms for these purposes. UE has a staff of engineering personnel that directs site investigation activities, guides plant design, implements a quality assurance program, and prepares for construction and operation of the plant." Union Electric Procedure QA-303 (References 4.5 and 4.6), which governs the Union Electric review process, is consistent with the FSAR commitments in this subject area.

The team reviewed the work assignments of the three individuals for the May 1975 time frame when many of the basic decisions in the civil-structural discipline were made. The work was divided between the power block work (Bechtel scope of design) and site (Sverdrup and Parcel scope of design). The site work apparently consumed a significant portion of the time available to the Union Electric personnel. In addition, the supervising civil-structural engineer was responsible for all disciplines with respect to site-related design work.

The function of these Union Electric civil-structural engineers was to provide comments and input to the Company's representative on the SNUPPS Technical Committee for consideration by that Committee for incorporation into the standard plant design. Once a design or engineering decision was reached by the SNUPPS Technical Committee, or the Management Committee if necessary, NPI would provide the direction to Bechtel. Various other committees and groups existed within the SNUPPS concept to provide input, to complete reviews and to give direction to the various management decisions which had to be made, including those related to engineering and design.

We reviewed in excess of 125 letters and meeting summaries and 13 specifications related to Union Electric Company's involvement in the civil structural design (References 4.9, 4.10, and 4.13 to 4.23). Generally they indicated involvement, coordination, and responsiveness to regulatory concerns with work conducted in accordance with Union Electric Company's procedures and FSAR commitments.

We found that Union Electric was involved in the review process of the basic civil-structural design criteria after September 1973 when Specification C-0 (Reference 4.10) was issued by Bechtel for the SNUPPS utilities' approval. The Union Electric review was conducted before Union Electric had a formal procedure to govern such reviews since Union Electric Procedure QA-303 (Reference 4.5) was not issued until March 1974. This appeared to be contrary to Criterion III of Appendix B to 10 CFR 50 which requires such procedures. The team's examination of the items noted by Union Electric during the review process and the resolution of comments did not indicate that improper consideration was given during the review to the pertinent safety issues. Therefore there was no apparent impact on the review work performed or actions taken by Union Electric prior to the issuance of QA-303. It was a procedural matter that had been corrected in March 1974 with issuance of the appropriate procedure. (Finding No. 4-1.)

Currently, the NPI staff includes 13 technical personnel (compared with 8 to 9 at the start of the project). They are organized into project functional areas with the civil-structural area being addressed by two systems engineers under the Technical Director. The only civil-structural engineer involved is the Manager of Technical Services. Earlier (1975-1976) one additional civil engineer was involved. This staffing level appears to be consistent with the NPI role of coordinating and consolidating utility efforts since the utilities provide civil-structural engineering expertise for the review process.

The principal means for the utilities and NPI staff to provide input into the design process is by the Technical Committee's actions. The team reviewed the records related to several sample areas of Technical Committee activity in detail, including meeting minutes.

It appears that all parties were aware, at the outset of the project, of the need to define interfaces among the various groups involved in design, engineering, construction and management. In addition, levels of review and categories of comments for design documents produced by Bechtel had been defined. The team reviewed several letters and minutes from early in the project related to the Technical Committee's review of the basic civil and structural design criteria document. We also found that the Technical Committee had been fairly active in the early phases of the project when many of the basic design decisions were being made. The Committee averaged one day per week in session from June 1973 to June 1974. We noted and examined the following items that involved the Technical Committee in the civil-structural area for selected time frames:

1973
1. Bechtel - Sverdrup and Parcel interface
2. Review of Civil-Structural Design Criteria, C-0
3. Plant layout planning

Early 1974
1. Concrete aggregate sources, testing, etc.
2. Reinforcing steel procurement
3. Third level reviews for safety review of selected systems
4. Functioning of the Technical Committee
5. Systems descriptions and SAR consistency and updates
6. Procedures of design review
7. Procedures for bid packages
8. QA requirements on the operation of the Technical Committee

Late 1975
1. Status Report - Bids - Specification C-202; Pipe Hangers and Supports and Miscellaneous Metal
2. Bid recommendation on Specification C-202
3. Development procedure for bidder's lists
4. Civil-structural design review

Early 1976
1. Reactor cavity design
2. Third level reviews
3. Base mat seismic design
4. Bid award for Specification C-202
5. Design reviews

Late 1981
1. Deletion of selected pipe whip restraints

Late 1982
1. Retrofit of specifications and drawing revisions
2. Disposition of field reports
3. Installation tolerances for surface mounted plates
4. Intermediate design change packages
5. Walkdown of piping systems
6. Nonstandardization - Startup Field Reports, Field Change Requests and Nonconformance Reports
7. Hanger status
8. Penetration closures

The team also reviewed a number of items related to efforts of the Construction Review Group to evaluate the consideration of items such as constructability, cost, schedule and sequence. A brief line item summary of the subjects noted and examined for selected time frames is provided below.

<u>1976</u>

1. Comments on Specifications C-101, 103 and 131
2. Schedule and concrete placement in the auxiliary building
3. Field Change Requests - Site interfaces and communications
4. Concrete specification
5. Field Change Requests and Nonconformance Reports and waivers
6. Structural steel bolting
7. Construction details and blockouts
8. Blockout reinforcing steel spacing
9. Resolution of comments on Specification C-103
10. Construction Review Group's recommendation for field run pipe
11. Pipe whip restraints
12. Technical Committee review levels
13. Construction joint at containment-auxiliary building wall intersections.

<u>1977</u>

1. Concrete problems
2. Reinforcing detailing problems/errors
3. Component support boundaries
4. Wall reinforcing steel erection
5. Construction Review Group Charter and Management Committee Action
6. Nonconformance Reports on minor concrete deviations
7. Design drawings vs. American Concrete Institute Standard 318 and resulting conflicts
8. Reinforcing steel placing tolerances
9. Construction Review Group meetings
10. Procedures for Field Change Requests and Construction Variance Requests
11. Reinforcing steel interferences
12. Auxiliary building reinforcing steel

The team did not review the activities of other groups, such as the Management Committee and the Quality Assurance Committee.

Additional inspection was performed of the NPI involvement in the design and engineering effort by selective review of specifications in the civil-structural discipline. This was conducted in the same manner as for Union Electric Company by selecting distinct specifications and the related correspondence. The areas inspected included the documents reviewed at Union Electric. In addition, two other specifications and related correspondence files were reviewed (References 4.17 and 4.18).

It appeared that most of the independent technical input in the civil-structural area had originated with the utilities. The coordination and consolidation function performed by NPI was evident. NPI had set an excellent example from a quality assurance standpoint on items related to the civil-structural design criteria in diligently pressing for resolution of issues.

Based on the information reviewed, it appears that the relevant commitments in FSAR Section 3.8.4 have been correctly translated into specific project design documents such as specifications, drawings and procedures. The basic civil-structural design criteria document (Reference 4.10), which contained the civil-structural design criteria for the facility, is consistent with the commitments contained in the FSAR. This document appears to have been adequately reviewed, controlled and maintained. The individual design subjects and criteria commitments were developed into technical specifications addressing the acquisition of materials, the fabrication of assemblies and the erection of various portions of the civil-structural items. These documents have also been subjected to a review process which was controlled and the documents have been maintained.

Our review indicated that the transmittal of information between the various groups involved in civil-structural design and engineering process was good. Coordination meetings and effective communications contributed to this good level of design interface. Where problems seemed to develop there had been timely recognition of them by engineering and project management through the controls that had been instituted before and during the project. Resources were directed to the problems until a solution was prescribed, implemented and monitored for the desired results.

4.2 Personnel and Guidance

This section describes our review of staffing and guidance information in the civil-structural area.

At Union Electric Company, the supervising civil-structural engineer had 30 years experience in civil engineering with the company and had been working on the Callaway project as a supervising engineer since 1973. The other civil engineer had 8 years experience in civil engineering with the company and had been assigned to the Callaway project since 1976. Both had BS degrees in civil engineering, were registered professional engineers and had received additional company training in quality assurance in connection with their Callaway assignments.

At NPI, the civil engineer that remained on the project had 30 years professional experience, mostly related to nuclear plant design, following receipt of a BS degree in civil engineering. He had also received an MS degree in nuclear engineering and a law degree and was a registered professional engineer. This individual was originally involved with the SNUPPS project as the licensing engineer and was the Manager of Technical Services at the time of our inspection.

The training and experience records for a civil-structural engineer who was employed by NPI from June 1975 to May 1976 could not be located. This was contrary to Criterion XVII of Appendix B to 10 CFR 50, which requires that records shall also include data such as qualifications of personnel. We found no adverse effects on the design from this specific item, which was a record keeping error. (Finding 4-2)

At Bechtel, a cross-section of 6 civil-structural engineers, ranging from junior to senior levels, representing working design engineers as well as supervisors, was selected as being representative of the civil-structural engineers that had worked on the project over time. Their qualifications were summarized as shown on Table 4-1. Additionally, all had received training while at Bechtel, including project related quality assurance training.

TABLE 4-1

BECHTEL PERSONNEL QUALIFICATION SAMPLE

Engineer Number	1	2	3	4	5	6
Function	Designer	Designer	Group Leader	Special Problems	Group Leader	Group Supervisor
Degrees	BSCE	BSCE	BSAE MSCE PhDCE	Technical Institute Graduate	BSCE	BSCE MSCE
Registration	—	EIT	EIT	PE	PE	PE
Years of Experience						
a. Total Professional	1.5	27	5	24	12.5	12
b. Nuclear Plant Construction	—					2
c. Nuclear Plant Design	1.5	8	5	7	8.5	7.5
d. SNUPPS Project	1.5	5	5	6	8.5	6.5

The team reviewed the records of the project related training required by Bechtel procedures for individuals working on various aspects of the project for the civil-structural group. The requirements related to training and indoctrination were addressed in Bechtel Procedure EDP 5.34 (Reference 4.52). The Bechtel project quality engineering group had also implemented supplemental procedures. Basically the group supervisor was responsible for defining which specific procedures were necessary for a given individual to read and understand. A log was maintained identifying the individual records of these required reviews. As new assignments or functions were detailed to individual engineers the group supervisor was responsible for reviewing the individual's training and indoctrination record to ascertain whether the individual must receive training on additional procedures.

For revised procedures the project quality engineer, who was responsible for the procedures, issued a memorandum to project group supervisors noting the substance of the changes. The individual group supervisors then determined how they would pass that information to the individuals within their group.

Our review of the project's execution of training and indoctrination of project procedures and instructions for the civil-structural group indicated that it was consistent with the Bechtel procedures. Interviews and contacts with the various individual engineers in the civil-structural group during the design inspection led us to conclude that the individual engineers generally knew the procedures and followed them.

The results of our review of design details in the civil-structural area are described in the following sections.

4.3 Auxiliary Building and Floor Response Spectra

The objective of this portion of the inspection was to examine the adequacy and coordination of analysis, design, and the resulting floor response spectra for the auxiliary building which housed the auxiliary feedwater system. We also examined the as-built structure.

The auxiliary building was designed with both exterior and interior concrete walls to transfer lateral shear force from seismic loads and steel columns to transfer only vertical loads. The capacities of concrete walls were mostly governed by, and designed for, missiles and were later checked for seismic capability. The team checked a sample of design calculations for the auxiliary building and found them correct and adequately documented. Two engineers who were involved in the design were interviewed and both had a good understanding of the overall design concept of the auxiliary building and were able to relate the construction drawings to design calculations quickly. Based on these spot checks of the design calculations and drawings, and interviews, it appeared that the overall design of the auxiliary building had been properly executed.

Our review of seismic analysis was somewhat hampered because the seismic model of the auxiliary building was a part of an integrated power block structures model which was quite complicated and could not be fully evaluated within the time frame of our inspection. Nevertheless, it appeared to us that the geometry of the auxiliary building had been properly represented in the mathematical model.

Some problems were found in the dissemination and coordination of updated floor response spectra.

We found that seismic analysis calculations on the auxiliary building had been given final approval by the civil group supervisor in March 1982, but had not been sent for microfilming at the time of our inspection in December 1982. This violated Bechtel procedure EDPI 4.37-01, Section 4.2, which required that all calculations completed or revised during the month be submitted for microfilming by the 15th day of the following month (Reference 4.39). This was a procedural matter that had no apparent effect on the design. (Finding No. 4-3)

Floor response spectra are not only used as design loads for civil structures, but also are used as basic input loads for other engineering disciplines, such as piping, mechanical, and electrical equipment. Bechtel had calculated revised floor response spectra using actual as-built conditions for the auxiliary building. Some of the revised spectra exceeded the original spectra that had been used in design, by significant amounts in some cases. The calculations had been completed and checked in August 1981. During our inspection, in December 1982, the effects of these revised spectra had not yet been accounted for in the design. Revised spectra had not yet been sent to the other discipline groups, such as mechanical and electrical, to evaluate the effects of the greater seismic loads upon systems and components.

It was appropriate, in these circumstances, for the Civil-Structural Group to examine means by which the spectra might be reduced before providing the revised seismic inputs to other groups in order to minimize the impact. Judging from the amount of exceedance, however, it appeared that some revised floor response spectra would have to be sent to other groups eventually. The team was concerned about the amount of time taken to achieve a resolution of this matter. The time scale of 16 months without yet achieving a final resolution did not appear consistent with efficient design and project management needs.

A memorandum in May 1982 (Reference 4.127) indicated that the Civil Group had discussed the situation to some degree with other groups. However, the matter had not yet been resolved and new spectra had not been entered in the central file system which was the controlled system for obtaining current response spectra. Our interviews indicated that personnel in other groups were not generally aware of the item. Accordingly, the delay introduced ~ likelihood that someone might base new work on the older spectra ar such work might eventually have to be corrected or justified when the matter was resolved. However, the concern in this regard was not a finding or an open item. No adverse effect on the final design was expected because the issue was recognized, was being worked on and would not have been overlooked.

Accordingly, this delay in dissemination of design input information is mentioned as an area recommended for licensee consideration with respect to efficiency and project management needs. (Observation No. 4-1)

The team examined essential shear walls that transferred lateral loads in the plant. The walls were constructed consistent with the drawings which themselves reflected the design conditions and no voids or significant cracks were found.

The team identified a questionable assumption concerning typical electrical raceway supports in the electrical penetration room and the lower cable spreading room. A typical support consisted of a vertical square structural steel tube section connected (at the floor) to a base plate by two welded angles on opposite sides of the tube. Both the angles and the welds were designed for horizontal shear forces but not for bending moments because the baseplate attachment was assumed to act as a hinge in the mathematical model. This assumption corresponded to a normal civil-structural design practice for a typical hinged connection between a beam and a column. However, in this installation the tube was butted against the baseplate in contrast to the normal practice of providing a gap to allow rotation between the beam and column. Thus the installation had a degree of fixity and would attract some moment under seismic loading rather than acting purely as a hinge. Accordingly, the welds and angles should be evaluated in terms of the actual fixity of the attachment to determine whether or not adequate strength exists. (Unresolved Item No. 4-1).

4.4 Generic Embedded Plate Program

The objective of this portion of the inspection was to review samples of specific design calculations and engineering work concerning embedded plates to ascertain whether or not:

1. design commitments were being met,
2. design controls were effective, and
3. proper information flow and interfacing were evident.

A major discipline interface occurred in the design of the SNUPPS plants generally in the area of the boundaries between structural support plates and supported elements. The defined interfaces which occurred on this project were between the Civil-Structural Group and Plant Design Group (mechanical items), between the Civil-Structural Group and the Electrical Group and between the Civil-Structural Group and the Instrumentation and Control Group. This section of the report represents the review of a sample of the interfacing between two distinct design disciplines. Specifically the review of the generic embedded plate program instituted by Bechtel for this project is discussed. Specific use of the methodology and details for a given support are addressed in Section 4.5.

FSAR Section 3.8.4.6.4 defines relevant general commitments for embedded base plates. Loads and load combinations were defined in Section 3.8.4.3 and the design and analysis procedures were defined in Section 3.2.4.4 as conventional analytical methods of standard engineering practice and computer methods as defined in Appendix 3.8A. The basic materials were identified in Section 3.8.4.6.4 as well as erection, examination and quality control aspects. The design commitments provided in the FSAR were properly reflected in Bechtel Specifications C-0, C-121 and C-131 (References 4.10, 4.17 and 4.18). Drawings allowed the use of surface mounted plates or chipped and grouted embed plates instead of embedded plates placed prior to the casting of the concrete elements. Owner approval was required to exercise these options. Details of the options were provided on approved drawings. Use of the substitution was to be documented and traceability of the plate and bolt materials maintained. Other variations to these had also been developed which consisted of through bolting for plates as well as grouted bolts. These alternates had also been detailed on approved drawings. The need for alternates to embedded plates arose from several reasons: (1) development of locations and/or loads for specific plates lagged concrete placement, and (2) changes made from the original design.

Further commitments for base plate design and engineering had been made in the SNUPPS reply to an NRC Bulletin 79-02 (Reference 4.110). It was noted that the design efforts and programs in this area had been well underway before the bulletin had been issued.

Analyses for the embedded plates were completed using the computer programs ANSYS and BSAP as described in FSAR Sections 3.8.A.1.9 and 3.8.A.1.10 and Appendix 3.8.A. The models used to consider the various embedded plate configurations included the flexibility of the plate, the flexibility of the anchorage device (tension) and the concrete (compression), and the loading interactions as well as the geometrical parameters. Based on the analyses, a series of design aids in the form of nomographs had been developed for use on the project to allow sizing or checking of a specific plate assembly for a given set of conditions. If multi-directional loading was involved, it was necessary to utilize one of a series of interaction formulas which were also analytically developed for use on the project along with empirically derived constants. The use of these design aids also considered construction tolerances by performing analyses for the worst location of the attachment within the middle third of the plate. The definition of the middle third used in the analytical work had been reflected in the design documents in several cases. If the geometry and conditions were not such that the attachment could be made within the middle third then the constructor filed a middle third deviation report which must be resolved by Bechtel. This disposition required an engineering review and determination of acceptability based on the specific geometry and loading for that case. The controls for dimensions of such items as attachments, bolt holes and edge distance surface mounted plates were provided as notes on approved drawings. The control of those attachments outside the middle third was also addressed in Bechtel Procedure EDPI 4.62-01 (Reference 4.47). We reviewed Revision 13 to this procedure with respect to Middle Third Deviation Notices and found it to be consistent with the design assumptions and that it had been used correctly.

We conducted specific checks of several individual calculational packages which formed the basis of the design aids for embedded plates. They were:

1. Calculation 03-53.4-F, "Capacities of Embedded Plate Type EP912A" (Reference 4.54)

2. Calculation 03-107-F, "Formulation of Load Capacity Coefficients of Embedded and Replacement Plates" (Reference 4.55)

3. Calculation 03-109-F, "Load Nomographs for Embedded and Replacement Plates" (Reference 4.56)

We reviewed these calculations to verify that the assumptions, boundary conditions and input data and analyses were correct. The model used in the computer based analysis for Plate Type EP 512A reflected the geometry and material properties for the actual structure and input data appeared to be properly and accurately prepared.

Several of the Bechtel procedures were reviewed in part during this effort since they directly provided controls and guidance for the design process in this area. They were:

1. EDPI 4.25-01, Design Interface Control (Reference 4.36)
2. EDPI 4.37-01, Design Calculations (Reference 4.39)
3. EDPI 4.46-01, Project Engineering Drawings (Reference 4.41)

The project procedure on design interface control (EDPI 4.25-01, Section 4.0) appeared somewhat general. The requirements for defining interfaces are contained in Regulatory Guide 1.64 (Reference 4.126) and ANSI N45.2.11 (Reference 4.125) to which the licensee had committed in FSAR Section 17.1.2. The procedure addressed interfaces among Project Engineering, Project Construction, speciality groups and other Bechtel divisions and companies. However, there was no precise definition or prescribed procedure for design interface between subunits within the project such as the Stress Analysis Group and the Civil Group. Subunit interfaces were addressed by the following statement: "The interface responsibilities are well understood through existing organizational agreements and established practice."

These agreements and practices varied in formality, precision and the degree of personnel awareness. For the most part, our reviews indicated that interfaces among discipline groups were understood. However, the following items are examples of problems:

1. Zone of influence drawings not being prepared, contrary to the memorandum that defined interfaces and responsibilities for high energy line break analyses (Finding 2-4 in Section 2.4)
2. Failure of discipline groups to exchange information or take action needed to meet pipe support stiffness requirements (Finding 3-8 and Unresolved Items 3-3 and 3-6 in Section 3.2.3)
3. Failure of a standard support location tolerance provided by the Stress Analysis Group to reflect the Civil Group's needs regarding load path (Unresolved Item 4.2 in Section 4.5)

Accordingly, in our judgment, the general statement (in EDPI 4.25-01) that subunit interfaces were well understood through existing agreements and established practices was not uniformly borne out in practice. We conclude that this is contrary to the licensing commitments discussed above. The licensee should employ more formal and precise methods or training to enhance the effectiveness of subunit interface control. (Finding No. 4-4)

As discussed above, a weakness was identified in the definition of internal interface controls. This finding and the associated examples applied to the project in general. However, as discussed in this and other sections, for the most part our reviews indicated that internal interfaces were understood.

With respect to embedded plates, based on our review and interviews, we concluded that adequate procedures generally existed to control the transmittal of design related information. Calculations we reviewed in this area reflected correct input and were current with other design documents being utilized for design and construction. The designs and analyses had been conducted in accordance with the appropriate procedures. Assumptions were judged to be valid.

4.5 Pipe Supports, Hangers and Restraints

The objective of this portion of the inspection was to determine, for a sample of hangers, piping supports and restraints selected by our inspection team's mechanical systems, components, and piping engineers, whether or not:

1. the licensee's design commitments contained in the FSAR and other relevant documents had been met,

2. correct design information had been coordinated and complete interfaces made through a rational design process,

3. design engineers had sufficient training experience and guidance to complete the necessary design work, and

4. the completed design was adequate.

Pipe Hanger 0-AL04-C009/135(Q) supporting the turbine driven auxiliary feedwater pump discharge pipe, was designed by the pipe support group It consisted of a double sway strut vee assembly hung from the bottom flange of a structural steel beam which formed part of the structural building frame supporting a concrete slab floor. The attachment of this hanger assembly to the flange was through field welds. The team found no discrepancies related to this hanger. The review is described below to illustrate the nature of the coordination necessary in such designs.

A review of documents indicated that Revision 4 of the hanger drawing M-06AL04 (Reference 4.97) had been coordinated with the Civil Group as a markup working print prior to issuance by the Pipe Support Group. The markup contained the location of the needed welded attachments to the structural steel as well as the revised forces and displacements at the centerline of the pipe. Also included was information clearly defining the orientation of the pipe forces and displacements. The coordinated markup also contained a reference to the correct and current civil drawing associated with the structural steel framing to which the hanger was attached.

Action by the Civil Group was documented only on the markup work print which carried a civil coordination stamp with the date and initials of the individual reviewing for the Civil Group noted. Discussion within the Civil Group regarding their normal actions on such an item indicated that a check would be made that there was in fact a structural steel beam at the location defined in the drawing. Bechtel procedure EDPI 4.46-01 (Reference 4.41) generally described the coordination, review and approval process. The requirements for documentation are contained in ANSI N45.2.11 (Reference 4.125) to which the licensee committed in FSAR Section 17.1.2. From discussions with personnel in both the Civil and Pipe Support Groups it appeared that the process defined in the Bechtel procedure had been followed. The procedure required no records related to internal coordination of drawings and comments thereon once the drawing had been approved and released by the project engineer. Coordinating prints could be destroyed, although they were generally being saved by the originating group for those instances examined by the team. Without the Pipe Support Group saving the marked up working print, the Civil Group has no record of the actions on base plate selection. This item is noted as an area recommended for licensee consideration. (Observation No. 4-2)

The resolution of the above item may be related to Finding No. 4-6.

The question of the load's effect on the structural steel in this case did not require unique consideration since the maximum pipe force was 3.1 kips and the pipe loads were not in an area with heavy piping concentrations. The civil-structural design criteria, specifically address the manner in which piping dead loads are to be treated as follows:

"For permanently attached small equipment, piping, conduits, and cable trays, a minimum of 50 psf shall be added where appropriate. In the event structural design must precede the availability of piping loads, a concentrated load of 20 kips shall be applied in the above areas or in other areas of concentrated piping (in lieu of the actual piping loads) to maximize moments and shears."

The structural loads resulting from pipe reactions during normal operating or shutdown conditions, based on the most critical transient or steady state conditons, were addressed in the civil-structural design criteria and were consistent with the FSAR. In this case no specific values for live load were defined with the apparent assumption that the prescribed dead load values were sufficient for design. Based on inspection of the actual pipe loads provided by the Pipe Support Group to the Civil Group we determined that the loads represented a conservative combination of all piping loads at the support point, including dead load, normal operating pipe reactions and seismic loads. Since the loading combination elements in each of the combinations which must be considered had identical load factors in all cases, it was in fact not necessary to specifically separate the two load effects.

For this instance, the prescribed allowance for a 50 psf uniform dead load and the 20 kip concentrated load application was considered by the designer to be sufficient to encompass the imposed loads from the hanger. Based on the dates of erection of structural steel in this area and the date of Rev. 0 of this specific hanger drawing no specific loads would have been available at the time of the basic structural steel design.

Based on the above facts we concluded that the correct design information had been transferred from the Pipe Support Group to the Civil Group and that appropriate action had been taken by the Civil Group. The design commitments in the FSAR had been correctly transferred into the civil-structural design criteria document. Considering the loads used in design of the basic structural steel framing and the magnitude of the actual loads for this hanger and observation that no other significant loads were currently supported by the beam we concluded that the civil structural design was adequate for the hanger assembly. It should also be noted that additional margins besides that resulting from the magnitude of the load existed since all loads were considered for resistance capacity at allowable stress levels whereas the criteria would allow for increased stresses of 50 and 60 percent under the working stress methods for certain load combinations.

Other hangers, supports and restraints were examined during the inspection based on the selections made by the mechanical engineers from the inspection team. This group of piping support hardware (along with hanger 1-AL01-C009/135Q discussed at the beginning of this section) included interfaces and design input to the Civil Group for standard pipe struts, spring hangers, support frames, stanchion type anchors and isolation restraints. Some were supported by structural steel building frames and others by embedded plates in concrete walls. Two pieces of pipe support hardware designed by the Civil Group were also included among these. The following is a list of the other support hardware and related interfaces examined during the inspection.

Hangers 0-AL01-H001/135Q and 0-AL01-R005/135Q represented a combination spring hanger and support frame with the hanger suspended from the frame. This combination supported the turbine driven auxiliary feedwater pump suction piping. The support was found by field inspection to have been installed outside the middle third of the embedded plate and therefore was required to be checked. No middle third deviation notice (MTDN) had been prepared for this as-built condition. However, the licensee's representatives indicated final acceptance had not been completed for this assembly. Based on our field measurements the Bechtel Civil Group in Gaithersburg performed an evaluation for the as-built conditions utilizing the project's interaction equations and found more than adequate margin with respect to allowable stress levels for the support plates.

Hanger 0-FB01-A002/135Q represented a stanchion type pipe anchor designed to be welded to a pair of embedded plates and to resist pipe collapse loads. It was located on the steam supply piping from the auxiliary boiler to the turbine for the turbine driven auxiliary feedwater pump. Based on early criteria set for this project, a load greater than 15 kips placed the anchor design responsibility with the Civil Group. We found that loadings had been revised on 10/14/81. Because of this change the issued drawing, M-06FB01 (Reference 4.108), was undergoing a change to reflect the new loads. At the time of the inspection the Civil Group had completed the design of the necessary additional increases in the stanchion's cross-section based on calculations (Reference 4.59) approved on 9/29/82. The drawing had been revised but had not yet been processed and issued.

Our field inspection indicated that the load transfer path used in the design calculations did not reflect actual conditions (References 4.59 and 4.108). The stanchion had been mislocated by about 4 inches. Since the piping design group allowed a 6 inch tolerance for this situation, the licensee's representatives at the site indicated that they would consider the installation satisfactory. However, in this case, such a tolerance was not consistent with the design load path that had been used by the Civil Group for design. The design calculations had assumed that the stanchion would be centered over and connected to two embedded plates which would share the load. The 4 inch mislocation had placed the stanchion on one plate only. In our judgment this condition would likely not have been detected in subsequent system walkdowns. This specific condition, however, turned out to be adequate. During our inspection, Bechtel personnel revised the calculations for this design to address the as-built condition and found adequate load carrying capacity in the single plate (Reference 4.59). However, in the team's judgment, further evaluation should be conducted to determine whether or not there are other similar instances where the standard Hanger Group tolerance does not match the Civil Group's load path. (Unresolved Item No. 4-2).

Hanger 0-AL03-C010/135Q and 0-AL03-C011/135Q were two of five identical support frames designed by the Pipe Support Group which were field welded to embedded plates, Type EP 912B, provided by the Civil Group. They support the discharge piping from the motor driven auxiliary feedwater pump (Pump B). The worst case selected for the support frame design was based on Hanger 0-AL02-C009/135Q.

Interfacing between groups in design indicated good information flow. The team checked loads, selected by the Pipe Support Group as representing the worst case for the supports, against the embedded plate design. We utilized the interaction curves (Reference 4.56) to check the adequacy of the plates which had been selected and found them to have substantial margin.

Isolation restraint FC02 consisted of a series of plane frames which geometrically formed a space frame whose purpose was to serve as eight pairs of restraints at a tee pipe intersection on the steam supply line to the auxiliary feedwater pump turbine. This structure was designed by the Civil Group with interaction between the Civil Group and the Pipe Support Group for loads and stiffnesses. The design calculations for this restraint (Reference 4.58) had been performed and checked in November 1982, but were still undergoing review for approval. The detail drawing had been used for fabrication in January 1982 as Revision 0 (Reference 4.93) and was issued for construction in November 1982 as Revison 2 (Reference 4.93) before the calculations discussed above were performed. We questioned what design calculations had existed in order for the drawing to have been released for fabrication or construction. A set of calculations that had not gained final approval had existed in the group. They had been overtaken by field conditions in the form of interferences. These field problems had been detailed in drawing change notices which were subsequently considered when the final calculation was made. These actions were contrary to Bechtel procedures EDPI 4.37-01 and EDPI 4.46-01 (References 4.39 and 4.41) which required approved calculations prior to release of drawings for construction. This item did not have any apparent adverse effect on the final design product. It is one of two examples of release of design information prior to approval of calculations. Finding 6-4 provides a discussion of the other example. (Finding No. 4-5)

We did not review the calculation package of 54 sheets in detail. We noted that interfacing information between the Civil and the Pipe Support/Pipe Stress Groups did occur and the calculation package appeared to contain the neccesary information.

Support 2-AL01-A002/125Q was a stanchion type anchor for which a field change request had been prepared because of a 2" differential between the design height and the as-built condition. The initial request was processed through the Pipe Support Group and then coordinated with the Civil Group which evaluated the embedded plate design (EP 912B) and elected to add stiffness to the plate-stanchion connection. The team requested a check of the original plate's selection as no documentation was maintained for each individual plate selection. Based on this current evaluation it was concluded by Bechtel that, although an initial check indicated over-stressing, further analysis demonstrated the plate as originally detailed would have been adequate. It was assumed that when an engineer evaluated the information on the Field Change Request he stopped with the initial check and elected to added the stiffeners. Based on the current evaluation the anchor is adequate for the design loads.

We found that, in general, no specific design calculations existed for embedded plates to document the basis for their selection and placement on design drawings designating the type of plate for use at a given location. In some cases the selection of a specific plate could be completed by the use of one of a series of nomographs but in many cases the selection was based on the results of calculations using the appropriate interaction equation. The lack of documented analyses for each specific plate was contrary to EDPI 4.37-01 (Reference 4.39) which required that design calculations be made to provide the basis of drawings used to construct the facility. However, the team was still able to conclude that a controlled process for these selections had been in effect. (Finding No. 4-6)

In summary, there existed excellent evidence of the interface action between the plant design groups (Stress Analysis Group and Pipe Support Group) and the Civil Group on the examples reviewed. There appeared to be good coordination of the necessary information from one group to another. Examples of the analysis completed by one group being translated into input for the other group existed.

While it was possible to check the selection of a specific type of embedded plate in accordance with the standard techniques, documentation did not exist to ascertain how the actual selection had been made. Nevertheless, in our opinion, based on the sample examined and discussions with the personnel involved, there was a consistent process for designing supports and restraints in the Civil Group including the embedded plates. Only one instance was identified where there was a question of why the original designer had selected a particular type of plate. The original selection was apparently a judgment call, as it was unlikely that the refined analysis which was performed during our inspection was in fact performed originally to support the selection. However, the more refined analysis did support the original design, validating the judgment been made by the original designer.

Overall, there was evidence that when an interface problem was identified, management had taken corrective action and the inspector was able to see how the coordination process had improved although the written procedures might not in every case reflect the actual functioning process as a requirement.

4.6 Control of FSAR and Design Changes

The objective of this portion of the inspection was to examine whether licensing commitments were being met and maintained as changes and deficiencies arose as well as to evaluate the flow of information and the design control process. The team reviewed a sample of procedures to evaluate their adequacy, coverage of the design process and implementation. The procedures reviewed were:

EDPI 4.22-01, Preparation and Control of SAR (Reference 4.34)

EDPI 4.23-01, SAR Change Control (Reference 4.35)

EDPI 4.47-01, Drawing Change Notice (DCN) (Reference 4.42)

EDPI 4.60, Processing Corrective Action Reports (CAR) (Reference 4.45)

EDPI 4.61-01, Nonconformance Reports (NCR) (Reference 4.46)

EDPI 4.62-01, Field Change Request, Construction Variance Request and Middle Third Deviation Notice (FCR, CVR, MTDN) (Reference 4.47)

EDPI 4.65-01, Design Deficiency Processing (Reference 4.48)

No items within this group of procedures were identified as being questionable nor were any specific omissions of necessary procedural controls identified. The similarity of the flow path for information and actions in the NCR, FCR and MTDN process presented a decided advantage in that each type of tracking control did not require that different actions be taken on the part of project individuals. In the cases where the Bechtel Site Liaison Group had authority for preliminary disposition under certain defined conditions, all such actions were reviewed by the Gaithersburg Office before becoming final. During the conduct of this inspection the use of these procedures by design and engineering personnel was observed as well as the results of using the procedures. Several specific examples some of which directly related to the civil-structural engineering aspects are provided below.

We reviewed Drawing C-0003 (Reference 4.60) and DCN's which had been issued against it. This specific drawing contained many important references and notes since it contained most of the structural steel and concrete related general notes for the project. DCN No. C-0003(Q)-8-5 (Reference 4.111) was reviewed to see if EDPI 4.47-01 had been followed. We found the DCN form had been properly completed. During our inspection four DCN's dating from 8/23/82 to 11/8/82 were reviewed. (References 4.112 to 4.115) We found no deficiencies related to meeting commitments or controlling the design process relative to DCN's.

During inspection activities at the Callaway site several FCR's (References 4.116 to 4.119) were selected from the FCR log which was maintained within the Bechtel site liaison engineer's organization. Four FCR's were reviewed to ascertain what types of changes were being requested by the constructor, the reason for the changes and the disposition of the requests. Action was taken on the FCR's during the last half of October 1982 and the first half of November 1982. Three of the four involved missing or interferring embedded plates for supporting electrical or mechanical items and the fourth involved interferences and tolerance problems on elastic shock absorption material and pipe supports. Three of the four cases had been initially resolved by the Bechtel Site Liaison Group. We noted that in all three cases of disposition in the field by Bechtel site liaison engineering, the FCR contained a notation of persons in project engineering at Bechtel Gaithersburg who had discussed the item in coordination with the field liaison effort and the date this had occurred. This appeared to be an excellent way of documenting the coordination effort regarding the consultation between the field and project engineering at Bechtel Gaithersburg although the procedures did not require it. The completed FCR would then be routed to the Gaithersburg Office for review and final approval as required by procedures.

During the team inspection at the site it was noted that the exterior wall penetration at Elevation 1991'-0" in the auxiliary building for the suction line to the auxiliary feedwater pumps from the condensate storage tank was not as detailed on Drawings C-0C1931, C-0029, and C-0019, (References 4.89, 4.69 and 4.67). No information such as an FCR or DCN apparently addressed this change. The licensee should address the acceptability of the actual installation. (Unresolved Item No. 4-3)

During the team's inspection at the site on 11/11/82 it was noted that a number of voids and surface defects existed in certain areas of the walls of Area #5 of the auxiliary building between elevations 2000' and 2026'. Some of these defects were significant enough to require engineering approval of the repair methods. Upon the team's return to the Callaway site during the period 12/6/82 - 12/8/82, it was found that repairs had been made in most of these areas.

Certain portions of these defects were tracked to an NCR (Reference 4.120), which was originated on 7/27/82 on concrete repairs in seven rooms. Concrete was placed in this area in the 1977-1978 time frame with one of the specific placements involved being made on 7/12/77. The cause noted on the NCR and the action to prevent recurrence states: "Craft error; Construction notified of this NCR, No further Daniel action necessary." It was noted within the descriptive text of the NCR that the "voids/honeycombs, after chipping, require prior approval per Bechtel Specification C-103, Section 15.2 before repairing." Other observed defects were repairable without approval. Daniel's proposed corrective action was to use non-shrink grout, stating that it should satisfy design requirements. However, several of the defects Daniel had identified as requiring repair were required under Section 15.3.2.b.4 to be repaired using replacement concrete. Because of the timing of the repair, Daniel had proposed using non-shrink grout, citing economic considerations and physical location. Bechtel subsequently approved the use of non-shrink grout. The best repair method in the opinion of the team was replacement concrete, but the grouted repair was determined to be acceptable. This is an instance in which the engineering personnel were not promptly made aware of the field construction problem so that the best solution could be obtained. Nevertheless, the team considered the approved repair methods adequate.

Opinion not fact — not enough basis is established to support these findings

The Bechtel specification C-103 states that "imperfections in formed concrete requiring repair shall be repaired as soon as practicable after removal of forms and shall be completed without delay, except in cases where approval is required." Concrete in Placement 2C135W01 was made on 7/12/77 and the deficiencies noted by an NCR on 7/27/82. This appeared to be contrary to the specification. (Finding No. 4-7)

Procedure in effect then or now?

The delay in initiating the NCR meant that the information was not available in a timely manner for trending and analyses conducted by the construction quality group. Resolution of the above finding should address the significance and extent of such delays as well as whether the proper quality control measures were in place during the concrete placement in this particular area (area 5 of the Auxiliary Building).

what is the basis for this?

In addition to the previously mentioned NCR, four other NCR's (References 4.121 to 4.124) were reviewed based on a selection of examples from the NCR log maintained by the Bechtel Site Liaison Group. All were generated in the last half of 1982. One involved a pipe whip restraint member being located out of tolerance and three related to damaged reinforcing steel as a result of coring or drilling in reinforced concrete walls. All four of these cases were resolved by the Bechtel site liaison engineering group in coordination with the project engineering office of Bechtel in Gaithersburg. The personnel involved in the coordination and the date of the contact were noted on the NCR. The team's review of the resolution of these items and of the controls in effect resulted in no concerns.

The procedure controlling the disposition of MTDN's (middle third deviation notices) which is contained in Section 5.0 of EDPI 4.62-01 (Reference 4.47) was reviewed. We determined the controls to be adequate. As a result of the large number of MTDN's to be processed, the Bechtel site liaison engineering

The pt. is whether or not the defective areas are identified and repaired. Not all the rest of this.

group forwards all of them to Bechtel project engineering in Gaithersburg for review. The team's observation and review of this effort by the Civil-Structural Group in Gaithersburg is included in Section 4.5.

In summary, the single finding in this area concerned failure to document a construction deficiency rather than weakness in the process for controlling design documents. Based on the review of documents, interviews and observations the team concluded that the design commitments were being met and there was adequate control over the design process.

4.7 Bechtel Site Liaison Engineering

The objective of this portion of the inspection was to review the involvement by the Bechtel Site Liaison Engineering Group for the civil-structural discipline in the design process as related to:

1. the interface between the Site Liaison Group and the constructor,
2. the actions taken by the Site Liaison Group, and
3. the interface with the Civil-Structural Group in project engineering in Gaithersburg.

The entire Site Liaison Group was under the direction of the lead site liaison engineer and the four engineers reported to the civil-structural leader. This group was one of the five discipline groups that make up the site liaison engineering. The groups were organized by discipline and function parallel to the project engineering activities in the Gaithersburg office. The team noted that nearly all of the civil-structural personnel had design experience in the project engineering design functions on the SNUPPS project or others, so that they had a good working knowledge of the design process and the general considerations made for a particular item with respect to assumptions, simplifications, analysis, design, fabrication and construction.

The following are the principal tasks of the Site Liaison Group:

1. Maintain field engineering log for all NCR's, FCR's and MTDN's.
2. Review submittals from the constructor to determine if disposition can be made in the field or must be forwarded to project engineering. Guidelines of what can be dispositioned in the field are provided in the governing procedure/instruction.
3. Disposition those items meeting the criteria for field disposition and indicate any drawings needing revision.
4. Forward completed items to the constructor and distribute copies to groups such as project engineering.

The team concluded, on the basis of field observations, that the Site Liaison Group in the civil-structural discipline was performing in accordance with the procedures and that the procedures were adequate to control the group's efforts.

4.8 As-Built Programs for Reinforced Concrete and Structural Steel

The objective of this portion of the inspection was to ascertain:

1. How the final loads resulting from the location of and addition of pipe supports, electrical cable trays and ventilating systems not specifically considered in the original design were checked, and

2. How the deficiencies found to be acceptable on an individual basis by engineering would be integrated into an overall as-built review to assess the acceptability of the as-built structures in the civil-structural discipline.

The Civil-Structural Group for the project had prepared two documents, known as civil design guidelines, for the purpose of reviewing and assessing final as-built structural adequacy. CDG-1 addressed the structural steel framing system (Reference 4.11) and CDG-2 addressed the reinforced concrete structural elements (Reference 4.12). At the time of the inspection the concrete program had not started and the structural steel program was just beginning.

For those steel structures or portions of structures which were framed with structural steel the guidelines prescribed that a sample of 60 beam-type elements in each of the five powerblock structures would be randomly selected for review and evaluation. Several levels of analysis would be conducted if warranted on each beam element reviewed. The first level analysis made very conservative assumptions and provided a simple check procedure. If a particular beam element using this approach was found to be over-stressed then a more refined set of assumptions was used. If overstressing remained, there were provisions for physical modifications to the beam element. This could result in such actions as adding cover plates or stiffeners. Provisions in the procedures addressed non-composite and composite design and considered moments and forces in three directions. The team noted that, if either of the first two level of reviews resulted in acceptance, significant margins would exist in the design.

We recommend that consideration be given to selecting the sample on some basis other than randomly and that more than the scale model, or composite drawings for unmodeled areas, should be used to identify the additional loading points. After the above have been studied and a tentative selection of the sample made, a field walkdown should be performed to ascertain whether other elements are more heavily loaded or loaded in a manner not considered. We would also recommend that during a field walkdown all structural steel columns should be checked to verify that no loadings from attachments introduce moments into the columns as the columns were designed on the basis of only vertical loads. These recommendations are neither findings nor unresolved items but recommendations for licensee consideration as the program is implemented. (Observation No. 4-3)

For the reinforced concrete structures or portions of structures the elements would be reviewed by reviewing each fabrication drawing and calculations made on a "worst case" basis to address the effects of cut reinforcing steel. The elements would also be reviewed for the effects of load concentrations from closely spaced pipe supports, cable tray and duct supports. This guideline was in the development process and was released as Rev. 0 during our inspection. Our review of the draft, which was undergoing internal Bechtel technical review, resulted in a significant comment regarding the load combinations which would be considered in the as-built worst case studies. As the Bechtel review evolved and the document was revised and issued it was apparent that the internal Bechtel review had identified the same item. The guidelines were revised to reflect the loads and loading combinations specified in the FSAR and the civil-structural design criteria for the project.

A control system had been set up so that each piece of reinforcing steel cut in the field during coring of concrete for penetrations or drilling of concrete for anchor bolts would be documented. This information was transferred to the specific fabrication drawing which detailed the location and the cut reinforcing. These as-built drawings were being assembled by the Civil-Structural Group as they were transferred in from the field in preparation for the as-built review.

The review would use these marked up detail drawings, the original calculations and the analyses for the various defined "worst case" situations until all cut reinforcing steel had been checked for its particular effect on the structure as well as cummulative effects of other cut reinforcing or additional loads. The guidelines allowed for the use of simplifying assumptions when a very conservative analysis was made. Other more refined analyses could be performed when the overly conservative analyses indicated the criteria were exceeded. We had no specific comments on the guidelines which reflected a good method of assessing the as-built conditions of loading and reinforcing steel.

The effort on the part of Bechtel to analyze for as-built conditions reflected a good program for assuring that reported field conditions which modified loading and load resistance parts were studied for their individual and cummulative effects. We noted that this program can be no better in addressing as-built conditions than the field input data. Efforts by Region III NRC inspectors had previously identified problems in the field with the accuracy of the field data regarding cut reinforcing steel. We would recommend that care be taken in conducting this program to assure that the field data have been made accurate. This is neither a finding nor an unresolved item from our inspection but a recommendation for licensee consideration. The appropriate findings have been made previously in an NRC Region III inspection report, Report No. 50-483/82-09. (Observation No. 4-4)

4.9 Conclusion

Based on the results of this integrated design inspection relative to selected portions of the auxiliary feedwater system and other features reviewed in the civil-structural discipline, we concluded that the design and engineering aspects were controlled and the design function was being completed in conformance with the commitments of the FSAR. Areas for improvement have been identified as well as some findings but, as discussed in the preceeding sections, an evaluation of the design and engineering process for the sample areas we reviewed in the civil-structural area indicates that the project is under control from the standpoint of design and engineering.

It is our opinion that for the numbers of personnel involved in this project in the civil-structural area for Union Electric and NPI, the control of the design and engineering effort by Bechtel has been effective. This appears to have been possible because of the good capability and execution by the Bechtel Civil-Structural Group assembled for the SNUPPS project. In this regard, it appeared that the SNUPPS concept, which integrated the staffs of several utilities into the review and control process of criteria and design documents, played an important role.

5.0 Electrical Power

The objectives of this portion of the inspection were to evaluate the electrical power portion of the design with respect to standards, guides, criteria, assumptions and calculational methods with emphasis on the handling and control of interface information. Usually, the electrical power aspects of the design did not consist of separate work packages for the auxiliary feedwater system. For instance, the voltage drop calculations dealing with the station distribution systems include the auxiliary feedwater system as well as other systems. Accordingly, the team's review included a range of design features, technical issues and information systems that often related to other plant systems.

5.1 Auxiliary Feedwater Components

The objective of this portion of the inspection was to determine the adequacy and consistency of basic design documents.

The team reviewed the auxiliary feedwater system description, the motor driven pump circuit breaker, the motor driven pump and valve logic, the motor driven pump discharge valve operator schematic, and pump motive power and cable routing. The recently revised system description was an accurate source of guidelines for the system design. The logic diagram prepared by the Control Systems Group for the motor driven pump operation was found to be correctly transferred into the circuit breaker schematic diagram by the Electrical Group. The team checked the control and motive power to the redundant motor driven pumps and the turbine control system for the turbine driven pump and the design was found to follow appropriate criteria for separation, adequacy and redundancy. In general, we found this area to be in good order with reference to criteria, standards and information interfaces.

5.2 Class 1E Motor Control Centers

The team reviewed the design files for a typical Motor Control Center (MCC). The objectives of this review were to:

1. Evaluate how equipment electrical data was transmitted to and used by the electrical group, and
2. Evaluate the design calculations and selection and application of MCC components

MCC load data were transmitted between engineering disciplines in the manner prescribed by Bechtel Procedure EDPI 5.16-01 (Reference 5.58). Electrical loads for assignment to the motor control centers were obtained from review of the supplier's electrical equipment data sheets and entered into a computerized data base. A software routine prepared by the Electrical Group used the information stored in the data base to generate a load summary for each MCC. Inspection of the load summary printout allowed monitoring of the loading as a function of bus capacity. The software usage procedures were documented in a users manual. It thus appeared that the MCC loads were being monitored in an adequate manner.

In accordance with the SNUPPS electrical design criteria the MCCs generally had the following ings: 480V, 600A, 25,000 A RMS symmetrical short circuit current brac . The configurations used standard factory components. In each motor starter cubicle power was fed from the bus work to a molded case circuit breaker, then to a motor starter and then to the motor branch circuit. Where circuits entered the containment structure, current limiting fuses were to be applied in order to meet the NRC staff's Regulatory guidance for additional protection of the penetration assemblies.

The interrupting ratings of a typical molded case branch circuit breaker were 14,000 A RMS symmetrical. The vendor (Gould) had provided Bechtel with a copy of a form letter from one of its subsidiaries (Rowan Controls) which summarized the results of a short circuit test conducted on a MCC of similar configuration to the SNUPPS design and indicated a maximum let through current for the circuit breaker duty to be approximately 10,000 A. We had no further questions about the breaker application.

We found that the capability of motor controllers to withstand fault currents had not been addressed or assured in the design process. The best information available during our inspection was from the Gould environmental qualification report which indicated that the controllers could withstand 5000 A fault currents with a limited degree of damage. However, the potential fault current in this application was 10,000 A or more. This appeared to be contrary to Bechtel Design Criteria Document E-0 (Reference 1.7) which stated that "short-circuit protection of combination motor starters will be provided by circuit breakers ...." The calculations reviewed were intended to be typical for all Class 1E MCC assemblies controlling loads of up to 50 horsepower. Thus, the oversight applied to essentially all Class 1E motor control centers. (Finding No. 5-1)

In summary, our review in this area indicated one finding concerning the fault current capabilities of motor controllers. This represented an instance of improper detailed design. In other aspects, the samples reviewed indicated controlled transmittal and use of data.

5.3 Equipment Qualification Reports

The team reviewed three equipment qualification reports to evaluate the methods used to review and process the data.

In response to NRC guidance contained in NUREG-0588 (Reference 5.78), Bechtel had been reviewing and compiling qualification reports on all Class 1E electrical equipment for about 1 year. The electrical group had established a subgroup of specialists who compared qualification reports submitted by the suppliers of electrical equipment with checklists prepared in accordance with the requirements of NUREG-0588. Unresolved items on the checklist were transmitted to the equipment supplier and resolved before the report was finalized. When this process was completed the overall results would be submitted for NRC review.

All reports, including any that might have been previously reviewed and approved, were to be reviewed in this manner. For a sample the team selected one report that was being reviewed for the first time by the specialists group and two reports that had previously been approved but had not yet been reviewed by the specialists group.

In the first category, the team examined the Bechtel review of the environmental qualification report for the motor driven discharge valve actuator (Reference 5.41). The generic checklist being used was comprehensive and this review appeared to be proceeding well.

In the second category, the team reviewed the seismic qualification report for Motor Control Centers (Reference 5.42) which had been approved by Bechtel in June 1978. The report referred to the required response spectra that had been provided to the vendor (Gould) as an attachment to Bechtel Specification E-018 (Reference 5.79). The supplier performed seismic capability testing and the report indicated that the test response spectra enveloped the required response spectra for all SNUPPS sites. We found two revised spectra (U.E. Site Ultimate Heat Sink Cooling Tower, Mass Point 1) which had higher peaks than the required response spectra that had been provided to the vendor. These revised spectra had been forwarded from the Civil Group to the Electrical Group in a memorandum dated September 1, 1978 (Reference 5.38) with a request that their impact on equipment qualification be evaluated. However, no indication could be found that the Electrical Group had evaluated their effect on motor control center qualification. During our inspection, Bechtel personnel evaluated the revised spectra and found them to be less severe than the test response spectra that the vendor had used to qualify the motor control centers and, therefore, this specific oversight had no adverse effect on the design. The same revised spectra had been sent to General Electric, the supplier of the only other equipment affected at that particular location, within 2 months after receipt from the Civil Group. However, we found no systematic tracking in place in the electrical group to assure that such revised spectra were addressed. (Finding No. 5-2)

Generally, the Civil Group notified other groups of revised spectra but did not receive responses or track the completion of required actions. As indicated above, we found a problem with this area in the Electrical Group. We did not check in other groups to determine whether or not the problem might apply more widely. Accordingly, this question should also be addressed in resolving the above finding.

Also in the second category, we reviewed the environmental qualification report for Motor Control Centers (Reference 5.57). This report had been resubmitted six times and the latest revision had been approved by Bechtel in May 1981. The short circuit tests of the motor control center and of the components were selected for review. This report summarized test results for an MCC which had a configuration different from that specified for use on the SNUPPS project. The tests had been conducted with current but the team was unable to develop a clear picture during the inspection. Because it appeared that there might be a generic problem with the valve, the team asked NPI personnel to investigate further. After the inspection, NPI personnel informed us of the following results:

(1) The valve had always been correctly specified to be safety grade.

(2) The pump vendor had requested and received permission to ship the pump prior to completing environmental qualification of the valve actuator. The matter had been documented by exchanges of correspondence. The open item regarding qualification of the valve actuator had been tracked on a SDDR.

(3) Eventually, it had been decided to replace the valve actuator with one of a different (qualified) model rather than qualifying the original model. The valve had been returned for this purpose.

The team found this response adequate.

In general, the samples reviewed in this area indicated a controlled process.

5.9 Test Procedures

The team reviewed test procedures for a sample (13.8 kV switchgear) at the job site. Union Electric has developed a system of generic test procedures to perform tests in Union Electric plants before start-up tests are carried out. After the completion and release of a system by the constructor (Daniel) the Union Electric staff performs the generic test and writes data sheets (Startup Field Reports). These data sheets are transmitted to Bechtel along with any observed deficiency in the drawing or design. These data sheets are logged against the drawings and the items are closed out when the drawings are changed.

With respect to startup tests, Bechtel submits start-up procedures to the utility on each system. Bechtel also writes procedures for hydrostatic test, energization and flushing that are used by the constructors and the utilities. Bechtel written start-up (acceptance) test procedures are re-written by the utility and assigned a new document number. This is the final test procedure which is used by the utility for the start-up/pre-operational testing.

No problems were found in this area.

5.10 Tracking NRC Generic Communictions

Implementation of NRC bulletins, circulars and information notices in the design and installation process was examined by the team at Union Electric, Bechtel and NPI to assess the control and tracking systems. At Union Electric the Nuclear Group tracked actions in implementing these documents. As a sample, the team checked the followup and response for NRC Bulletins 82-02, 79-25 and 81-02 (References 5.85, 5.86, and 5.87). At NPI, such documents were logged and co-ordinated with Bechtel for review and response

5.12 Storage of Class IE Equipment

The team reviewed the on-site storage of class IE equipment to determine compliance with ANSI Standard N45.2.2 (Reference 5.89). We checked various environmental control and protective features provided in the storage area. Level B storage is maintained at 72°F. Overhead smoke detectors and water sprinkler mesh are provided throughout the storage area. Weekly inspection of water pressure and temperature records is required by Daniel procedures. The records for Level A storage area air conditioning systems, fire protection systems and temperature are inspected and checked 4 times in a week. Automatically initiated Halon Systems are employed as fire extinguishers. Smoke detectors, provided in this area, automatically shut the doors and actuate the Halon system. A sign-in and sign-out procedure is used to control access to this area. The team also reviewed the Daniel warehouse procedures and material control functions. These procedures contained material receiving, storage and handling instructions. A Material Receiving Report was written by Daniel and the Overage, Storage or Deferral (OSD Sheet) was signed by Bechtel Site Liaison. The equipment or material was stored in specified level of storage with the OSD tag signed by the Quality Control Organization.

The site storage and handling of class IE material appeared to follow the ANSI Standard.

5.13 Conclusion

In the electrical power area our review included a range of design features, technical issues and information systems related to various plant systems along with the Auxiliary Feedwater System. In general, we found the handling and control of interface information among Bechtel, NPI, Union Electric and equipment suppliers to be controlled. In most cases, the Union Electric and the other SNUPPS utilities (through NPI) had considerable involvement in the design and procurement process. Bechtel, as the architect-engineer, had implemented procedures to provide reasonable assurance of the quality of the design and procurement activities. These procedures were generally followed and interface information was controlled.

Findings 5-1 and 5-3 concerned improper application of motor controllers and an oversight in review of the qualification report for the same controllers. Finding 5-2 concerned the handling of revised seismic response spectra. However, most of the information reviewed was adequate and consistent and our review did not indicate significant breakdowns in the design process or control of interface information.

6. Instrumentation and Control

The objective of this portion of the inspection was to review the instrumentation and control (I&C) aspects of the auxiliary feedwater (AFW) system design. In general, the I&C aspects of the design did not consist of separate work packages for the AFW system. For example, purchase specifications for control valves, flow orifice elements and control panels included equipment for several plant systems. However, the team's detailed review was devoted to the AFW system with specific emphasis placed upon the control of design interface information. Selected samples of field installation and the reactor vendor's design input were also reviewed.

6.1 Design Information

This section summarizes basic information reviewed concerning the flow of design information.

The team conducted a review at Union Electric Company and at Nuclear Projects Inc. (NPI) to determine the Union Electric and NPI involvement in the design process. All utility comments (from Union Electric and other project participants) relating to the design are coordinated through the NPI office and a utility committee process is used to determine which comments will be forwarded to Bechtel for incorporation into the design. The design documents that required NPI and/or utility review and comment prior to Bechtel issue were identified early in the design process and comment categories were established to indicate to Bechtel which comments were required to be incorporated into the design. Bechtel is responsible to assure that the initial issue of all required documents are routed through NPI for review and that all comments received are resolved in accordance with established procedures prior to document issue. Revisions to design documents after the initial issue do not require an NPI review prior to issue, but the revisions are distributed to NPI for informational purposes concurrent with the document issue. Review and comments by NPI and the utilities are not intended to take the place of the required independent design reviews, but are more in the nature of a broad overview of the design and a operability/maintainability review.

The review of design products is described in the following sections.

6.2 Auxiliary Feedwater System Design

The objective of this portion of the inspection was to evaluate the adequacy and control of a sample of detailed design information.

The team reviewed the applicable Final Safety Analysis Report (FSAR) sections that described the design and operational requirements of the auxiliary feedwater system in order to establish the base instrumentation and control design requirements. The motor driven pump B, the turbine driven pump discharge valve (AL-HV12), the automatic switchover of the suction supply, and the system discharge flow elements were selected for a detailed design review to assure that applicable design inputs were incorporated in the instrumentation and control design and that the design interface requirements were properly considered. The results of these reviews are discussed below.

The team reviewed the motor driven pump B control logics, schematic diagram, vendor submittals and the initiating signals for automatic start of the motor driven pumps. Bechtel was reviewing vendor submittals in accordance with established procedures and the process appeared to be controlled.

One discrepancy was noted in that Logic Diagrams, 02AL05, 02AL06, and 02AL07, (References 6.50, 6.51, and 6.52) had not been submitted by Bechtel to NPI for review prior to initial issuance. This was a violation of section 4.2.1 of Bechtel procedure EDPI 4.41-01 (Reference 6.53). Although a procedural violation did occur, the nature of this item was such that we did not consider it indicative of any systematic weakness in the control of design information and it had no adverse effect on design. (Finding No. 6-1)

During our review of Logic Diagram J.02AL01 (Reference 6.25), it was noted that the logic diagram was incorrect. The logic diagram indicated that the pump would start given a coincidence of several signals whereas FSAR section 10.4.9.2.3 and the schematic diagram (Reference 6.24) correctly indicated that the pump would start given any of the signals. This error should have been detected in the design review of the schematic diagram. However, the actual equipment design, as represented by the schematic diagram was correct and consistent with the FSAR. Although we found no similar control logic errors in the AFW system, the sample reviewed was not large enough to make a firm determination as to whether this was a systematic error which might indicate some weakness in the design process for development and use of control logic diagrams. This should be addressed in resolving the item. During our inspection, the control logic diagram was corrected while being revised to enter fire protection changes. (Finding No. 6-2)

The team reviewed the turbine driven auxiliary feedwater pump discharge valve (AL-HV12) purchase specification, control logic, emergency operation requirements, incorporation of design basis, and the interface with the supplier in the area of seismic testing and the required Bechtel review of certain vendor document submittals. The purchase specification included the applicable design basis and established requirements for vendor document submittals to provide assurance that the specification requirements were implemented by the supplier. The Bechtel design process required an engineering review and approval of the vendor submitted documents and, within the scope of this inspection, these requirements were being implemented in this area. The purchase specification also included requirements for seismic and environmental qualification of the control valves and the specification/procedural requirements were being implemented in this area. It was noted that during the initial seismic testing of these air operated valves, certain modifications to the valve design were required to assure proper function during seismic events. The areas noted were additional bracing and support for the lower limit switch the check valve downstream of the auxiliary feedwater tie in. Although Westinghouse normal design scope did not include the main feedwater piping analysis, Westinghouse had issued a "Technical Bulletin" in 1979 to inform operating reactor customers of the need to evaluate water hammer effects upon fast closure of the main feedwater check valve during certain transient/accident conditions. Westinghouse had also informed the SNUPPS construction project by a memorandum in 1979. Documentation was not available during this inspection to show that Westinghouse had transmitted this information to other construction projects. Although this area of review revealed no discrepancies, the discussion on water hammer effects is provided for informational purposes and for potential NRC inspection followup at Westinghouse to determine which construction projects were issued the technical bulletin information. (Observation No. 6-1)

6.5 Pre-Operational Testing Program

The team reviewed the auxiliary feedwater preoperational testing program at Bechtel. The following start-up test procedures were reviewed:

(1) "Auxiliary Feedwater Turbine-Driven Pump and Valve Pre-Operational Test S-03AL02";
(2) "Auxiliary Feedwater Motor-Driven Pump and Valve Pre-Operational Test S-03AL01"; and
(3) "Auxiliary Turbine Pre-Operational Test S-04FL01".

These test procedures were used by the Union Electric start-up group as the core of the actual tests to be run in the field. At Union Electric the team reviewed the start-up testing schedule and test agenda, particularly the test sequence and event timing since some tests are interdependent and others depend on construction scheduling and loop turnover. We concluded that the procedures were thorough and complete, the test schedule was well coordinated with construction events, and adequate time was allocated for preliminary preparations and systems checkout.

6.6 Conclusion

The four findings from our inspection in this area did not indicate adverse effects on the actual design or systematic weaknesses. In general, the information reviewed was adequate and consistent, indicating a controlled design process.

7.0 Reference Material

7.1 General

7.1.1 - Background Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
1.1	NPI letter	SLNRC 81-39, letter to NRC (Denton) reviewing AFS vs. SRP, Action Plan Items, staff questions, etc.		6/3/81
1.2	NPI letter	SLNRC 81-44, letter to NRC (Denton) on AFS reliability analysis		6/8/81
1.3	Organization Charts	Charts for NPI, Bechtel, and Union Electric		
1.4	Magazine Article	Article in Nuclear Engineering International, "SNUPPS- the Multiple Utility Standardization Project," by N. A. Petrick		11/75
1.5	Bechtel Design Criteria	10466-A-000, "Architectural Design Criteria for SNUPPS"	3	8/11/80
1.6	Bechtel Design Criteria	10466-C-0, "Civil and Structural Design Criteria for SNUPPS"	10	6/9/82
1.7	Bechtel Design Criteria	10466-E-0, "Electrical Design Criteria for SNUPPS"	11	6/25/81
1.8	Bechtel Design Criteria	10466-J-000, "Control Systems Design Criteria for SNUPPS"	9	9/30/80
1.9	Bechtel Design Criteria	10466-M-000, "Mechanical/Nuclear Design Criteria for SNUPPS"	6	8/30/77
1.10	Bechtel Procedure	Project Engineering Procedures Manual Index for Job 10466	52	
1.11	Bechtel Procedure	Engineering Department Project Instruction (EDPI) 4.1-01, "Design Criteria"	5	5/12/80

Ref. No.	Document Type	Description/Title	Rev.	Date
1.12	Bechtel Procedure	EDPI 4.22-01, "Preparation and Control of SAR"	7	5/8/81
1.13	Bechtel Procedure	EDPI 4.23-01, "SAR Change Control"	9	8/25/80
1.14	Bechtel Procedure	EDPI 4.25-01, "Design Interface Control"	1	5/9/78
1.15	Bechtel Procedure	EDPI 4.34-01, "Off Project Design Review"	4	1/15/79
1.16	Bechtel Procedure	EDPI 4.37-01, "Design Calculations"	8	1/19/81
1.17	Bechtel Procedure	EDPI 4.46-01, "Project Engineering Drawings"	17	7/30/82
1.18	Bechtel Procedure	EDPI 4.47-01, "Drawing Change Notice"	12	9/18/81
1.19	Bechtel Procedure	EDPI 4.49-01, "Project Specifications"	11	9/18/81
1.20	Bechtel Procedure	EDPI 4.61-01, "Nonconformance Reports"	14	7/30/82
1.21	Bechtel Procedure	EDPI 4.62-01, "Field Change Request, Construction Variance Request and Middle Third Deviation Notice"	13	7/30/82
1.22	Bechtel Procedure	EDPI 5.30-01, "Project Release Procedure and Document Release Log"	2	12/10/79
1.23	Bechtel Drawing	MS-1, "Piping Class Summary for the SNUPPS"	14	12/29/81
1.24	Bechtel Specification	10466-M-204(Q), "Field Fabrication and Installation of Piping and Pipe Supports to ASME Section III"	33	7/20/82

Ref. No.	Document Type	Description/Title	Rev.	Date
1.25	Bechtel Specification	10466-M-216(Q), "Fabrication of Non-Catalog Pipe Supports"	16	5/12/81
1.26	Bechtel Specification	10466-M-217(Q), "Design Specification for Pipe Supports to ASME Section III, Subsection NF	6	2/26/80
1.27	Westinghouse Specification	SG 689, Steam Systems Design Manual, Subsection 7 AFS	2	8/73
1.28	Bechtel Drawing	M-00AL(Q), "AFS Description SNUPPS"	3	12/15/77
1.29	Bechtel Drawing	M-02AL01(Q), "Piping and Instrumentation Diagram AFS"	11	9/21/82
1.30	Bechtel Drawing	M-03AL01(Q), "Piping Isometric Auxiliary Feedwater Pumps Suction Piping"	9	
1.31	Bechtel Drawing	M-03AL02(Q), "Piping Isometric Motor Driven Auxiliary Feedwater Pump 'A' Discharge Piping"	10	
1.32	Bechtel Drawing	M-03AL03(Q), "Piping Isometric Motor Driven Auxiliary Feedwater Pump 'B' Discharge Piping"	8	
1.33	Bechtel Drawing	M-03AL04(Q), "Piping Isometric Turbine Driven Auxiliary Feedwater Pump Discharge Piping"	7	
1.34	Bechtel Drawing	M-03AL05(Q), "Piping Isometric Auxiliary Feedwater Pumps Recirculation Piping	9	
1.35	NPI Letter	SLNRC 81-010, "SNUPPS AFS Meeting"		2/19/81
1.36	Bechtel Letter	BLSE 9344, "Response to Action Items Resulting from 2/12/81 meeting with NRC"		4/3/81

Ref. No.	Document Type	Description/Title	Rev.	Date
1.37	PSAR Extract	SNUPPS Project QA Programs for Design and Construction	4	12/81
1.38	NPI Procedure	SNUPPS Staff Administrative Control Procedures Manual	58	10/1/82
1.39	Bechtel Specification	E-012.2(Q), "Technical Specification for Purchase of Large Induction Motors 250 Hp and Larger for SNUPPS"	2	3/18/77
1.40	Bechtel Specification	E-091(Q), "Technical Specification for Seismic Qualification of Class IE Equipment for SNUPPS"	4	5/25/76
1.41	Bechtel Specification	M-021(Q), "Design Specification for Auxiliary Feedwater Pumps and Turbine Drive for SNUPPS"	13	5/28/81
1.42	Bechtel Specification	M-900(Q), "Technical Specification for Qualification of Seismic Category 1 Mechanical Systems and Equipment for SNUPPS"	2	7/9/76
1.43	Bechtel Specification	J-820(Q), "Technical Specification for Seismic Qualification Requirements for Class IE Control and Instrumentation Devices for SNUPPS"	1	5/27/75
1.44	Bechtel Specification	J-601(Q), "Design Specification for Nuclear Service Control Valves for SNUPPS"	13	10/17/80
1.45	Bechtel Specification	E-025(Q), "Technical Specification for Valve Electric Motor Actuators for SNUPPS"		
1.46	Bechtel Specification	10466-MS-6, "End Preparation Data"	5	2/3/77

Ref. No.	Document Type	Description/Title	Rev.	Date
1.47	Bechtel Specification	10466-J4-102, "Instructions for Typical Instrument Tagging"	1	11/14/74
1.48	Bechtel Specification	10466-MS-7, "End Transition Detail"	2	2/2/76
1.49	Bechtel Design Criteria	I0466-C-04A03S, "Floor Response Spectra for SNUPPS"	0	11/1/76
1.50	Bechtel Design Criteria	10466-C-04A03B, "Floor Response Spectra for SNUPPS"	0	11/1/76
1.51	Bechtel Design Criteria	10466-C-04A04S, "Floor Response Spectra for SNUPPS"	0	11/1/76
1.52	Bechtel Design Criteria	10466-C-04A04B, "Floor Response Spectra for SNUPPS"	0	11/1/76
1.53	Bechtel Drawing	10466-M-01AL01(Q), "System Flow Diagram AFS"	D	
1.54	Bechtel Photographs	Six Composite Photographs of SNUPPS Model of AFS		
1.55	NUREG	NUREG/CR-2458, "Sandia Comments on SNUPPS AFS Reliability Analyses		
1.56	NRC Paper	SECY 82-352, "Assurance of Quality," page 5 and Enclosure 1, pages 6 and 7		8/10/82
1.57	Magazine Article	Article in Nuclear Engineering International, "A Progress Report on the SNUPPS Nuclear Stations," by N. A. Petrick		9/77
1.58	Magazine Article	Article in Power, "Standardization of Nuclear Plants Offers Better Designs, Faster Construction"		11/77

7.1.2 - Meeting Attendance

Name	Organization	Title	11/10/82	11/11/82	11/12/82	11/15/82	11/16/82	11/19/82	12/03/82	12/06/82	12/08/82	12/09/82
			Meeting Attended									
D.P. Allison	NRC	Team Leader	X	X	X	X	X	X	X	X	X	X
D.P. Norkin	NRC	Team Member, Mechanical Sys.	X	X	X	X	X	X	X	X	X	X
J.R. Fair	NRC	Team Member, Mechanical Comp.	X	X	X	X	X	X	X	X	X	
D.K. Morton	EG&G	Team Member, Mechanical Comp.	X	X	X	X	X	X	X			
R.E. Shewmaker	NRC	Team Member, Civil/Structural	X	X	X	X	X	X	X	X	X	
J.S. Ma	NRC	Team Member, Civil/Structural				X		X	X	X	X	
I. Ahmed	NRC	Team Member, Electrical Power	X	X	X	X	X	X	X	X	X	X
R.L. Sprague	EG&G	Team Member, Electrical Power	X	X	X	X	X	X			X	X
D.D. Chamberlain	NRC	Team Member, I&C	X	X	X	X	X	X	X		X	X
R.O. Karsch	NRC	Team Member, I&C	X	X	X	X	X	X	X	X	X	X
J. Neisler	NRC	Resident Inspector	X	X						X	X	
G.E. Edison	NRC	Licensing Project Manager	X	X	X							
E.L. Jordan	NRC	Director, DEQA, IE	X									
T.L. Harpster	NRC	Chief, QAB, DEQA, IE					X	X	X			
H.M. Wescott	NRC	RIII Project Inspector									X	
J.E. Konklin	NRC	RIII Project Section Chief									X	
R. Stright	NPI	Licensing Manager						X	X			
S.J. Seiken	NPI	QA Manager	X	X	X	X	X	X	X		X	
N.A. Petrick	NPI	Executive Director	X									
F. Schwoerer	NPI	Technical Director				X						
J.O. Cermak	NPI	Manager, Nuclear Safety				X						
J.H. Riley	NPI	Staff Engineer				X						
D.J. Klein	NPI	Staff Engineer				X						
R.P. White	NPI	Nuclear Engineer				X						
W.W. Baldwin	NPI	Administrative Manager				X						
E. Dille	UE	Executive Vice President	X									
D.F. Schnell	UE	VP, Nuclear	X	X	X							
J.F. McLaughlin	UE	Assistant to VP Nuclear	X	X								
D. Capone	UE	Manager, Nuclear Eng.	X	X	X						X	
R.J. Schukai	UE	General Manager, Eng.	X	X	X							
W.H. Weber	UE	Mgr., Nuclear Construction	X	X								
F.D. Field	UE	Manager, QA	X	X	X							
A.C. Passwater	UE	Licensing Manager	X									
N.G. Slayten	UE		X									
W.H. Zvanut	UE	Supervising Engr., Nuclear	X									
W.B. Bobner	UE		X									
T.H. McFarland	UE	Superintendent, Site Liaison	X							X	X	
R.P. Wendling	UE	Supervising Engr., Nuclear	X									
J.E. Kaelin	UE			X								

Name	Organization	Title	11/10/82	11/11/82	11/12/82	11/15/82	11/16/82	11/19/82	12/03/82	12/06/82	12/08/82	12/09/82
			Meeting Attended									
K.W. Kuechenmeister	UE	Supv. Engr., UE Construction		X						X	X	
D.J. Maxwell	UE	Construction Engineer		X						X	X	
W.H. Mawyer	UE	Consulting Engineer		X						X	X	
R.K. Cothren	UE	Consulting Engineer		X								
F.E. Maddy	UE	Consulting Engineer		X								
W. Steinberg	UE	Construction Engineer								X	X	
J.R. Veatch	UE	Supervising Engineer								X	X	
J.A. McGraw	UE	Supervising Engineer								X	X	
R.L. Powers	UE	Superintendent Site QA								X		
C.J. Plows	UE	Consulting Engineer, Quality									X	
J.V. Laux	UE	Supervising Engineer									X	
D.E. Shafer	UE	Nuclear Engineer, Licensing									X	
C.C. Wagoner	Daniel	Project Manager		X						X		
M.K. Smith	Daniel	Audit Response Coordinator								X		
G.M. Warblin	Daniel	Project Administrator								X	X	
D.C. King	Daniel	Construction Manager								X	X	
W.A. Peppe	Bechtel	Group Leader, Mech/Nuclear		X								
R.C. Boles	Bechtel	Site Liaison Eng (Mech.)		X						X	X	
G.P. Schwartz	Bechtel	Control Sys. Site Liaison		X							X	
J. Kroehler	Bechtel	Proj. QA Manager, SNUPPS					X	X	X			
D.R. Quattrociocchi	Bechtel	Proj. Engineer, SNUPPS					X	X	X			
J.A. Chlapowski	Bechtel	Proj. Engineer, SNUPPS					X		X			
J. Milos	Bechtel	Project Quality Engineer					X	X	X			
J.H. Smith	Bechtel	Project Engineering Manager					X	X	X			
L.F. Rotondo	Bechtel	Project Engineer, Facilities					X	X				
D.C. Kansal	Bechtel	Division QA Manager						X	X			
B.L. Meyers	Bechtel	Project Manager, SNUPPS						X	X			
N.P. Goel	Bechtel	Project Engineer, Mechanical						X	X			
L.E. Ruhland	Bechtel							X				
J.S. Prebula	Bechtel	Group Leader, Mech/Nuclear							X			
R.W. Bradford	Bechtel	Site Lead Liaison Engineer									X	
P.T. McManus	W*	Mgr., Design Assurance Sys. & Quality Engineer										X
J.B. Stearns	W	SNUPPS QA Engineer										X
W.R. Spezialetti	W	Mgr., Plant Licensing										X
D.L. Cecchett	W	License Engineering SNUPPS										X
M.H. Shannon	W	Senior Quality Engineer										X
S.T. Maher	W	Engineer, Nuclear Safety										X

*W - Westinghouse

Name	Organization	Title	Meeting Attended 11/10/82	11/11/82	11/12/82	11/15/82	11/16/82	11/19/82	12/03/82	12/06/82	12/08/82	12/09/82
J.S. Schlonski	W	Engineer, Fluid Sys. Design										X
N.I. Beck	W	Engineer, Fluid Sys. Design										X
R.A. Loose	W	Balance of Plants System Design										X
J.W. Swogger	W	SNUPPS Project Engineer										X
P.A. Barille	W	Engr., Chemical & Waste Process Sys.										X
C.A. Vitalbo	W	Senior Engineer										X
T. Kitchen	W	Process Control Technician										X
J. Cunningham	W	Nuclear Safety Engineer										X
R. Tuley	W	Nuclear Safety Engineer										X

7.2 Mechanical Systems

7.2.1 - Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
2.1	Westinghouse Procedure	SSE-SF-37, Secondary Systems Parameters Required for FSAR Accident Analyses	1	9/81
2.2	Bechtel Internal Memo	File 0332, Mechanical/Nuclear Group Organization and Responsibilities	13	8/25/82
2.3	Bechtel Calculation	AL-21, Motor Drive Auxiliary Feedwater Pumps; Determine Total Head	0	12/1/81
2.4	Bechtel Calculation	AL-20, Turbine Driven Auxiliary Feedwater Pump; Determine Total Head	0	11/20/81
2.5	Westinghouse Specification	SIP/10-1, Section 4-4 Steam System Design Manual (10-1)	3	3/78
2.6	Westinghouse Specification	SIP/10-1, Section 5-4 Steam System Design Manual (10-1)	3	3/78
2.7	Westinghouse Letter	SNP-2256, SNUPPS Projects Steam System Design Manual (10-1)		1/17/79
2.8	Westinghouse Letter	SNP-2342, SNUPPS Projects Areas of Significant Change in Rev. 3 of Steam System Design Manual		3/6/79
2.9	Bechtel Letter	BLWE-1082, Westinghouse PIP Volume 10-1, Steam System Design Manual, Rev. 3		10/2/79
2.10	Westinghouse Letter	SNP-3121, Revised Steam Systems Design Manual		2/5/80
2.11	Bechtel Calculation	AL-26, Aux. Feedwater Pumps; Verify Turbine Driven Pump Performance Throughout the Feedline Break Transient Provided by Westinghouse in SNP 2243	0	12/17/79

Ref. No.	Document Type	Description/Title	Rev.	Date
2.12	Westinghouse Letter	SNP-1857, Impact of New Steam Break Protection System on Design of AFS Relative to Secondary Pipe Rupture		6/8/78
2.13	Bechtel Letter	BLWE-916, AFS Secondary Pipe Rupture Accidents		8/3/78
2.14	Westinghouse Letter	SNP-2243, Auxiliarry Feedwater System		1/10/79
2.15	Bechtel Letter	BLWE-1155, AFS; Pump Runout During Steam Generator Pressure Transients		1/30/80
2.16	Bechtel Letter	BLWE-1345, AFS; Design Information on Delivery Times and Flowrates		12/8/80
2.17	Westinghouse Letter	SNP-1054, AFS; Turbine Driven Pump Flow Rate		1/22/76
2.18	Bechtel Letter	BLWE-380, Feedwater Isolation; Deletion of Check Valve		1/22/76
2.19	Bechtel Calculation	AL-16, AFS; Determine Available NPSH for Aux Feedwater Pumps	0	10/20/81
2.20	Ingersoll-Rand-Curve	10466-M-021-118-01, Characteristic Curve, Motor Driven Pump (AFS)		1/31/78
2.21	Ingersoll-Rand-Curve	10466-M-021-096-01, Characteristic Curve, Turbine Driven Pump (AFS)		10/18/77
2.22	Bechtel Calculation	AL-22, AFS; Revise Flow Diagram Data	0	12/2/81
2.23	Bechtel Drawing	M-01AL01(Q), System Flow Diagram, AFS	D	12/15/77
2.24	Bechtel Drawing	M-01AL01(Q), System Flow Diagram, AFS	E	11/15/82

Ref. No.	Document Type	Description/Title	Rev.	Date
2.25	Westinghouse Letter	SNP-384, Revised Recommended AFS		2/5/75
2.26	Westinghouse Specification	SG-689, Steam Systems Design Manual, III-5 and V-7	2	8/83
2.27	Bechtel Specification	M-00AL(Q), System Description, AFS	4	11/15/82
2.28	Bechtel Drawing	FSAR Fig. 3.6-1, SH 49, High Energy Pipe Break Isometric Main Steam Supply to Turbine AFP Outside Containment	9	5/82
2.29	Bechtel Calculation	PBFC01, "Pipe Break Analysis"	1	8/31/78
2.30	Bechtel Calculation	PBFC01, Pipe Break Analysis	2	11/10/82
2.31	Bechtel Internal Memo	SNUPPS High Energy Line Break Analyses Task Force Reorganization		8/ 9/80
2.32	Bechtel Analyses	Break By Break Dynamic Effects Analyses for Main Steam Branch Line to AFS Turbine Driven Pump		Undated
2.33	Bechtel Specification	10466-M-021(Q), Design Spec For Aux FW Pumps and Turbine Drive	13	5/28/81
2.34	Bechtel Calculation	FL-13, Aux Building Area 5 Flooding	0	10/28/82
2.35	Bechtel Calculation	FL-01, Flooding of the Aux Building	0	10/4/82

Ref. No.	Document Type	Description/Title	Rev.	Date
2.36	Bechtel Drawing	M-02AL01(Q), Piping and Instrumentation Drawing Auxiliary Feedwater System	11	9/21/82
2.37	NPI Letter	SLNRC 81-44, Reliability Analysis of the SNUPPS Auxiliary Feedwater System		6/8/81
2.38	NPI Letter	SLNRC 81-010, SNUPPS Auxiliary Feedwater System Meeting		2/19/81
2.39	Bechtel Calculation	GF 175, Miscellaneous Building, HVAC		10/15/75
2.40	Bechtel Calculation	HV 319		3/6/81
2.41	NPI Letter	Letter to NRC Enclosing Page Changes for PSAR		12/9/77
2.42	Bechtel Drawing	MOP 1451, "Drainage System Auxiliary Building	4	7/14/80
2.43	Bechtel Drawing	MOP 1902, "Drainage System Auxiliary Building	4	8/19/77
2.44	NRC SER	NUREG-0830, Safety Evaluation Report Related to the Operation of Callaway Plant, Unit No. 1		10/81
2.45	NRC SER	NUREG-0830 Supplement No. 1, "Safety Evaluation Report Related t the Operation of Callaway Plant Unit No. 1		1/82

7.2.2 - Personnel Interviewed

Name	Title	Organization
J. D. Hurd	Group Supervisor, SNUPPS Mechanical/Nuclear Group	Bechtel
J. S. Prebula	Deputy Group Supervisor, SNUPPS Mechanical/Nuclear Group	Bechtel
K. Miller	Hazards Task Force Coordinator, SNUPPS Mechanical/Nuclear Group	Bechtel
A. Woolard	Engineer, SNUPPS Mechanical/Nuclear Group	Bechtel
W. A. Poppe	Power Conversion Group Leader, SNUPPS Mechanical/Nuclear Group	Bechtel
J. Canale	Engineer, SNUPPS Mechanical/Nuclear Group	Bechtel
B. C. Seam	Facilities/Site Group Leader SNUPPS Mechanical/Nuclear Group	Bechtel
D. L. Herrich	Engineer, SNUPPS Mechanical/Nuclear Group	Bechtel
B. Spezialetti	SNUPPS Licensing Manager	Westinghouse
J. Swogger	Project Engineer, SNUPPS Project	Westinghouse
N. [illegible]ck	Engineer	Westinghouse
S. Maher	Engineer	Westinghouse

7.3 Mechanical Components

7.3.1 - Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
3.1	Bechtel Procedure	EDPI 4.37-01, Design Calculations	8	1/9/81
3.2	Bechtel Procedure	EDPI 4.1-01, Design Criteria	5	5/12/80
3.3	Bechtel Specification	10466-M-200(Q), Design Specification for ASME Section III Piping Systems for the Standardized Nuclear Unit Power Plant System (SNUPPS)	5	10/17/80
3.4	Bechtel Design Criteria	BP-TOP-1, Seismic Analysis of Piping Systems	2	1/75
3.5	Bechtel Design Criteria	BP-TOP-1, Seismic Analysis of Piping Systems	3	1/76
3.6	Bechtel Design Criteria	Stress Analysis Newsletter File - Loose Leaf Binder Containing Stress Analysis Newsletters		
3.7	Bechtel Analysis	SNUPPS Stress Analysis Problem No. 60 File	4	10/16/81
3.8	Bechtel Analysis	SNUPPS Stress Analysis Problem No. 44A File	1	6/28/78
3.9	Bechtel Analysis	SNUPPS Stress Analysis Problem No. 70 File	4	3/11/81
3.10	Bechtel Internal Memo	Memo from R. Lee to F. Banes		5/11/82
3.11	Bechtel Internal Memo	Memo from R. Lee to F. Banes		10/15/81
3.12	Bechtel Internal Memo	Memo from I. Shiudansani to B. Shah		6/2/78
3.13	Bechtel Internal Memo	Memo from R. Lee to E. Thomas		11/10/81

Ref. No.	Document Type	Description/Title	Rev.	Date
3.14	Bechtel Internal Memo	Memo from J. Hurd to B. Shah		9/23/82
3.14	Bechtel Internal Memo	Memo from C. Herbst to C. Barbier		6/12/79
3.16	Bechtel Specification	10466-M-217(Q) "Design Specification for Pipe Supports to ASME Section III, Subsection NF for the Standardized Nuclear Unit Power Plant system (SNUPPS)."	6	2/26/80
3.17	Bechtel Design Criteria	Plant Design Hanger Engineering Standards	12	8/20/82
3.18	Bechtel Calculation	Pipe Support Calculation No. AL01-22	2	6/23/78
3.19	Bechtel Calculation	Pipe Support Calculation No. FC01-28	0	1/27/82
3.20	Bechtel Calculation	Pipe Support Calculation No. AL02-34	0	7/8/81
3.21	Bechtel Procedure	Procedure No. TB-011	1	1/4/78
3.22	Bechtel Internal Memo	Memo from I. Shiudasani to E. Thomas		9/7/79
3.23	Bechtel Calculation	Pipe Support Calculation No. AL01-27	2	11/23/82
3.24	Field Change Report	FCR No. 2FC-1191-MH		6/22/82
3.25	Field Change Report	FCR No. 2FC-1284-MH		6/25/82
3.26	Bechtel Computer Program	ME 909		
3.27	Bechtel Computer Program	ME 101 Users Manual	G-1/1	11/16/79

Ref. No.	Document Type	Description/Title	Rev.	Date
3.28	Bechtel Computer Program	ME 210		
3.29	Bechtel Drawing	M-03AB01(Q), Main Steam System Reactor Building and Auxiliary Building r Area 5	12	
3.30	Dravo Drawing	Pc. 2AB01 S032/145	5A	5/2/79
3.31	Dravo Drawing	Pc. 2AB01 S032/145	5	8/5/78
3.32	NRC MEB Position	Interim Technical Position - Functional Capability of Passive Piping Components for ASME Class 2 and 3 Piping Systems		7/19/78
3.33	Bechtel Analysis	SNUPPS Stress Analysis Problem No. 12 File	3	5/4/82
3.34	Ingersoll-Rand Report	EAS-TR-7707-ASR, "Structural Integrity and Operability Analysis of 6HMTA-6 Pump for Bechtel (SNUPPS)"	2	11/15/77
3.35	Terry Corp. Report	GS-2N, "Qualification Report for Ingersoll-Rand-Cameron F-40176-40180"	1	8/18/78
3.36	Masoneilan Report	Seismic Qualification of Masoneilan Control Valves for Bechtel Purchase Order Number 10466-J 601A-1 through -5 Specification Numbers 10466-J-601A and 601B Masoneilan Order Numbers N-00172-176 and N-00198-202 Test Valve Number 803		
3.37	Bechtel Drawing	M-04AL04(Q)	6	9/1/81
3.38	Daniel Procedure	AP-IV-04, "Field Change Requests"	13	10/6/82
3.39	Bechtel Internal Memo	Memo from J. Hurd to B. Shah		9/23/82
3.40	Bechtel Calculation	Pipe Support Calculation AL01-13	2	6/22/78

7.3.2 - Personnel Interviewed

Name	Title	Organization
B. Shah	Plant Design Group Supervisor	Bechtel
L. DiGiacomo	Pipe Support Group Leader	Bechtel
R. Lee	Pipe Stress Group Leader	Bechtel
N. Kalyanam	Engineer Plant Design Staff	Bechtel
I. Shivdasani	Engineer Plant Design Staff	Bechtel
J. Canale	Engineer Mech/Nuclear Group	Bechtel
J. Prebula	Mech/Nuclear Group Leader	Bechtel
B. Lulla	Piping & Valve Group Leader	Bechtel

7.4 Civil and Structural Engineering

7.4.1 - Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
4.1	SNUPPS FSAR	Section 3.7.1(B)-3.7.3(B) Seismic Design	10	9/30/82
4.2	SNUPPS FSAR	Section 3.8.4 Other Category I Structures	10	9/30/82
4.3	SNUPPS FSAR	Figure 13.1-2 UE Organization Chart	5	1982
4.4	Union Electric QA Procedures	Procedure Status Index		
		Sections QS, QA, QE	-	11/8/82
		Section QAC	-	10/13/82
		Section QP	-	6/2/82
4.5	Union Electric QA Procedure	QE-303, Design Document Review and Design Interface Control	0	3/25/74
4.6	Union Electric QA Procedure	QE-303, Design Document Review and Design Interface Control	9	10/13/81
4.7	SNUPPS (NPI) Procedure	1.1, SNUPPS/NPI Staff Administrative Control Procedures, Figure 1.1-1: Organization	4	3/1/81
4.8	SNUPPS (NPI) Log	Standard Power Block - SNUPPS Document Release Log, pp. 752-754, 819, 882	-	10/25/82
4.9	Bechtel Criteria	A-0, Architectural Design Criteria for SNUPPS	3	8/11/80
4.10	Bechtel Criteria	C-0, Civil and Structural Design Criteria for SNUPPS	10	6/9/82
4.11	Bechtel Civil Design Guideline	CDG-1, Structural Adequacy Review of Structural Steel Framing for SNUPPS	0	9/29/82

Ref. No.	Document Type	Description/Title	Rev.	Date
4.12	Bechtel Civil Design Guideline	CDG-2, Structural Adequacy Review of Reinforced Concrete Elements for SNUPPS	2	12/6/82
4.13	Bechtel Specification	C-103, Technical Specification for Forming, Placing, Finishing and Curing of Concrete for SNUPPS	0	2/21/75
4.14	Bechtel Specification	C-103, Technical Specification for Forming, Placing, Finishing and Curing of Concrete for SNUPPS	21	9/8/82
4.15	Bechtel Specification	C-103A, Technical Specification for Installation of Concrete Expansion Anchor Bolts for SNUPPS	5	5/27/80
4.16	Bechtel Specification	C-103B, Technical Specification for Core Drilling of Concrete Structures for SNUPPS	0	9/20/78
4.17	Bechtel Specification	C-121, Technical Specification for Furnishing Structural Steel for SNUPPS	13	10/28/80
4.18	Bechtel Specification	C-122, Technical Specification for the Erection of Structural Steel for SNUPPS	11	5/24/79
4.19	Bechtel Specification	C-131, Technical Specification for the Purchase of Miscellaneous Metal for SNUPPS	14	10/25/82
4.20	Bechtel Specification	C-132, Technical Specification for Erecting Miscellaneous Metal for SNUPPS	6	8/31/82
4.21	Bechtel Specification	C-134, Technical Specification for the Purchase of Steel Anchor Bolts for SNUPPS	9	12/4/80
4.22	Bechtel Specification	C-202, Technical Specification for the Purchase of Pipe Whip Restraints and Embedded Supports for SNUPPS	8	10/4/78
4.23	Bechtel Specification	C-202B, Technical Specification for Purchase of Pipe Whip Restraints for SNUPPS	6	10/25/82
4.24	Bechtel Directive	MED-78-01, Manager of Engineering Directive, EDP Manual Applicability Index	15	6/25/82
4.25	Bechtel Manual Index	Project Engineering Procedures Manual Index, SNUPPS pp. 7-12	52	7/30/82
4.26	Bechtel Procedure	EDP-1.1, Introduction to the EDP System	1	3/31/78

Ref. No.	Document Type	Description/Title	Rev.	Date
4.27	Bechtel Procedure	EDP-1.7, Engineering Department Procedures	2	3/31/78
4.28	Bechtel Procedure	EDP-1.8, Engineering Department Procedures Manual	0	1/20/78
4.29	Bechtel Procedure	EDP-1.10, Engineering Department Project Instructions	2	3/31/78
4.30	Bechtel Procedure	EDPI-1.11-01, Project Engineering Procedures Manual	1	1/15/79
4.31	Bechtel Procedure	EDP-1.13, Manager of Engineering Directives	2	3/31/78
4.32	Bechtel Procedure	EDPI-2.13-01, SNUPPS Project Organization	8	12/23/81
4.33	Bechtel Procedure	EDPI-4.1-01, Design Criteria	5	5/12/80
4.34	Bechtel Procedure	EDPI-4.22-01, Preparation and Control of SAR	7	5/8/81
4.35	Bechtel Procedure	EDPI-4.23-01, SAR Change Control	9	8/25/80
4.36	Bechtel Procedure	EDPI-4.25-01, Design Interface Control	1	3/9/78
4.37	Bechtel Procedure	EDPI-4.34-01, Off-Project Design Review	4	1/15/79
4.38	Bechtel Procedure	EDP-4.36, Standard Computer Programs	1	9/26/80
4.39	Bechtel Procedure	EDPI-4.37-01, Design Calculations	8	1/9/81
4.40	Bechtel Procedure	EDPI-4.41-01, Base Design Document Review, Approval, and Release Requirements	1	5/8/78
4.41	Bechtel Procedure	EDPI-4.46-01, Project Engineering Drawings	17	7/30/82
4.42	Bechtel Procedure	EDPI-4.47-01, Drawing Change Notice	12	9/18/81

Ref. No.	Document Type	Description/Title	Rev.	Date
4.43	Bechtel Procedure	EDPI-4.49-01, Project Specifications	11	9/18/81
4.44	Bechtel Procedure	EDPI-4.58-01, Specifying and Reviewing Supplier Engineering and Quality Verification Documentation	4	9/18/81
4.45	Bechtel Procedure	EDP-4.60, Processing Corrective Action Reports	3	5/31/78
4.46	Bechtel Procedure	EPDI-4.61-01, Nonconformance Reports (NCR's)	14	7/30/82
4.47	Bechtel Procedure	EDPI-4.62-01, Field Change Request, Construction Variance Request, and Middle Third Deviation Notice	13	7/30/82
4.48	Bechtel Procedure	EDPI-4.65-01, Design Deficiency Processing	4	9/18/81
4.49	Bechtel Procedure	EDPI 5.1-01, Communications Control	6	1/9/81
4.50	Bechtel Procedure	EDPI 5.7-01, Project Filing System	6	5/12/80
4.51	Bechtel Procedure	EDPI 5.30-01, Project Release Procedure and Document Release Log	2	12/10/79
4.52	Bechtel Procedure	EDP 5.34, Project Quality Program Indoctrination and Training	2	12/8/75
4.53	Bechtel Calculation	Final Calculation 13-08-F, Auxiliary Building Floor Response Spectra	0	8/24/81 Comp 8/26/81 Ckd. 3/1/82 App.
4.54	Bechtel Calculation	Final Calculation 03-53.4-F, Capacities of Embedded Plate Type EP 912A	0	2/14/79 Comp 8/17/79 Ckd. 8/17/79 App.
4.55	Bechtel Calculation	Final Calculation 03-107-F, Formulation of Load Capacity Coefficients of Embedded and Replacement Plates	0	7/30/81 Comp 7/30/81 Ckd. 11/2/82 App.
4.56	Bechtel Calculation	Final Calculation 03-109-F, Load Nomographs for Embedded and Replacement Plates	1	1/29/82 Comp 1/29/82 Ckd. 2/6/82 App.

Ref. No.	Document Type	Description/Title	Rev.	Date
4.57	Bechtel Calculation	Final Calculation 03-411-F, Isolation Restraint FC-02	0	12/1/81 Comp.
4.58	Bechtel Calculation	Final Calculation 03-411-F, Isolation Restraint FC-02	0	11/17/82 Comp. 11/18/82 Ckd.
4.59	Bechtel Calculation	Final Calculation 03-90.25-F, Pipe Anchor No. 0-FB01-A002/135	1 2	9/29/82 App. 12/14/82 App.
4.60	Bechtel Drawing	C-0003, Structural Steel and Concrete General Notes	26	6/22/82
4.61	Bechtel Drawing	C-0010, Standard Details, Sheet No. 7	7	7/9/80
4.62	Bechtel Drawing	C-0011, Standard Details, Sheet No. 8	13	7/14/81
4.63	Bechtel Drawing	C-0012, Standard Details, Sheet No. 9	13	9/18/80
4.64	Bechtel Drawing	C-0016, Standard Details, Sheet No. 15	11	9/18/80
4.65	Bechtel Drawing	C-0017, Standard Details, Sheet No. 21	11	11/6/78
4.66	Bechtel Drawing	C-0018, Standard Details, Sheet No. 31	9	2/14/78
4.67	Bechtel Drawing	C-0019, Standard Details, Sheet No. 29	14	7/12/82
4.68	Bechtel Drawing	C-0020, Standard Anchor Bolt Details	9	4/9/82
4.69	Bechtel Drawing	C-0029, Standard Details, Sheet No. 33	7	9/8/82
4.70	Bechtel Drawing	C-0030, Standard Details, Sheet No. 35	12	7/12/82
4.71	Bechtel Drawing	C-0033, Standard Anchor Bolts Schedule	12	1/21/82
4.72	Bechtel Drawing	C-0035, Standard Details, Sheet No. 24	15	2/23/81

Ref. No.	Document Type	Description/Title	Rev.	Date
4.73	Bechtel Drawing	C-0037, Standard Details, Sheet No. 34	16	11/12/82
4.74	Bechtel Drawing	C-OC0241, Condenser Storage and Demineralized Water Tanks, Concrete Neat Line and Reinforcing	9	6/22/82
4.75	Bechtel Drawing	C-0408, Cable Tray Supports, Typical Details, Sheet 8	11	10/17/82
4.76	Bechtel Drawing	C-0418, Cable Tray Supports, Typical Details, Sheet 18	9	10/18/82
4.77	Bechtel Drawing	C-0419, Cable Tray Supports, Typical Details, Sheet 19	7	6/14/82
4.78	Bechtel Drawing	C-OC1113, Auxiliary Building Concrete, Plan Floor El 1974'-0"	6	4/21/80
4.79	Bechtel Drawing	C-OR1151, Auxiliary Building Area 5 Reinforcing, Plan at Elev. 1974', 1989' and 2000'	6	1/29/82
4.80	Bechtel Drawing	C-OC1151, Auxiliary Building Area 5, Concrete Neat Lines, Plan at Elev. 1974', 1989' and 2000'	19	1/12/82
4.81	Bechtel Drawing	C-OC1352, Auxiliary Building Area 5, Concrete Neat Lines, Plan at Elev. 2013'-6", 2026' and 2090'	16	8/24/82
4.82	Bechtel Drawing	C-OS1352, Auxiliary Building, Area 5, Structural Steel Framing Plans, Elev. 1989', 2000', 2013'-6" and 2026'	5	8/3/82
4.83	Bechtel Drawing	C-OC1353, Auxiliary Building, Area 5 Concrete Neat Line, Plan of Embeds, Underside of Slab at Elev. 2026'	8	9/1/82
4.84	Bechtel Drawing	C-OS1452, Auxiliary Building, Area 5, Structural Steel Framing Plans, Elev. 2037'-7-¼", 2042', 2055'-6" and 2090'	5	8/26/82
4.85	Bechtel Drawing	C-OR1905, Auxiliary Building Reinforcing Sections and Details, Sheet 4	6	12/28/80
4.86	Bechtel Drawing	C-OR1906, Auxiliary Building Reinforcing, Sections and Details, Sheet 6	4	3/20/80

Ref. No.	Document Type	Description/Title	Rev.	Date
4.87	Bechtel Drawing	C-OC1924, Auxiliary Building Concrete Neat Lines and Reinforcing, Wall Elevations, Sheet 24	17	7/16/82
4.88	Bechtel Drawing	C-OC1928, Auxiliary Building, Concrete Neat Lines and Reinforcing, Wall Elevations, Sheet 28	10	7/16/82
4.89	Bechtel Drawing	C-OC1931, Auxiliary Building, Concrete Neat Lines and Reinforcing, Wall Elevations, Sheet 6	14	11/1/82
4.90	Bechtel Drawing	C-OC1932, Auxiliary Building, Concrete Neat Lines and Reinforcing, Wall Elevations, Sheet 5	13	7/16/82
4.91	Bechtel Drawing	C-OC1942, Auxiliary Building, Concrete Neat Lines and Reinforcing, Equipment Pads, Sheet 2	5	12/3/79
4.92	Bechtel Drawing	C-OS4481, Turbine Building, Area 8, Structural Steel Framing Plan at Elevation 2035' and 2017'-9"	7	8/14/80
4.93	Bechtel Drawing	C-03FC02, Isolation Restraints, Auxiliary Turbine System, Auxiliary Building	0 1 2	1/26/82 7/22/82 11/5/82
4.94	Bechtel Drawing	M-03AL01, Piping Isometric, Auxiliary Feedwater Pumps, Suction Piping	9	
4.95	Bechtel Drawing	M-03AL04, Piping Isometric, Turbine Driven Auxiliary Feedwater Pump Discharge Piping	7	
4.96	Bechtel Drawing	M-03AL05, Piping Isometric, Auxiliary Feedwater Pumps Recirculation Piping	9	
4.97	Bechtel Drawing	M-06AL04, Hanger No. 0-AL04-C009/135Q	4	6/29/81
4.98	Bechtel Drawing	M-06AL01, Hanger No. 0-AL01-R005/135Q	2	9/21/78
4.99	Bechtel Drawing	M-06AL01, Hanger No. 0-AL01-H001/135Q	3	9/20/78
4.100	Bechtel Drawing	M-06AL03, Hanger No. 0-AL03-C004/135Q	2	9/1/81

Ref. No.	Document Type	Description/Title	Rev.	Date
4.101	Bechtel Drawing	M-06AL03, Hanger No. 0-AL03-C009/135Q	2	9/1/81
4.102	Bechtel Drawing	M-06AL03, Hanger No. 0-AL03-C010/135Q	0	9/1/81
4.103	Bechtel Drawing	Embedded Plate Location Request - Plate No. 14807	0	11/21/81
4.104	Bechtel Drawing	M-06AL03, Hanger No. 0-AL03-C011/135Q	0	9/1/81
4.105	Bechtel Drawing	Embedded Plate Location Request - Plate No. 14808	0	11/21/81
4.106	Bechtel Calculation	Calculation AL03-15, Hanger 0-AL03-C003/135Q	4	6/29/81
4.107	Bechtel Calculation	Calculation AL03-26, Hanger 0-AL03-C010/135Q	0	7/2/81
4.108	Bechtel Drawing	M-06FB01, Anchor No. 0-FB01-A002/135Q	1 2	10/9/79 (in process)
4.109	Bechtel Drawing	M-26AL01, Anchor No. 2AL01-A002/125Q	0	7/20/82
4.110	SNUPPS Letter	SLNRC 79-11, Response to IEB 79-02, Rev. 1		7/5/79
4.111	Bechtel Drawing Change Notice	DCN No. C-0003-8-5		8/10/77
4.112	Bechtel Drawing Change Notice	DCN No. C-0003-26-1		8/23/82
4.113	Bechtel Drawing Change Notice	DCN No. C-0003-26-2		9/2/82
4.114	Bechtel Drawing Change Notice	DCN No. C-0003-26-3		10/18/82

Ref. No.	Document Type	Description/Title	Rev.	Date
4.115	Bechtel Drawing Change Notice	DCN No. C-0003-26-4		11/8/82
4.116	Field Change Request	FCR No. 2FC-1098-C		10/18/82
4.117	Field Change Request	FCR No. 2FC-1110-C		10/18/82
4.118	Field Change Request	FCR No. 2FC-1121-CX		11/5/82
4.119	Field Change Request	FCR No. 2FC-1152-C		11/5/82
4.120	Nonconformance Report	NCR No. 2SN-6306-C		7/27/82
4.121	Nonconformance Report	NCR No. 2SN-6360-CX		8/11/82
4.122	Nonconformance Report	NCR No. 2SN-6594-C		10/29/82
4.123	Nonconformance Report	NCR No. 2SN-6737-C		10/28/82
4.124	Nonconformance Report	NCR No. 2SN-6847-C		11/5/82
4.125	ANSI Standard	ANSI N45.2.11		1974
4.126	NRC Regulatory Guide	RG 1.64	2	June 1976
4.127	Bechtel Internal Memo	R. L. Burris to L. Rotondo on seismic calculations for the as-built power block structures		5/4/82

7.4.2 - Personnel Interviewed

Name	Title	Organization
William H. Zvanut	Supervising Engineer	Union Electric Company
Don B. Stecko	Engineer	Union Electric Company
Ken W. Kuechenmeister	Supervising Engineer/ Construction	Union Electric Company
J. R. Veatch	Supervising Engineer	Union Electric Company
Wayne Steinberg	Construction Engineer	Union Electric Company
Cliff J. Plows	Quality Engineer	Consultant to Union Electric Company
Eugene F. Beckett	Manager, Technical Services	Nuclear Projects, Inc.
Ken Y. Lee	Chief, Civil-Structural Engineer	Bechtel (Gaithersburg)
Eugene W. Thomas	Group Supervisor, Civil-Structural Staff	Bechtel (Gaithersburg)
James A. Ivany	Civil-Structural Group Supervisor	Bechtel (Gaithersburg)
Peter A. Labarta	Civil-Structural Group Leader - Special Problems	Bechtel (Gaithersburg)
Dwight M. Cornell	Civil-Structural Group Leader - Special Problems	Bechtel (Gaithersburg)
Gerald D. Brown	Civil-Structural Group Leader - Auxiliary Building	Bechtel (Gaithersburg)
Robert L. Burris	Civil-Structural Group Leader - Seismic	Bechtel (Gaithersburg)
Larry Nagielski	Civil-Structural Engineer Auxiliary Building	Bechtel (Gaithersburg)
Bhupesh G. Shah	Plant Design Group Supervisor	Bechtel (Gaithersburg)
William A. Poppe	Mechanical-Nuclear Group Leader - Power Conversion	Bechtel (Gaithersburg)
Nick Cherish	Assistant Project Lead Site Liaison Engineer	Bechtel Site Liaison Engineering
Andy S. Wilkin	Lead Civil-Structural Site Liaison Engineer	Bechtel Site Liaison Engineering

7.5 Electrical Power

7.5.1 - Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
5.1	Bechtel Test Procedure	S-04PA01, 13.8KV Systems Pre-Op Test Procedure	1	3/28/80
5.2	Union Electric Test Procedure	CS-04PA01, 13.8KV Systems Pre-Op Test Procedure	0	7/21/82
5.3	Daniel International Procedure	AP-1V/AP.1, 9, Material Control Function/ Warehouse Procedures		5/24/82
5.4	Union Electric Computer Listing	Computer Listing of all IE Bulletins, Circulars and Information Notices with Follow-up Information		11/82
5.5	Union Electric RCI	Request for Clarification of Information		12/8/82
5.6	Bechtel Internal Memo	Memo from J. H. Smith "Procedure for RCI"		11/5/82
5.7	Bechtel Letter	BLWE-810, "Safe Shutdown Design Criteria and NRC Fire Protection Questions"		1/26/78
5.8	Westinghouse Letter	SNP-1722, "Safe Shutdown"		3/15/78
5.9	Westinghouse Letter	SNP-2027, "Safe Shutdown		10/3/78
5.10	Bechtel Letter	BLSE-7110, "Safe Shutdown" Meeting Notes of 4/10/79		4/18/79
5.11	Bechtel Letter	BLWP-514, "Safe Shutdown Modifications"		8/10/79
5.12	Bechtel Letter	BLWE-1061, "Safe Shutdown Modifications		8/20/79
5.13	Bechtel Letter	BLWE-1081, "Order Confirmation for Item 5"		9/27/79
5.14	Westinghouse Internal Memo	CN-9415, Change Control #9415 for Item 5		10/3/79

Ref. No.	Document Type	Description/Title	Rev.	Date
5.15	Westinghouse Letter	SNP-3360, "Drawing Change Notice to Bechtel"		5/21/80
5.16	Bechtel Letter	BLWP-534, Order for "Q" PORVs		1/9/80
5.17	Bechtel Letter	BLWE-1555, List of Outstanding Items		12/8/81
5.18	Westinghouse Drawing	DWG #7250D64 SH. 17 and 18		
5.19	Westinghouse Drawing	DWG #8756D37, SH. 12		
5.20	NPI Letter	SLBE 79-853, Regarding BFD Relays (IE Bulletin 79-25)		11/8/79
5.21	Bechtel Letter	BLSE 79-57, No BFD Relay Used in SNUPPS Design		1/17/80
5.22	NPI Letter	SLBE-887, Failure of Gate Type VV. to Close Against Differential Pressure (IE Bulletin 81-02)		8/25/81
5.23	Bechtel Letter	BLSE-10, 014, Based on Westinghouse Letter SNP(s)-675 Dated 10-27-81 on IE Bulletin 81-02		11/13/81
5.24	NPI Letter	SLT 7-236, File-J-201, Cold Shutdown from Outside the Control Room		11/7/77
5.25	NPI Letter	SLT 81-182, Agreement Between Bechtel, NPI, W on Auxiliary Shutdown Panel, Instrumentation and Control Isolation		11/30/81
5.26	NPI File	02-78-10 Master File, Bulletin and Information Notice List and Follow-up Record		
5.27	Bechtel Standard Form	J-201-2-3, Supplier Deviation Disposition Request (SDDR) for specification change		10/27/79
5.28	Bechtel Standard Form	J-201-2-11, SDDR for specification change		1/22/80
5.29	Bechtel List	Log Book for All SDDRs with Follow-up Record		

Ref. No.	Document Type	Description/Title	Rev.	Date
5.30	Bechtel Letter	BLSE-10849, Checklist Summarizing NUREG-0588 Requirements		8/03/82
5.31	Bechtel Letter	Letter to Anchor/Darling Forwarding Open Items on Qualification of Valve Operators		11/15/82
5.32	Bechtel Standard Form	FCR - Field Change Request		10/27/82
5.33	Bechtel Design Change Notice	DCN #E-OR2421(Q)-13-2 and DWG #E-OR2421(Q) Incorporating FCR of reference 5.32		
5.34	Bechtel Computer Printout	Raceway Schedule E-25000, E-05000, E-25000		11/82
5.35	Bechtel Letter	BLSE-8561, Relay Setting for Site Feeders		3/5/80
5.36	KG&E Letter	KNLS-099, Relay Setting for Site Feeders		10/15/80
5.37	Bechtel Internal Memo	Floor Response Spectra (FRS), ESWS Pump House Wolf Creek Site (KG&E/KCPL)		6/15/79
5.38	Bechtel Internal Memo	FRS, UHS Cooling Tower Callaway Site (U.E.)		9/1/78
5.39	Bechtel Specification	E-025, Valve Actuator Specification, Attachment Specification to M223-0051 (Check and Gate VV. Spec.)		
5.40	Bechtel Letter	BLWE-1560, FILE 10,581, Isolation of Auxiliary Shutdown Panel Instrumentation - Westinghouse Instrumentation		12/28/81
5.41	Limitorque Report	M-223A-0051-01, Environmental Qualification Report on Limitorque Valve Operator		12/10/76
5.42	Gould Report	E-018-0043-04, Seismic Qualification Report for the Motor Control Centers		6/2/78
5.43	Union Electric Letter	E09 #4, Preliminary Report Callaway 13.8 kV Fault		10/26/81
5.44	Union Electric Letter	ULS-3901, Site Feeder Parameters Callaway Plant		12/8/81
5.45	NPI Letter	SL081-211, File 0491.102/E-009		12/9/81

Ref. No.	Document Type	Description/Title	Rev.	Date
5.46	Bechtel Trip Report	Trip Report, W. Heinmiller		12/10/81
5.47	Bechtel Calculation	F2, Sizing of Cable		
5.48	Bechtel Calculation	F3, Cable Derating		
5.49	Bechtel Calculation	F7, Minimum Cable Size for Fault Current Withstand		
5.50	Component Data Book	Okonite Cable Data Book		
5.51	Bechtel Calculation	A7, Fault Current Calculations	0	
5.52	Bechtel Calculation	A3, Fault Current Calculations		
5.53	Bechtel Calculation	B5, Power System Voltage Drops	0	In Process
5.54	Bechtel Calculation	B6, Control System Voltage Drops	A	In Process
5.55	Bechtel Calculation	F9, Fault Current Calculation Motor Control Centers	1	10/22/82
5.56	Bechtel Specification	J-201, Shutdown Panel Specification	7	
5.57	Gould/ Bechtel Qualification Report	CC-323.74-1/#E/018/0189, Gould Qualification Summary Report for Class 1E Equipment	6	5/24/81
5.58	Bechtel Procedure	EDPI-5.16-01, Supplier Document Control	8	
5.59	Bechtel Procedure	EDPI-4.58-01, Vendor Data Review Procedures	4	9/27/81
5.60	Bechtel Test Criteria	E-091.0 (Q), Seismic Testing Criteria	4	5/25/76
5.61	Underwriters Laboratories	UL508, Industrial Control Equipment Magnetic (NLDX2)		

Ref. No.	Document Type	Description/Title	Rev.	Date
5.62	Underwriters Laboratories	General Information From Electrical Construction Materials Directory		5/78
5.63	Bechtel Drawing	E-03AL05A (Q), Auxiliary Feedwater Pump Air Operated Discharge Control	0	7/7/82
5.64	Bechtel Curves	E-01021, Time-Current Characteristic Curves		
5.65	Bechtel Curves	Sheet 5, Time-Current Characteristic Curves	2	
5.66	Bechtel Curves	Sheet 6, Time-Current Characteristic Curves	4	
5.67	Bechtel Curves	Sheet 7, Time-Current Characteristic Curves	5	
5.68	Bechtel Curves	Sheet 8, Time-Current Characteristic Curves	5	
5.69	Bechtel Curves	Sheet 9, Time-Current Characteristic Curves	4	
5.70	Bechtel Curves	Sheet 10, Time-Current Characteristic Curves	4	
5.71	Daniels International Shipping Request	MN21-B03802, Shipping Request		10/22/82
5.72	Bechtel Letter	Bechtel to Daniels (Pam Nelson to Joe Candrel)		9/7/82
5.73	Westinghouse Diagrams	8756037 Sheets 6, 11, 34, SNUPPS Process Control Diagrams	8	10/26/82
5.74	Westinghouse Diagrams	7246D92, Sheet 17, SNUPPS Process Control External	1	
5.75	Westinghouse Diagrams	7246D92 Sheet 3, Wiring Diagrams	10	10/26/82
5.76	Westinghouse Letter	SNP-4981, PIP Transmittal Letter		11/11/82

Ref. No.	Document Type	Description/Title	Rev.	Date
5.77	Westinghouse Status Report	WRM-ADM-210.6, Task Status System	0	7/1/80
5.78	NUREG	NUREG-0588, Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment		7/31/81
5.79	Bechtel Specification	E-018 for Motor Control Center		
5.80	Bechtel Calculation	B-3, Voltage Drops	1	7/17/81
5.81	IEEE Standard	IEEE Std 399, Recommended Practice for Power System Analysis		
5.82	IEEE Standard	IEEE Std 141, Recommended Practice for Electrical Power Distribution in Industrial Plants		1976
5.83	Union Electric Non-Conformance Report	2SN-6678-M, Auxiliary Feedwater Pump Turbine Trip and Throttle Valve		10/8/82
5.84	Return Material Form	From P. Nelson to J. Candrel, P.O. 10466-M-021-2, Limitorque Trip and Throttle Valves		9/7/82
5.85	NRC Bulletin	82-02		
5.86	NRC Bulletin	79-25		
5.87	NRC Bulletin	81-02		
5.88	Regulatory Guide	1.139, "Design Requirements of the Residual Heat Removal System		
5.89	ANSI Standard	N45.2.2, "Packaging, Shipping, Receiving Storage and Handling of Items for Nuclear Power Plants		1972
5.90	Union Electric Material Shipping Report	MN21 B03802		10/8/82

7.5.2 - Personnel Interviewed

Name	Title	Organization
D. Schnell	Vice President	Union Electric Company
D. Capone	Manager, Nuclear Engineering	Union Electric Company
W. Katterhenry	Power Systems Engineer	Union Electric Company
S. Hillman	I&C Engineer	Union Electric Company
W. Weber	Site Superintendent	Union Electric Company
Al Passwater	Supt. Licensing	Union Electric Company
W. H. Mawyer	Elect. Consultant	Union Electric Company
D. Pruitt	Site Staff	Union Electric Company
K. Kuechenmeister	QA	Union Electric Company
P. Burrello		Westinghouse
C. Vitalbo		Westinghouse
Jim Swogger	Project Engineer, SNUPPS	Westinghouse
Phil Barilla	Shutdown Panel In Charge	Westinghouse
Tim Kitchen	Process Rack In Charge (I&C)	Westinghouse
Phil Marasco	Process Rack In Charge (I&C)	Westinghouse
D. Schwartz	Cable Terminations Engineer	
R. Moreno	Lead EE Liaison	Bechtel Site
P. Schwartz	I&C Systems Engineer	Bechtel Site
D. Quattrociocchi	PE-Electrical/CS	Bechtel Gaithersburg
M. Tantawi	Supervisor-Electrical Group	Bechtel Gaithersburg
W. Heinmiller	Supervisor-Power Systems	Bechtel Gaithersburg
D. Doan	Electrical Engineer	Bechtel Gaithersburg
J. Kohler	Deputy Supervisor-Electrical Group	Bechtel Gaithersburg
J. Hurd	Supervisor-Mechanical Group	Bechtel Gaithersburg
J. Prebula	Deputy Supervisor-Mechanical/Nuclear Group	Bechtel Gaithersburg
B. Seam	Facilities/Site Group Leader, SNUPPS Mechanical/Nuclear Group	Bechtel Gaithersburg
P. Burris	Civil-Structural Group Leader-Seismic	Bechtel Gaithersburg
A. Hassan	Group Leader Electrical Group	Bechtel Gaithersburg
D. Abel	Engineer	Bechtel Gaithersburg
P. Ward	Licensing	Bechtel Gaithersburg
Marco Hechavarria	Quality Engineer	Bechtel Gaithersburg
Anthony Diperna	Supervisor, Control System	Bechtel Gaithersburg
Stan J. Seiken	Manager, Quality Assurance	NPI
Dr. J. Cermak	Manager, Nuclear Safety	NPI
F.Schwoerer	Technical Director	NPI
M. Fennetau	Sales Engineer	Gould C&S Division

7.6 Instrumentation and Control

7.6.1 Documents

Ref. No.	Document Type	Description/Title	Rev.	Date
6.1	Bechtel Design Specification	10466-J-601A(Q) Design Specification for Nuclear Service Control Valves	13	10/17/80
6.2	FSAR	Section 9.3 Process Auxiliaries	7	9/81
6.3	FSAR	Section 7.4 Systems Required for Safe Shutdown	1	9/80
6.4	Bechtel Vendor Data	10466-J-601A-099-01 HV-12 Control Valve Vendor Data		8/19/77
6.5	IEEE Standard	IEEE STD 323-1974 Qualifying Class IE Equipment for Nuclear Power Generating Stations		1974
6.6	Bechtel Test Plan	10466-J-601A-0102-04 Environmental Qualification Test Plan	C	1/21/80
6.7	Bechtel Test Plan	10466-J-067-05 Seismic Qualification Test Plan	E	3/29/78
6.8	IEEE Standard	IEEE Std 344 Seismic Qualification of Class 1E Equipment		1975
6.9	Bechtel Test Report	10466-J-601A-0148-03 Seismic Qualification Test Report	C	3/3/82
6.10	Bechtel	10466-J-601A-0163-01 Supplementary Seismic Qualification		8/23/82
6.11	Bechtel	10466-J-601A-0158-01 Environmental Test		4/9/82
6.12	Bechtel	10466-SK-J-103(Q) Modifications and Additions to the Instrument Loops	N	3/31/82
6.13	Bechtel Design Criteria	10466-J-000 Control Systems Design Criteria	8	1/26/78
6.14	Bechtel Specification	10466-QA-1 Specification of General Requirements for Supplier QA Programs	4	10/15/75

Ref. No.	Document Type	Description/Title	Rev.	Date
6.15	Westinghouse Specification	V-7 Subsection 7 - Auxiliary Feedwater System	2	8/73
6.16	Bechtel Drawing	M-02AL01(Q) Piping and Instrument Diagram Auxiliary Feedwater System	11	9/21/82
6.17	Bechtel Drawing	10466-J-110-0350-03 Auxiliary Feedwater Flow Control - Turbine Driven AFP to Steam Generator D	3	2/15/79
6.18	Bechtel Drawing	E-03AL05A(Q) Auxiliary Feedwater Pumps, Discharge Control Air Oper. Valves	0	7/7/82
6.19	Bechtel Drawing	10466-J-110-0356-03 Auxiliary Feedwater Flow Control - Motor Driven AFP B to Steam Generator C	3	2/19/79
6.20	Bechtel Drawing	J-02AL01A(Q) Auxiliary Feedwater System Motor Driven Aux Feedwater Pumps	0	11/11/82
6.21	Bechtel Drawing	E-03AL01B(Q) Motor Driven Aux Feedwater Pump B	0	7/7/82
6.22	Bechtel Procedure	EDPI 4.46-01 Project Engineering Drawings	17	5/21/82
6.23	Bechtel Drawing	E-02NF01(Q) Load Shedding and Emergency Load Sequencing Logic	2	12/7/77
6.24	Bechtel Drawing	E-03AL01B(Q) Motor Driven Auxiliary Feedwater Pump B	0	7/7/82
6.25	Bechtel Drawing	J-02AL01(Q) Auxiliary Feedwater System Motor Driven Auxiliary Feedwater Pumps	3	1/27/82
6.26	Bechtel Drawing	J-02FC19(Q) Auxiliary Turbines SGFP Turbines ESFAS Block Control Logic Diagram	0	2/16/82
6.27	Bechtel Drawing	E-03FC27(Q) SGFP Turbines A&B Isolation Input To ESFAS	2	5/5/82
6.28	Bechtel Drawing	E-03AL04A(Q) Supply from ESS Service Water System	0	7/7/82
6.29	Bechtel Drawing	E-03AL04B(Q) Supply from ESS Service Water System	0	7/7/82

Ref. No.	Document Type	Description/Title	Rev.	Date
6.30	Bechtel Drawing	E-03AL02A(Q) Motor Operated Valves	0	7/7/82
6.31	Bechtel Drawing	E-03AL02B(Q) Motor Operated Valves	0	7/7/82
6.32	Bechtel Specification	J104(Q) Technical Specification for Engineered Safety Features Actuation System	12	8/11/82
6.33	Bechtel Specification	J110(Q) Major Electronic Instrumentation and Controls Package	5	4/19/82
6.34	Bechtel Specification	J-301(Q) Electronic Pressure and Differential Pressure Transmitters	11	9/30/82
6.35	Bechtel Drawing	J-104-0147-08 LSELS IE Relay Allocation		4/11/78
6.36	Bechtel Drawing	J-104-0042-12 Actuation Outputs - Channel 4		10/26/82
6.37	Bechtel Drawing	J-104-0034-12 Actuation Outputs - Channel 1		8/4/82
6.38	Bechtel Procedure	EDPI-4.37-01 Design Calculations	8	1/7/81
6.39	Bechtel Specification	J-435(Q) Orifice Plates for Nuclear Class 2 and 3 Piping Systems	13	7/15/82
6.40	Bechtel Calculation	ME-223-001 Calculation Verification of Computer Program ME 223 Thin Edge Orifice Plates	0	11/4/80
6.41	Bechtel Calculation	J-435 Calculation Orifice Type Flow Elements	0	11/29/82
6.42	Bechtel Drawing	7250D64 Sheet 15 - SNUPPS Projects Functional Diagram Auxiliary Feedwater Pumps Startup	3	
6.43	Bechtel Drawing	7250D64 Sheet 7	2	
6.44	Bechtel Drawing	7250D64 Sheet 15	4	

Ref. No.	Document Type	Description/Title	Rev.	Date
6.45	Bechtel Drawing	7?50D64 Sheet 8	3	
6.46	Bechtel Drawing	7243D59 Sheet 1 Solid State Protection System SNUPPS Projects Interconnection Diagram	7	
6.47	Bechtel Drawing	M-23KA47 Small Piping Isometric N2 Beck-up Gas Supply Auxiliary Building	1	3/10/82
6.48	Technical Bulletin	Technical Bulletin		
6.49	Westinghouse Letter	Westinghouse Letter to SNUPPS		
6.50	Bechtel Logic Diagram	02AL05	0	
6.51	Bechtel Logic Diagram	02AL06	0	
6.52	Bechtel Logic Diagram	02AL07	0	
6.53	Bechtel Procedure	EDPI 4.41-01, "Base Design Document Review, Approval, and Release Requirements	1	
6.54	Bechtel Procedure	JIGEN		
6.55	Union Electric Procedure	QS-14, "Preparation, Review and Document Control of Safety Analysis Reports and Subsequent Changes"	2	9/23/82

7.6.2 Personnel Interviewed

Name	Title	Organization
Tony Diperna	CS Group Supervisor	Bechtel
D. R. Quattrociocchi	Project Engineer	Bechtel
A. Hassan	Electrical Engineer	Bechtel
W. A. Poppe	Group Leader, Mech/Nuclear	Bechtel
G. P. Schwartz	Control Sys. Site Liaison	Bechtel
P. Trimbach		Bechtel
I. Tessier	Startup Testing	Bechtel
B. Vich	Group Leader, Control Sys. Group	Bechtel
D. Grove	Group Leader, Control Sys. Group	Bechtel
J. J. Milos	Project Quality Engineer	Bechtel
R. P. Wendling	Supervising Engineer, Nuclear	Union Electric Company
T. H. McFarland	Superintendent, Site Liaison	Union Electric Company
R. J. Schukai	General Manager, Engineering	Union Electric Company
K. W. Kuechenmeister	Supv. Engr., UE Construction	Union Electric Company
D. MacIsaac	Startup Engineer	Union Electric Company
S. Hogan	QA Engineer	Union Electric Company
D. Brady	Startup Program Coordinator	Union Electric Company
R. Cothran	Consulting Engineer	Union Electric Company
R. Huston	Startup Test Coordinator	Union Electric Company
R. Veatch	Supervising Engineer	Union Electric Company
A. Sassani	Consulting Engineer	Union Electric Company
R. Trimbach	Supervisor, Metrology	Union Electric Company
F. Maddy	Consulting Engineer	Union Electric Company
W. Minerich		Union Electric Company
W. Spezialetti	Manager, Plant Licensing	Westinghouse
J. Swogger	SNUPPS Project Engineer	Westinghouse
P. Barilla	Eng., Chem. & Waste Process Sys.	Westinghouse
N. Beck	Engineer, Fluid System Design	Westinghouse
Steven T. Maher	Systems Engineer	Westinghouse
Frank Thomson	Engineer	Westinghouse
S. J. Seiken	QA Manager	Nuclear Projects, Inc.

7.7 Other Information

7.7.1 - Chronology

10/20/82	Team members began study of background information and preparation of inspection plans.
10/22/82	Team meeting
11/4/82	Team meeting
11/10/82	Entrance meeting at Union Electric Inspection at Union Electric
11/11/82	Entrance meeting at construction site Inspection at construction site
11/12/82	Inspection at Union Electric Exit meeting
11/15/82	Entrance meeting at Nuclear Projects, Inc. Inspection at Nuclear Projects, Inc.
11/16/82	Inspection at Nuclear Projects, Inc. Entrance meeting at Bechtel Power Corporation
11/17/82 to 11/19/82	Inspection at Bechtel Power Corporation Exit meeting (11/19/82)
11/29/82 to 12/3/82	Inspection at Bechtel Power Corporation Exit meeting (12/3/82)
12/6/82 to 12/8/82	Inspection at construction site Exit meeting (12/8/82)
12/9/82	Entrance meeting at Westinghouse Electric Inspection at Westinghouse Electric (some team members at Union Electric)

12/10/82 Inspection at Westinghouse Electric
Exit meeting
(some team members at Bechtel)

12/13/82 to 12/14/82 Inspection at Bechtel Power Corporation
(some team members only)

1/20/82 Team meeting

PRINCIPAL STAFF

RA		DPRP	
D/RA		DE	
A/RA		DRSS	
PO		DRMA	
PAO		SCS	
SGA		ML	
ENF		File	

(8)

November 4, 1983

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DOCKETED
USNRC

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

'83 NOV -7 A10:20

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of)
)
UNION ELECTRIC COMPANY) Docket No. STN 50-483 OL
)
(Callaway Plant, Unit 1))

APPLICANT'S RESPONSE TO THE APPEAL BOARD'S
MEMORANDUM AND ORDER OF OCTOBER 20, 1983

On September 23, 1983, Joint Intervenors filed a Petition for Reconsideration of ALAB-740, 18 N.R.C. ___ (Sept. 14, 1983), which affirmed LBP-82-109, 16 N.R.C. 1829 (1982), the Licensing Board's partial initial decision finding in Applicant's favor as to allegations of construction and quality assurance deficiencies at the Callaway Plant. Responses in opposition were filed on October 12, 1983 by Applicant and the NRC Staff.

On October 20, 1983, the Appeal Board issued a Memorandum and Order in which it directed Applicant and the NRC Staff to file additional information and views, including any affidavits that may be necessary, with respect to one matter raised in the petition. The inquiry aims specifically at Observation No. 4-1 in the NRC Staff's Integrated Design Inspection Program (IDIP) report.[1/] The Staff indicates, in the IDIP report, that Bechtel's civil-structural engineering group had recalculated the original design floor response spectra based upon as-built conditions,

1/ The IDIP report represents the purported basis for the petition.

and that the revised spectra, which in some cases exceeded the original design spectra, had not been formally transmitted to other engineering disciplines.

In its October 20 Memorandum and Order, the Appeal Board restates Joint Intervenors' assertion that the loads imposed by the floors of the auxiliary building, which in some cases are supported by embedded plates installed before the discovery of defects, may exceed design loads. The Board observes that, based upon the materials before it, there appears to have been no definitive assessment regarding the safety significance, if any, of the differences between the original and revised spectra. Consequently, the Board requests additional information ". . . with respect to what has been done since the December, 1982 I&E inspection with respect to determining if the loads imposed by the revised spectra exceed the design loads, and the safety implications, if any." Memorandum and Order at 3. More pointedly, the Board asked how the new seismic load would affect the parties' conclusions on the manually welded embeds if the record is based upon the original spectra. Id. at n.4.

Attached hereto is the Affidavit of Eugene W. Thomas, prepared in response to this Appeal Board inquiry. In his affidavit, Mr. Thomas provides a technical explanation of floor response spectra and their relationship to embedded plates, reports on the evolution of floor response spectra for the SNUPPS project, and explains the current status and conclusions of the assessments of floor response spectra as they relate to the safety of the manually-welded embedded plates at issue in this proceeding.

While the entire assessment program is not yet completed, the completed reviews encompass the loads on all 225 safety-related, manually-welded embedded plates installed in the Callaway Plant prior to June 7, 1977. These reviews constitute a definitive assessment for these plates of the safety significance of the difference between the floor response spectra used in the original design and the revised spectra. The assessment shows that there are no load increases on any of these plates as a result of the as-built floor response spectrum curves because, among other reasons, the maximum design loads on these plates are controlled by a loading combination which does not include seismic loads. Consequently, the revised floor response spectra have no safety significance for, and do not alter Applicant's conclusions with respect to, the acceptability of the manually-welded embeds. Thomas Affidavit at ¶¶ 11, 12.

The subject observation in the IDIP report therefore could not materially affect the outcome reached by the Board in ALAB-740 and does not carry Joint Intervenors' burden of support for their petition.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE

Thomas A. Baxter

Thomas A. Baxter, P.C.
Counsel for Applicant
1800 M Street, N.W.
Washington, D.C. 20036
(202) 822-1090

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of	)	
	)	
UNION ELECTRIC COMPANY	)	Docket No. STN 50-483 OL
	)	
(Callaway Plant, Unit 1)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Applicant's Response to the Appeal Board's Memorandum and Order of October 20, 1983" and "Affidavit of Eugene W. Thomas" were served this 4th day of November, 1983, by deposit in the U.S. mail, first class, postage prepaid, upon the following:

Alan S. Rosenthal, Esquire
Chairman
Atomic Safety and Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gary J. Edles, Esquire
Atomic Safety and Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. Reginald L. Gotchy
Atomic Safety and Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

James P. Gleason, Esquire
Chairman
Atomic Safety and Licensing Board
513 Gilmoure Drive
Silver Spring, Maryland 20901

Mr. Glenn O. Bright
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. Jerry R. Kline
Atomic Safety and Licensing Board
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Mr. John G. Reed
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Birch, Horton, Bittner & Monroe
1140 Connecticut Avenue, N.W., #1100
Washington, D.C. 20036

Thomas A. Baxter
Thomas A. Baxter

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of	)	
	)	
UNION ELECTRIC COMPANY	)	Docket No. STN 50-483 OL
	)	
(Callaway Plant, Unit 1)	)	

AFFIDAVIT OF EUGENE W. THOMAS

County of Montgomery	)	
	)	ss.
State of Maryland	)	

EUGENE W. THOMAS, being duly sworn, deposes and says:

1. I am employed by Bechtel Power Corporation, Gaithersburg Power Division, Gaithersburg, Maryland. My present position is Civil/Structural Engineering Staff Supervisor. I have previously testified on behalf of Applicant in this proceeding on the embedded plate issue, submitting prefiled written testimony dated November 6, 1981 (Applicant Embed Testimony) and appearing for oral testimony at the hearing on this issue on November 18-23, 1981. A complete statement of my professional qualifications is incorporated in Applicant Embed Testimony, following Tr. 501, at 4 and Attachment 2.

2. I previously prepared an affidavit, dated October 11, 1983, which was filed in support of (and as Exhibit D to) Applicant's Response to Joint Intervenors' Petition for Reconsideration, dated October 12, 1983. I make this Affidavit in response to the Appeal Board's Memorandum and Order of October 20, 1983, which seeks additional information with respect to an Observation (No. 4-1) made in the Integrated Design Inspection Program (IDIP) report (No. 50-483/82-22) prepared by the NRC Office of Inspection and Enforcement and

issued in April, 1983.

3. In particular, the IDIP report indicates that Bechtel's civil-structural engineering group had recalculated the original design Floor Response Spectra (FRS) based upon as-built conditions and determined that in some cases the revised FRS exceeded the original design spectra. The IDIP report further indicates that such revised FRS had not been formally transmitted to other engineering disciplines. The Appeal Board, in its Memorandum and Order, asks what has been done since the December, 1982 I & E inspection with respect to determining if the loads imposed by the revised spectra exceed the design loads, and the safety implications, if any.

4. This Affidavit is organized into the following four sections: Technical Explanation and Relationship to Embedded Plates; Historical Background; Current Status; and Conclusions.

Technical Explanation and Relationship to Embedded Plates

5. A floor response spectrum represents the maximum dynamic response, as a function of frequency, of a single-degree-of-freedom system when excited by an acceleration time history. More simply, a floor response spectrum represents the basic seismic load input (i.e., acceleration) of an item at a given location in a structure and is used for design and qualification of seismic Category I systems, components, and structures. Approximately 1200 floor response spectra curves (which are graphical plots of the acceleration versus frequency) were generated for the SNUPPS Project. Although FRS curves are derived from a seismic analysis of the building structure they are neither

dependent upon nor a function of the load-carrying capacity of embedded plates which may, in some cases, support portions of the building structure. Design loads for embedded plates are derived from a number of different loading combinations, not all of which include seismic loads in the controlling combination. Since the FRS curves are used to develop seismic loads, the potential exists that revised FRS curves might result in higher loads on supports for systems and components which, if attached to embedded plates, might result in higher loads on the plates than those for which they were originally designed.

Historical Background

6. The original seismic analysis of the power block structures, performed in 1976, was based on the structural configuration and foundation (soil) properties established at that time for the various SNUPPS sites. As a result of this seismic analysis, FRS curves were generated and issued by the Civil engineering discipline for use in design and seismic qualification of Category I systems, components, and structures. These design FRS curves were generated for each of the four SNUPPS sites (Callaway, Wolf Creek, Sterling and Tyrone) in three directions (north-south, east-west, and vertical) at each floor level (masspoint) in the building structures. They were issued for use in late 1976 and early 1977 and were used by all engineering disciplines in the design of systems and procurement of components.

7. In mid-1979, it was determined by the Civil engineering discipline that, based on as-built foundation (soil) properties and

finalized structural configuration, as well as refinements in the seismic modeling of the power block, it was prudent to revise the analytical model used for seismic analysis and evaluate the impact of any resultant changes in structural response. This revised seismic analysis was completed in late 1980 for the Callaway, Wolf Creek and Sterling sites (current licensing commitment), and new as-built FRS curves were generated and preliminarily compared with the design FRS curves during late 1981 and early 1982. In general, this preliminary comparison indicated that the as-built FRS curves were enveloped by the design FRS curves. However, the comparison also indicated that, at certain frequencies and damping values, many as-built FRS curve accelerations were higher than the design FRS curve accelerations. Most of these excesses were very limited in either magnitude or affected frequency range. The as-built curves were not issued for use to other engineering disciplines because it was judged that the original design curves represented conservative seismic load input. This judgment was based on the overall comparison of the curves, our knowledge of conservatism in the generation and application of FRS curves, experience in resolving FRS curve revisions on other projects, and review of the magnitude and range of the FRS curve excesses. Conservatisms in the design FRS curves and the as-built FRS curves included a safe shutdown earthquate (SSE) ground acceleration level of 0.25g (versus a licensed level of 0.20g) and conservative mass distribution in the analytical models.

8. As a result, the Civil engineering group began an assessment of the excesses in mid-1982 in an attempt to establish that sufficient conservatisms existed in the design FRS curves to preclude the need for issuance of revised curves. This assessment consisted of the preparation of seismic load comparison calculations for the seismic Category I structures and the generation of detailed comparison graphs using computers and computer aided drafting. This effort was undertaken because the issuance of revised curves, when not warranted from a technical standpoint, could represent an unnecessary major impact on project cost and schedule. The assessment effort continued through early 1983, and it was during this effort that the NRC Integrated Design Inspection took place (November, 1982).

9. In early 1983, it was decided that the ongoing assessment methodology would not conclusively resolve every excess noted in the comparisons. Therefore, several alternative approaches were considered. These included:

(a) Issue the as-built FRS curves for use.

(b) Generate refined as-built FRS curves by redoing the seismic analysis with structural configuration more definitively modeled (using more masses distributed realistically in the structures) and using an input seismic motion at the licensed SSE level of 0.20g.

(c) Establish a task force to assess the impact of the as-built FRS curves on systems, components, and structures which were designed (c), Continued

or qualified using the design FRS curves. This assessment would be handled by performing an applications review (as opposed to comparing seismic analysis output) to establish the conservatism in original design and qualification.

It was decided in mid-1983 to pursue the latter two alternatives in a tandem effort to resolve concerns regarding the excesses.

Current Status

10. Generation of the refined as-built FRS curves was completed in mid-October, 1983. These curves eliminated or reduced the excesses previously addressed. These refined curves will be used in the on-going evaluations of an FRS task force which was established in July, 1983 to review the application of the FRS curves to 1) structural components (building structures and supports other than pipe supports), 2) equipment, and 3) pipe stress analyses (including pipe supports). The objective of this task force is to evaluate the seismic design and qualification of all seismic components of the SNUPPS plant in order to insure that they are adequate to satisfy the requirements of the as-built FRS curves.

11. The task force has completed its review of approximately ninety percent (90%) of the structural components and equipment. The seismic qualifications of all reviewed items meet the requirements of the as-built FRS curves. The completed reviews encompass the loads on all 225 safety-related manually welded embedded plates installed in the Callaway plant prior to June 7, 1977. There are no load increases on any of these plates as a result of the as-built FRS curves.

The maximum design loads on these plates are controlled by a loading combination which does not include seismic loads. In fact, the seismic design loads on these plates are reduced because the accelerations from the as-built FRS curves are lower than those used in the original design for the applicable plate locations and structural frequencies.

Conclusions

12. With respect to the safety-related, manually-welded embeds installed prior to June 7, 1977 at the Callaway Plant, there has been a definitive assessment of the safety significance of the difference between the FRS used in the original design and the revised FRS. The conclusion of that assessment is that the revised FRS curves do not result in load increases on those plates and, therefore, have no safety significance relating to those plates. Consequently, the Applicant's conclusions before the Licensing Board and the Appeal Board on the acceptability of those plates are not altered. (Reference is made to Footnote 4 of the Appeal Board's Memorandum and Order. The response provided at oral argument was based upon the original design FRS. As indicated above, however, the answer is not affected by consideration of the revised FRS for any of the 259 manually-welded

embeds, 34 of which are not safety-related.)

Eugene W. Thomas

Eugene W. Thomas

Subscribed and sworn to before me

this 3rd day of November, 1983.

Roberta B. Curren

Notary Public

My Commission expires ____________.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

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Pelke

NOV 16 1983

Docket No. 50-483

Union Electric Company
ATTN: Mr. Donald F. Schnell
Vice President - Nuclear
Post Office Box 149 - Mail Code 400
St. Louis, MO 63166

Gentlemen:

Your letter ULNRC-636, dated June 15, 1983, transmitted Union Electric's response to the findings and unresolved items identified during the Callaway Integrated Design Inspection (IDI) performed by NRC and documented in NRC Report No. 50-483/82-22. The IDI Team members have now reviewed your response and require additional information with regard to certain of the findings and unresolved items. Following your transmittal and the IDI Team's review of that information, and review by Team members of other information which you have stated is available at Bechtel's Gaithersburg office, a meeting should be held at the Callaway site to discuss in detail all open IDI findings and unresolved items. We will contact you or your staff separately regarding a mutually agreeable date for such a meeting.

The specific findings and unresolved items about which additional information is required are discussed in the attachment to this letter. As agreed to during a telephone conversation, on November 10, 1983, between R. L. Powers of your staff and J. E. Konklin of this office, your written response to these items should be made within 30 days following your receipt of this letter.

~~8311210166~~

Should you have any questions concerning this matter, please contact this office.

Sincerely,

"Original Signed By W. D. Shafer"

C. E. Norelius, Director
Division of Project and
Resident Programs

Enclosure: As Stated

cc w/encl:
W. H. Weber, Manager, Nuclear Construction
S. E. Miltenberger, Plant Manager
DMB/Document Control Desk (RIDS)
Resident Inspector, RIII
Region IV
K. Drey
Ronald Fluegge, Utility Divison
Missouri Public Service Commission
D. Allison, IE

RIII	RIII	RIII	RIII
Konklin/ol	Knop	Little	Norelius
11/09/83	11/14/83	11/15/83	11-15-83

ATTACHMENT

DISCUSSIONS AND REQUESTS FOR ADDITIONAL INFORMATION
INDEPENDENT DESIGN INSPECTION

Unresolved Item 3-1

Your response does not appear to address the concern. The concern involved the vector decomposition of a single direction of the seismic building response. Based on the discussion in the ME 101 users manual for skewed supports, the computer program multiples the building displacement by the support cosine vector to determine the movement along the support direction for input to the static displacement analysis. This procedure disregards the component of the building displacement perpendicular to the support direction. It should be noted that, since this is vector decomposition of a single component of the building displacement, these components are perfectly correlated. The specific concern involves the method of solution used by the computer program to determine forces and moments in the piping system. If the program resolves the imposed displacement along the support axis back into the global system using the cosine vectors, the imposed global displacement will be less than the original building displacement and a ficticious displacement will be added to the perpendicular global direction. This could occur if the original resolution of the displacement perpendicular to the support axis was lost as stated above.

You are requested to provide a detailed description of the method used by the computer to formulate the forces and moments and, if the method involves simplifying assumptions such as disregarding a displacement component, you are requested to describe the conservatism or lack of conservatism in the approach. Alternatively, an acceptable approach to resolution of the concern would be to run simplified test cases to demonstrate that displacement output at the support point in the global directions matches the building input motion at the support point.

Unresolved Item 3-5

Your response does not adequately resolve the item. Test data on components as cited in NUREG-0307 have demonstrated that some components such as welding tees have moment capacities equal to or greater than the attached straight pipe. The reduction procedure in TB-011 is not conservative for all components based on actual test results cited in NUREG-0307. Based on your response that the procedure was only used at elbows for Callaway, the design of those anchors should be adequate. However, the procedure should be modified to reflect the actual data for other types of components such as welding tees. You are requested to describe your plans for modifying the procedure.

Unresolved Item 3-6

Your response does not adequately resolve the item. The response addressed the question of the general stiffness of major structural elements such as concrete shear walls. However, you did not address the specific question of the stiffness at the support change 2FC-1191-MH or the specific concern of I-beam members loaded in torsion. The issue of loading structural I-beams in torsion with pipe supports has been found to be a problem at some facilities because the structural designers were not aware of support requirements. You are requested to describe your plans for addressing the stiffness of this specific example and the general concern of I-beams loaded in torsion.

Finding 3-8

Your response does not adequately resolve the item. You stated that standard support components (such as snubbers) are normally loaded axially and are therefore significantly stiffer than the associated structural support members and you cited a single example problem. However, the finding provided a specific example where the snubber was so flexible that the support assembly could not meet the stiffness requirements of Specification M-217, regardless of the stiffness of the associated structural support members. Furthermore, it is doubtful that the standard support components are generally so stiff that valid results will be provided by only considering the associated structural support stiffness.

You are requested to describe your plans to resolve the question about the specific support cited in the finding, which does not meet the stiffness requirements of Specification M-217 and, therefore, could affect the validity of the piping analysis. In addition, you are requested to describe your plans for identifying other instances where supports do not meet the stiffness assumptions used in the piping analysis and determining whether or not they have a significant effect on the analyses.

Finding 6-2

Your response does not adequately resolve the item. The error identified in logic diagram J02AL01 should have been detected and corrected by the review process prior to issuance of the drawing. The fact that it was detected and corrected during the review of a subsequent revision to the drawing (issued during the NRC inspection) does not attest to the effectiveness of the original design review. You are requested to describe your plans for review of other logic diagrams against the applicable schematics to determine whether or not a systematic problem is present.

Finding 6-3

No further information is required regarding this specific error, which appears to have been corrected by revision of the FSAR. However, we are concerned that this error may be indicative of other similar errors; inconsistencies between the FSAR commitments and the actual design. That concern is strengthened by other similar findings during the IDI review. Accordingly, please provide additional information concerning the actions you have taken to assure that other FSAR deficiencies of this type do not exist, and that further errors of this type will be precluded or identified.

Finding G-4

Please describe your assessment of the causes of this error, and the bases for your determination that this was an isolated incident.

(10)

UNION ELECTRIC COMPANY
1901 GRATIOT STREET
ST. LOUIS, MISSOURI

December 19, 1983

DONALD F. SCHNELL
VICE PRESIDENT

MAILING ADDRESS:
P. O. BOX 149
ST. LOUIS, MISSOURI 63166

Mr. C. E. Norelius, Director
Division of Project and Resident Programs
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Norelius: ULNRC-706

SECOND RESPONSE TO NRC INTEGRATED DESIGN INSPECTION (IDI) REPORT

Ref: Your letter to D. F. Schnell dated November 16, 1983

The referenced letter transmitted a request for additional information on seven items previously discussed in our June 15, 1983 letter to Region III. The attachment to this letter repeats the NRC's concerns and provides the requested additional information.

The referenced letter suggested a meeting in the near future to discuss "all open IDI findings and unresolved items". It is our hope that such a meeting will result in resolution of the entire IDI report. We are willing to meet at any time.

Sincerely,

Donald F. Schnell

Donald F. Schnell

ACP/lw

cc: John T. Collins, Region IV
Richard C. DeYoung, Director, OIE Hq.
G. L. Koester, KG&E
D. T. McPhee, KCP&L
NRC Resident Inspector, Callaway Plant
H. M. Wescott, NRC Region III
Missouri Public Service Commission
T. A. Baxter, Shaw, Pittman, Potts & Trowbridge
N. A. Petrick, SNUPPS
B. L. Meyers, Bechtel

STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Vice President
Nuclear

SUBSCRIBED and sworn to before me this 19th day of December, 1983

Mary C. Guinn
MARY C. GUINN
NOTARY PUBLIC—STATE OF MISSOURI
ST. LOUIS CITY
MY COMMISSION EXPIRES JUNE 16, 1986

NRC COMMENT ON THE RESPONSE TO FINDING 3-1 (11-18-83)

Your response does not appear to address the concern. The concern involved the vector decomposition of a single direction of the seismic building response. Based on the discussion in the ME 101 Users Manual for skewed supports, the computer program multiplies the building displacement by the support cosine vector to determine the movement along the support direction for input to the static displacement perpendicular to the support direction. It should be noted that, since this is vector decomposition of a single component of the building displacement, these components are perfectly correlated. The specific concern involves the method of solution used by the computer program to determine forces and moments in the piping system. If the program resolves the imposed displacement along the support axis back into the global system using the cosine vectors, the imposed global displacement will be less than the original building displacement and a ficticious displacement will be added to the perpendicular global direction. This could occur if the original resolution of the displacement perpendicular to the support axis was lost as stated above.

You are requested to provide a detailed description of the method used by the computer to formulate the forces and moments and, if the method involves simplifying assumptions such as disregarding a displacement component, you are requested to describe the conservatism or lack of conservatism in the approach. Alternatively, an acceptable approach to resolution of the concern would be to run simplified test cases to demonstrate that displacement output at the support point in the global directions matches the building input motion at the support point.

SECOND RESPONSE (12-16-83)

In order to demonstrate that skewed supports are properly treated in the seismic anchor movement analysis of Bechtel's ME 101 program, a sample problem was run to compare input and output values of seismic anchor movements - this method is in accordance with the alternative approach suggested by the NRC. The sample problem contained 3 skewed supports which addressed the range of conditions necessary to insure that no data has been misplaced by ME 101.

The results of this investigation are documented in Bechtel Study PDE-80-08. An exact correlation of input and output displacement values was demonstrated. The displacement output at the support point in the global directions matched the building input motion at the support point.

On this basis, it was concluded that the ME 101 non-conservatism postulated by the NRC does not exist.

NRC COMMENT ON THE RESPONSE TO UNRESOLVED ITEM 3-5 (11-18-83)

Your response does not adequately resolve the item. Test data on components as cited in NUREG-0307 have demonstrated that some components such as welding tees have moment capacities equal to or greater than the attached straight pipe. The reduction procedure in TB-011 is not conservative for all components based on actual test results cited in NUREG-0307. Based on your response that the procedure was only used at elbows for Callaway, the design of those anchors should be adequate. However, the procedure should be modified to reflect the actual data for other types of components such as welding tees. You are requested to describe your plans for modifying the procedure.

SECOND RESONSE (12-16-83)

Bechtel Procedure TB-011 will be revised to limit the application of stress intensification factor (SIF) to reduce the collapse piping loads at elbows only. A survey of all Bechtel projects using TB-011 has confirmed that the SIF reduction provision has been used for elbows only.

The revised procedure will be issued and distributed no later than December 16, 1983.

NRC COMMENT ON RESPONSE TO UNRESOLVED ITEM 3-6 (11-18-83)

Your response does not adequately resolve the item. The response addressed the question of the general stiffness of major structural elements such as concrete shear walls. However, you did not address the specific question of the stiffness at the support change 2FC-1191-MH or the specific concern of I-beam members loaded in torsion. The issue of loading structural I-beams in torsion with pipe supports has been found to be a problem at some facilities because the structural designers were not aware of support requirements. You are requested to describe your plans for addressing the stiffness of this specific example and the general concern of I-beams loaded in torsion.

SECOND RESPONSE (12-16-83)

As noted previously, Bechtel's standard practice is not to consider the contribution of Building Structural members in overall pipe support stiffness calculations. Therefore, no plans are currently in place to evaluate individual cases of building steel being loaded in torsion for stiffness. Nevertheless, Field Change Request 2FC-1191-MH has been re-evaluated to consider the contribution of torsional rotation on pipe support 0-FC01-R004/135Q and subsequently on stress problem No. 68.

The overall stiffness of pipe support 0-FC01-R004/135Q was calculated and provided as input for a reanalysis of stress problem No. 68. The resulting stress levels were well within allowable and indicate only minor changes from the previous analysis. Based on this example and the factors noted in our original response, this is not considered to be a generic concern.

The issue concerning the torsional loading of structural I-beams is not a problem at the Callaway Plant because the effects of torsional loading are considered by the civil group in its review of pipe supports.

The loads received by civil, from plant design engineering, for each hanger review include all loads at the civil/plant design interface point, including torsional moment. Civil then reviews the adequacy of the structural steel to handle these loads and approves the hanger, or makes modification, as necessary.

NRC COMMENT ON RESPONSE TO FINDING 3-8 (11-18-83)

Your response does not adequately resolve the item. You stated that standard support components (such as snubbers) are normally loaded axially and are therefore significantly stiffer than the associated structural support members and you cited a single example problem. However, the finding provided a specific example where the snubber was so flexible that the support assembly could not meet the stiffness requirements of Specification M-217, regardless of the stiffness of the associated structural support members. Furthermore, it is doubtful that the standard support components are generally so stiff that valid results will be provided by only considering the associated structural support stiffness.

You are requested to describe your plans to resolve the question about the specific support cited in the finding, which does not meet the stiffness requirements of Specification M-217 and, therefore, could affect the validity of the piping analysis. In addition, you are requested to describe your plans for identifying other instances where supports do not meet the stiffness assumptions used in the piping analysis and determining whether or not they have a significant effect on the analyses.

SECOND RESPONSE (12-16-83)

A study was performed on the support in question (0-FC01-R020/135Q) to determine its overall support stiffness. The revised stiffness value was then input into stress problem No. 60 to evaluate the effect. The study shows a negligible increase in piping stress levels.

We suggest the results of this study be reviewed with the cognizant NRC inspector. We believe any examination of the approach and methodology used in the referenced study, when considered in conjunction will the rationale provided to NRC in the initial response, will sufficiently support our contention that further consideration of this item is not required.

NRC COMMENT ON RESPONSE TO FINDING 6-2 (11-18-83)

Your response does not adequately resolve the item. The error identified in logic diagram J-2AL01 should have been detected and corrected by the review process prior to issuance of the drawing. The fact that it was detected and corrected during the review of a subsequent revision to the drawing (issued during the NRC inspection) does not attest to the effectiveness of the original design review. You are requested to describe your plans for review of other logic diagrams against the applicable schematics to determine whether or not a systematic problem is present.

SECOND RESPONSE (12-16-83)

We do not believe there exists a systematic problem involving logic diagrams. The discrepancy noted between logic diagram J-02AL01 and electrical schematic E-03AL01A&B was solely the result of a misinterpretation of load sequencer interlocks. To ensure that similar misinterpretations have not occurred, all logic diagrams and electrical schematics involving the load sequencer will be reviewed. This review will be completed by February 15, 1984.

NRC COMMENT ON THE RESPONSE TO FINDING 6-3

No further information is required regarding this specific error, which appears to have been corrected by revision of the FSAR. However, we are concerned that this error may be indicative of other similar errors; inconsistencies between the FSAR commitments and the actual design. That concern is strengthened by other similar findings during the IDI review. Accordingly, please provide additional information concerning the actions you have taken to assure that other FSAR deficiencies of this type do not exist, and that further errors of this type will be precluded or identified.

SECOND RESPONSE (12-16-83)

Our original responses to findings 2-1, 2-7 and 6-3 provided sufficient information to conclude that,

1) the actual configuration of the plant meets the safety design bases,
2) procedures that control FSAR preparation and revision processes are adequate to minimize the introduction of inconsistencies, and

3) the FSAR inconsistencies noted did not form the bases for a safety concern.

In the case of findings 2-7 and 6-3, it was determined that FSAR change control procedures were not executed properly. As a consequence, inconsistencies between the FSAR and actual plant configuration were not corrected. However, we do not believe these two examples are an indication of a breakdown in this area. As indicated in our previous comment with respect to finding 2-1, we believe existing design to be consistent with FSAR commitments.

Project Engineering procedures provide measures for control of the FSAR and are used to preclude the introduction of inconsistencies between evolving design detail and licensing commitments. Where changes in licensing detail are anticipated due to design evolution, the procedures provide a mechanism for identification, tracking and implementation of required changes. The primary procedures in place for this purpose at Bechtel are EDPI 4.22-01 "Preparation and Control of SAR," and EDPI 4.23-01 "SAR Change Control."

There are several additional mechanisms available for identifying FSAR material which may be inconsistent with current design configuration. Primarily, these are by audit and licensing reviews conducted internally within Bechtel or initiated through SNUPPS Staff/Utility review. In addition, final system design descriptions are updated at time of design completion and system turnover. This updating process is undertaken to assure compatibility and consistency between final system design and FSAR commitments. An added check of consistency with FSAR commitments is provided through preparation of preoperational test procedures which focus on demonstrating capability of the existing, as-built design to satisfy FSAR commitments.

In conclusion, although two cases were noted where the FSAR was not properly brought up to date to reflect final design configuration, the process of FSAR change is adequately controlled and has not resulted in any unresolved safety concerns. Consequently, no action beyond that currently indicated is proposed.

NRC COMMENT ON THE RESPONSE TO FINDING 6-4

Please describe your assessment of the causes of this error, and the bases for your determination that this was an isolated incident.

SECOND RESPONSE (12-16-83)

Bechtel acknowledges a procedural violation in that the J-435 (orifice plate) specification was issued prior to signoff approval of a formal calculation. The applicable Bechtel procedure, EDPI 4.37-01, allows such issue with permission of the Project Engineer. Although the issuance of the purchase specification was a sound engineering decision on the basis of completed computer calculations, permission to release the specification was not obtained. The technical adequacy of the specification was verified through a subsequent review of the calculations at which time the Bechtel design was confirmed to be correct.

Since the time of the initial NRC inspection, further reviews were conducted in this area. While no additional examples have been found of purchase specification release in advance of calculation checking and approval, instances were identified in which design drawings had been released in advance of approval of supporting calculations. This finding has led to further technical reviews and resulted in issuance of a directive by the Bechtel Division Engineering Manager reaffirming Division policy that release of design documents will be supported by checked and approved calculations. Instructions have since been issued by Bechtel to obligate the responsible engineering discipline to indicate whether issuance of a new (or revised) design document is supported by calculation and to require verification that such calculations have been checked and approved in accordance with existing procedure. Bechtel compliance with these procedural controls will be subject to increased SNUPPS/Utility monitoring and audit.

It should be noted that these technical reviews have not resulted in any design document changes.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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PRINCIPAL STAFF			
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Docket No. STN 50-483

Mr. D. F. Schnell
Vice President - Nuclear
Union Electric Company
1901 Gratiot Street
P. O. Box 149
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Dear Mr. Schnell:

Subject: Design Verification Activities - Callaway 1

As you are aware, the NRC staff has been seeking additional assurances from applicants for operating licenses that the design process used in constructing their plant has fully complied with NRC regulations and licensing commitments.

In this regard, we have evaluated the results from the recent Integrated Design Inspection (IDI) performed at Callaway 1 and believe that an Independent Design Verification Program or similar program is not necessary for this plant at this time pending satisfactory resolution of the Callaway 1 IDI report findings.

Sincerely,

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulations

cc: See next page

~~Doc # 8401190566~~

JAN 9 1984

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DONALD F. SCHNELL
VICE PRESIDENT

June 15, 1983

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ULNRC-636
SUBJ: Integrated Design
Inspection 50-483/82-22

Ref: NRC Letter DeYoung To Schnell, Union Electric, Dated 4/4/83:
Subj. As Above

Dear Mr. Keppler:

In accordance with the reference request, please find enclosed Union Electric's response to the findings and unresolved items identified in the subject design inspection of the SNUPPS/Callaway Auxiliary Feedwater System. The order of response has been arranged to coincide with the sequence used by NRC in the reference report. For purposes of brevity, specific inspection findings and unresolved items have, in most instances, been paraphrased rather than repeated in their entirety.

Aside from the responses addressing each inspection finding and unresolved issue, we believe it appropriate to comment on the conclusions cited in Mr. DeYoung's April 4th letter as follows:

1. The findings related to the lack of formal control of Bechtel newsletters; i.e. Item 1, and the indicated need for improvement in control of the Bechtel design process; i.e. Item 4, taken together appear to reflect the inspector's concerns with the control of design interface information. As noted in the response to finding 4-4, the need for improving internal design interface processes is acknowledged and actions have been taken to this effect over the past 12 months. Several of these actions are described in the enclosure. Notwithstanding this recognition of the benefit to be achieved from improvements in this area, we continue to believe that the interface controls in place over the life of the project have been effective and have been instrumental in producing a satisfactory design product. This conclusion appears to be substantiated by many of the inspection team's individual comments and observations contained in the body of the NRC report.

Which ~~findings~~ does Allison feel have been satisfactorily resolved by the ~~findings~~ licensee? Then, which ones should be done by Region III and which by Region IV?

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2. The concerns regarding seismic classification of the pump turbine exhaust pipe; i.e. Item 2, and the alleged noncompliance with FSAR commitments; i.e. Item 5 are addressed in the enclosed response to Findings 2-1, 2-7 and 6-3. As indicated in the detailed response to Findings 2-1 and 2-7, we are satisfied that the present system design meets all current regulatory requirements and licensing commitments and will satisfactorily function during events beyond the existing design bases established by NRC. Finding 6-3 involves an acknowledged inconsistency in the final design configuration from that specified in the FSAR. This inconsistency in configuration was the result of an oversight in updating descriptive material in the FSAR which has since been corrected. We concur with the inspector's conclusions that the functional design requirements have not been compromised by this oversight.

3. The conclusion in Item 3 of the NRC summary that the ability of motor controllers to withstand specified fault currents had neither been considered nor assured in the design process is not correct. As indicated in the discussion in response to Finding 5-1, existing data is available to demonstrate the capability of the controllers to meet the interrupting short circuit fault conditions established by approved design specifications. We are confident that a re-examination of available data and supporting design documentation will result in a similar conclusion on the part of the NRC inspector.

We believe the enclosed details together with the clarification and comments noted above satisfy all outstanding issues and questions raised in the reference inspection report. Should you have any questions concerning our response, please let us know.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

SJS/ACP/sla

Encl.

cc: John T. Collins, Administrator, Region IV
Richard C. DeYoung, Director, OIE Hq.
G. L. Koester, KGE
D. T. McPhee, KCPL
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MO. PSC
Gerald Charnoff, Esq.
Nicholas A. Petrick

STATE OF MISSOURI)
) S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Vice President
Nuclear

SUBSCRIBED and sworn to before me this 15th day of June, 1983

Barbara J. Pfaff
BARBARA J. PFAFF
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES APRIL 22, 1985
ST. LOUIS COUNTY

FINDING 2-1

This finding questions the design adequacy of the auxiliary feedwater pump turbine exhaust line which is non seismic category I beyond the boundary of the auxiliary building. The finding states that the design provisions for the line are shown on Figure 10.4-10; however, it contends that the design is improper in that it violates FSAR commitments related to the seismic design capability of the active AFW Turbine driven pump.

RESPONSE

The response to this finding is divided into three parts which address 1) the design adequacy of the exhaust line 2) the compliance with the FSAR, and 3) the content of the FSAR.

1. Design Provisions

The design of the AFP turbine exhaust line was established during the early phases of the project and it was shown in the PSAR and the FSAR as being non-seismic Category I beyond the boundary of the auxiliary building.

The design was based on current licensing requirements for system operation following a single failure. The design flow rate is delivered by the system for all credible initiating events and has been accepted by the NRC during both the PSAR and FSAR review phases.

The following exhaust line failure mode considerations were evaluated in establishing the design:

(a) The auxiliary boiler building is designed to UBC seismic considerations and is not expected to fail during a seismic event.

(b) If the auxiliary boiler building were to catostrophically fail and the exhaust line were sheared off completely, the AFP turbine would operate properly.

(c) Even if the exhaust line were to crimp significantly, the AFP turbine driven pump would still deliver design flow rates. The back pressure on the turbine may be increased significantly before the required flow rates will not be available. A local constriction of 90% of the free area of the exhaust line is required before the design flow will not be delivered. This type of failure is not considered to be credible.

Breaks in seismic Category I piping are not postulated during a seismic event. Thus a MSLB or MFLB inside containment or in the steam tunnel are not postulated following a seismic event and the design of the exhaust line does not enter into the evaluation of these breaks.

For a seismically induced MSLB in the turbine building, various single failures can be postulated, none of which result in adverse conditions even if the AFP Turbine is inoperable. If an MSLIV fails to close, one steam generator will blow down; however, 2 motor driven AFW Pumps are available to feed 3 intact steam generators. If one motor driven pump train fails for any reason, the other motor driven pump will feed 2 steam generators as required. In this case the break has been isolated by the MSLIV and all 4 steam generators are intact.

The turbine driven pump subsystem is designed to be independent of AC power as required by the NRC for defense-in-depth to reduce the consequences of a total loss of all AC power. Loss of all AC power is not a design basis condition of SNUPPS since it would require failure of both of the diesel generators to start concurrent with a loss of offsite power. However, the design capabilities of the SNUPPS plants for this condition were evaluated by the NRC staff and the ACRS and were found to be acceptable.

The possibility of both a seismic event and a total loss of AC power occurring simultaneously is remote. Even if this combination were to occur, the auxiliary boiler building would have to fail in a manner which would result in the nearly perfect sealing of the entire flow area of the exhaust line before the turbine driven pump would fail to deliver the required flow.

To summarize the design provisions of the AFW system, the system design meets all current requirements and will function for events beyond current design bases established by the NRC.

2. <u>Compliance With The FSAR</u>

The design of the AFP turbine exhaust pipe is in accordance with the original design intent and the FSAR requirements. The declassification of the exhaust line to non seismic and B31.1 was shown in the PSAR and the FSAR. The design of the AFW pump and turbine meet the FSAR requirements stated in Section 3.9(B).3.2.2.1: the pump is designed and qualified to operate during a safe shutdown earthquake. This section makes no commitment for the design of the exhaust line nor does it address the exhaust line.

The regulatory requirements for the seismic design of systems are addressed in Regulatory Guide 1.29. The SNUPPS response to this regulatory guide is provided in Table 3.2-3. As noted therein, the SNUPPS implementation of seismic requirements is shown on Table 3.2-1. The text of Section 3.2 states the following:

> "For identification of system and subsystem boundaries, Table 3.2-1 is supplemented (i.e., referenced to applicable figures) by piping and instrument diagrams which have been marked to clearly show the limits of the seismic category I and the various quality group classifications on a system."

Section 5.4 of Table 3.2-1 describes the AFW system pumps and provides a reference to Figure 10.4-9. Figure 10.4-9 clearly indicates the limits of the seismic Category I piping. Section 10.4.9 also references this table for the definition of seismic design limits.

In summary, it is SNUPPS position that there is no violation of FSAR commitments.

3. Content of the FSAR

This finding implies that the SNUPPS FSAR did not fully describe the design of the exhaust line. We believe that the FSAR content is appropriate.

The SNUPPS FSAR is written in accordance with Regulatory Guide 1.70. This regulatory guide and the Standard Review Plans (SRPS) do not require descriptions of design provisions which have not been provided nor do they require justification for not providing certain features. The SNUPPS FSAR does clearly identify the design of the exhaust line and references the specific location in which the exhaust line provisions can be reviewed.

UNRESOLVED ITEM 2-1

This unresolved item addresses the fact that the final room temperature calculations for the turbine driven pump room were not completed at the time of the audit. Since the AFW turbine driven pump is to be independent of AC power, no Class 1E cooling or ventilation is provided. The components within the room are designed for the ambient conditions resulting from the operation of the pump. This item also indicates an apparent need to calculate the resultant environment following a non-mechanistic pipe break in the steam tunnel.

RESPONSE

The audit report correctly indicates that the calculations had not been finalized and that, on the basis of engineering judgment, the final calculations would likely support the conditions previously specified. The final calculation has been completed and it confirms that room conditions will be maintained below equipment qualification temperature of 150°F during operation of the AFW turbine driven pump. These conditions are based on heat sinks and conduction heat losses from the room; no credit is taken for the non-safety related ventilation system since it is powered from AC power.

With respect to the environmental effects of a non-mechanistic break in the steam tunnel, please refer to the discussions provided in response to Finding 2-7. As noted in the response to Finding 2-7, the environmental conditions in an adjacent valve compartment stabilized when the fire dampers closed. For the turbine driven pump room, the HVAC system is isolated by valves which close on an SIS. Therefore, the amount of steam released into the room will be less than the analyzed compartment. The heat transfer through the slab would be a much slower transient which is not expected to provide a significant effect on the room's environment. The turbine driven pump can be expected to function during this transient even though it is not specifically qualified for the resultant conditions.

It should be noted that both motor driven pump rooms are provided with Class 1E air coolers which will minimize the effects of any steam release through the drains or conduction through the floor slab separating the pump rooms from the main steam tunnel. Since the total loss of AC power is not postulated with a nonmechanistic break in the tunnel, one or both motor driven auxiliary feedwater pumps would be available to mitigate the effects of the nonmechanistic break and to ensure the health and safety of the public.

As noted in the response to Finding 2-1, the turbine driven pump is designed to be independent of AC power for defense-in-depth for an event which is beyond the design basis of the SNUPPS plants. That event is the total loss of AC power (both onsite and offsite) in which both diesel generators fail to start. That event is very improbable and is not postulated to occur with any other DBE or with a nonmechanistic break in the steam tunnel. Therefore, the turbine driven pump is not considered to be subjected to these potentially adverse transients while it is the only source of auxiliary feedwater.

In summary, the required finalization of the AFW turbine driven pump room temperature calculation has been completed. Since the effects of a nonmechanistic break in the steam tunnel are not a design consideration for the room, the related effects are not included in the calculations.

FINDING 2-2

This finding addresses minor errors on the flow diagram at three nodes for one of the five analyzed modes of AFWS operation. The errors resulted from the use of previously calculated pressure drops from another case; however, the line was stagnant for this specific case and no flow related pressure drops would exist.

RESPONSE

Bechtel agrees with the substance of this audit finding and with the auditor's observation that this was not a systematic error, and that it had no effect on the design. The mode which was being analyzed would never exist in the actual plant. The mode was considered only to demonstrate the maximum pressure which the piping could potentially experience for defense in depth. The mode assumed that the pumps were operating in a recirculation mode with suction from the ESW system [higher pressure than the condensate storage tank (CST)] due to the unavailability of the CST. This case also assumed that the flow was returned to the CST. This flow scheme would not be used during a test since it would result in contamination of the CST water with essential service water. This flow scheme would not exist during system operation since the discharge valves to two steam generators would not be closed.

In summary, the errors had no significance and the flow diagram will be corrected to reflect the pressures of the assumed no flow condition.

FINDING 2-3

This finding addresses an error in AFWS calculation AL-20 wherein the head loss assigned to flow restriction orifices had been changed in one part of the calculation but not in another. The auditor concluded that this inconsistency had no effect on the results of the calculation since sufficient margin was provided in subsequent steps.

RESPONSE

The calculation has been revised to correct the error. Bechtel agrees with the finding in that an error existed, that the error was limited in scope and not systematic and that the error did not adversely affect the results.

FINDING 2-4

This finding addresses the fact that zone of influence drawings for pipe break effects evaluation had not been prepared in accordance with the instructions contained in the Project Engineering Manager internal memorandum of August 19, 1980.

RESPONSE

The zone of influence drawings were not prepared because other, more effective means were available to determine the area and equipment affected by each break. As noted by the inspector, the 3/4" engineering model was effectively utilized in actually determining the influence of breaks. The instructions have since been revised to reflect actual practice.

FINDING 2-5

This finding addresses an apparent misstatement in the documentation contained on a target sheet which is used to document the evaluation of the effects of a specific break. The break number is FC01-01. The Dynamic Effects Analysis (target sheet) stated that there would be "no whip"; whereas, the inspector's evaluation was that the pipe could potentially whip. (Note: The target sheet should have stated that while the pipe could whip, no impact would result due to the absence of unacceptable targets in the area). This misstatement was indicated to have no impact since there were no unacceptable targets in the area.

RESPONSE

The specific target sheet was completed as a formality following the evaluation of the content of the room, the significance of the break, and the effect on safe shutdown. All components within the room and particularly those in proximity to the break were associated with the turbine driven auxiliary feedwater pump. The pump was made inoperable due to the pipe break in question, therefore it was determined that no adverse effects would result whether the pipe whipped or not.

Without confirmatory analysis, the pipe should have been considered to potentially whip since the distance to the first rigid restraint was beyond the hinge distance. As noted above, this misstatement has no impact since there are no unacceptable targets in the area. A notation has since been made on the specific target sheet which states that "this pipe may potentially whip, however, there are no unacceptable targets if the pipe should whip".

This is considered to be an isolated case. In other areas of the plant where essential targets exist, the engineers determined whether the pipe actually would whip. All evaluations are conservative and ensure that the plant can be shutdown and the effects of the break mitigated.

FINDING 2-6

This finding reflects the inspector's view that the break by break effects analysis (target sheets) are quasi design documents and therefore should have been subject to controls of EDPI 4.37-01, Design Calculations, or other controls of a similar scope requiring the target sheets to be signed, dated, checked, and approved as they were developed. The finding also indicates the inspector's understanding that since this was not done, a final review near the end of the project would be performed (by Bechtel) to ensure the accuracy of the documents; however, in the interim period, these documents should be subject to formal control.

RESPONSE

High energy line break (HELB) has been a design consideration from the very early stages of the SNUPPS job. The engineers initially assigned to the SNUPPS Project were knowledgeable in HELB considerations and ensured that basic separation criteria were included in the plant layout. Since the SNUPPS concept of power block duplication provided for a detailed engineering model, the design for HELBs has been integrated into the base design of the plant and reflected on the engineering model. Starting in 1977, an informal Hazards Protection Task Force (HPTF) was formed to ensure that HELB considerations are incorporated into the design. Interdisciplinary meetings were held to define the HELB program requirements, formalize interfaces and establish design responsibilities.

In 1980, the Bechtel Project Engineering Manager issued the instructions referenced in Finding 2-4 to formalize previous agreements and to ensure that each discipline was aware of the other disciplines' design responsibilities and interfaces. Each discipline is responsible for developing appropriate design calculations to support HELB-related designs issued by the discipline. These calculations were generated in accordance with EDPI 4.37-01 and the design drawings were generated in accordance with EDPI 4.46-01. The finding acknowledges that data on the target sheets were extracted from design calculations and piping isometric drawings which have, since inception, been properly controlled.

The HPTF is not a design group. It serves mainly an advisory function and allows for interdisciplinary discussion of HELB concerns. Engineers within each discipline perform the actual design duties. The target sheets reflect the design of the plant, since the design had to exist prior to the development of the list of targets which could be impacted. The target sheets, therefore, do not form a basis of the design. Similarly, the action plans which summarize the potentially adverse conditions identified on the target sheets provide recommendations for discipline evaluations and designs. The discipline receiving the action plan determines if a design modification is required and notifies the HPTF coordinator of the results of the evaluation. The status of action plan resolution and the method of resolution is maintained.

Similarly, the HPTF documentation is not the primary backup for information submitted to the NRC. The design calculations and design drawings provide the primary backup for licensing submittals. The HPTF documentation does indicate that extraordinary efforts of review and coordination have been properly performed. It also provides a convenient well organized location for verification that the HELB program was correctly implemented.

The main issue in this finding is with the adequacy of the controls provided for the HPTF review documentation. Bechtel considered the need for controls and established those controls which were deemed appropriate, necessary, and cost effective to ensure that the design provided was correct and met the licensing commitments. Although Bechtel determined that signing, dating, checking and approving of the target sheets were not required, adequate controls were implemented.

Following completion of the target listings, the HPTF Coordinator issues dated action plans (by signed and dated memos to the disciplines) which document the need for additional evaluations or design work to be performed by a discipline. The action plans were controlled and reviewed informally by the Project Engineer and the supervisor of the Mechanical discipline, and the disciplines receiving the action plans. There was and still is daily contact between the HPTF Coordinator and supervision within the Mechanical group.

The target sheets have always been maintained in one central location along with other data relevant to the HPTF efforts. These files are closely supervised and controlled within the Mechanical group. As noted in the finding discussion a final review of this documentation will be performed to ensure that it reflects the final design. Since continuous control has been exercised, no significant deviations are expected to be found.

In summary, adequate and proper HELB control has been provided throughout the design phase. These controls have functioned properly for many years, and need not be altered prior to the final review of the HPTF documentation which is scheduled for the near future. All action plans have been dated, reviewed and transmitted to the design disciplines. The design disciplines will continue to exercise design controls for design functions to close out the action plans. Bechtel will continue to ensure that the HELB effort is adequately controlled and implements the licensing commitments.

FINDING 2-7

This finding identified an apparent instance where a statement in the FSAR had not been implemented in the design. The statement was that there is no water drainage to lower elevations of the auxiliary building following a nonmechanistic break of a main feedwater line. The main issue is whether the effects of nonmechanistic breaks in the steam tunnel should be considered in the design basis of the rooms below the steam tunnel.

RESPONSE:

In 1977 the NRC advised the SNUPPS utilities that the SNUPPS main steam tunnel room would have to be designed to withstand the pressure effects of a nonmechanistic break in a main steam or main feed line. The NRC also stated that any equipment required for safe shutdown located within the room should be qualified to the resultant environment. On March 9, 1978, the NRC accepted the design modifications and analyses provided by SNUPPS which allowed the venting of the structure and provided the parameters required for qualification of items within the room.

Flooding within main steam tunnel room from this nonmechanistic break was calculated. In order to ensure the integrity of the walls and to preclude the need for equipment qualification in a submerged condition, two twenty-inch drain lines were provided to drain the water to the turbine building. During preparation of the licensing submittal, note was taken of these large drain lines as well as certain sealed penetrations through the floor of the steam tunnel. It was erroneously assumed that there would be no drainage to the lower elevations of the plant even though the small drain lines were shown on the drainage system P&IDs. The FSAR will be revised to eliminate this error.

Although it was never SNUPPS' intent to extend the effects of this improbable, nonmechanistic break outside the steam tunnel, water drainage and steam escape through the small drain lines have been considered. Water drainage to lower elevations will not adversely affect safety-related equipment because the water goes to the auxiliary building basement which has a 7-foot design flood depth. Similarly steam escape is not likely to affect safety-related equipment due to the small driving force (steam tunnel pressure) and because fire dampers in the ventilation ducts close when the room temperature exceeds that normally anticipated. When the dampers close, the driving force equalizes, and passive heat sinks take effect to reduce room temperature.

FINDING 3-1

The finding noted that stress newsletters had not been evaluated for use on the SNUPPS project and were not controlled properly or implemented uniformly. The inspector judged this to be a violation of Bechtel Procedure EDPI 4.1-01, "Design Criteria".

RESPONSE

Bechtel concurs that the issuance of and the use of documents similar to stress newsletters should be subject to normal design document controls. Therefore, Bechtel recalled all stress newsletters and issued them as controlled documents on December 10, 1982. New issues or revisions to existing newsletters are also being controlled in accordance with guidelines issued by the Chief Engineer in his Dec. 10th memorandum.

Newsletters do not contain design criteria as defined in EDPI 4.1-01; therefore, the prior lack of formal control of the newsletters is not considered to be a violation of the EDPI. The newsletters contain information, such as discussions of analysis techniques and clarifications of code interpretations and procedures, which is available to the project through other sources.

UNRESOLVED ITEM 3-1

114

This item addresses the contention that for skewed supports (which did not align with east-west, north-south or vertical directions), the seismic anchor movement applied to the support by computer program ME 101 is the global movement multiplied by the cosine vector. It was noted that this practice might yield nonconservative results for some cases.

RESPONSE

ME 101 analysis of skewed piping utilizes input of two global seismic movements at the support point on the pipe. The program calculates the components of these two displacements in the direction of the support and two separate static analyses are performed. The responses (i.e, loads, deflections, moments) from the two analyses are then combined by the Square Root of the Sum of the Squares (SRSS) method. This methodology is acceptable because the transient responses of the components due to dynamic motions are relatively uncorrelated and have random peaking.

Therefore no further study or corrective action is necessary.

FINDING 3-2

HG

This finding addresses stress analysis problem 60 which had not employed the correct enveloped seismic response spectrum. The finding discussion indicated that since no formal design requirements exist to address response spectra input for branch lines, this problem could apply to other analyses where branch lines have been decoupled from larger piping systems. (Note: the discussion of Finding 3-1 indicates this type of error could have been avoided by use of an appropriate newsletter).

RESPONSE

Bechtel concurs that stress problem 60 used the incorrect seismic response spectrum. The stress problem has been reanalyzed with a new response spectrum which envelops the containment shell and Auxiliary Building. The results of the reanalysis do not significantly differ from the previous analysis.

In an effort to evaluate the potential for similar error, Bechtel has reviewed the stress input for four other stress problems (P-43, P-70, P-225 and P-27BY). These stress problems were chosen for review based on their similarity to problem 60. It was found that the proper spectrum was used in all cases. Therefore, it has been concluded that this error is an isolated incident and no further review is necessary.

It should be noted that the application of the building response spectra in pipe stress analysis problems is performed in accordance with normal stress analysis criteria. The misapplication of response spectra as noted in this finding is the result of analyst error and not the general misapplication of stress analysis newsletters.

HG/RIII.

FINDING 3-3

This finding related to the fact that drawing M-03AB01 did not reflect the correct "as-built" condition at the connection between the steam supply to the auxiliary feed pump turbine and the main loop 3 header. It was noted that the piping fabricator had supplied a configuration slightly different from that described on the Bechtel drawing.

RESPONSE

The subject connection has since been incorporated onto the applicable design isometric drawing. The drawing has been reviewed by the Bechtel stress group and the relevant stress problem (P-60) reanalyzed with the correct geometry and stress intensification factor. The stresses resulting from this change were found to be within code allowable limits.

Identification of inconsistencies between "as-built" configuration and the applicable design drawings such as that noted by the inspector are explicitly addressed in the SNUPPS IE 79-14 walkdown program currently underway at Callaway. The 79-14 walkdown program provides for reconcilation of all physical differences between as-built configuration and approved design; such reconcilation will be reflected in the final design drawings and stress analyses. This program provides assurance that other inconsistencies are corrected prior to fuel load.

FINDING 3-4

HQ.

This finding addresses the fact that pipe stress analysis problem 60 did not contain documentation for calculation of the stress intensification factor (SIF) used. The finding indicated that this was in violation of EDP 4.37, Design Calculations.

RESPONSE

Bechtel concurs that problem 60 did not provide the origin for the SIF used in the calculation. The specific value used has been confirmed to be correct. Since this problem has been reanalyzed, the origin of the SIF value has been indicated.

The prior lack of documentation is not considered a violation of EDPI 4.37-01. Assumptions are listed in the calculation; it is not required that the justification for every assumption be documented.

FINDING 3-5

This finding indicates that piping stress analysis problem 44A did not contain an evaluation of the imposed loads and movement due to the thermal expansion of the attached buried piping outside the auxiliary building. This is contrary to Section ND-3651 of the 1974 Edition of the ASME Code. The inspector noted that this appeared to be a unique situation involving an interface, without an anchor, between Non-Seismic Category I buried pipe and Seismic Category I pipe inside a building.

RESPONSE

Bechtel concurs that loads and movements from the attached buried piping had not been fully addressed in problem 44A. As such, a design procedure has been developed by Bechtel to address buried pipe installations. This procedure has been transmitted to the engineering group in the form of a Stress Newsletter.

As a result of this finding problem 44A has been reanalyzed to properly account for buried piping. The reanalysis results show that all pipe stresses are within code allowables. Bechtel is presently conducting a review of all SNUPPS analyses involving above-the-ground/buried piping interfaces. At present, it is unlikely that any physical modification to the piping systems will be required as a result of the review.

FINDING 3-6

The finding indicated that stress analysis problem 44A did not contain an analysis of piping from the condensate storage tank inside the building for the cold condition. It also noted that this omission did not appear to be systematic since a check (by the inspector) of the section from the ESSW and AFW discharge piping confirmed they had been analyzed for the low temperature condition.

RESPONSE

Bechtel concurs that the cold condition had not been evaluated in the pipe stress analysis. Problem 44A has been revised to account for the cold condition of the piping. The results of the reanalysis indicate that all piping stresses are within code allowables and that there is no significant increase in pipe support loading. Bechtel further concurs with the NRC that this is an isolated omission.

UNRESOLVED ITEM 3-2

This item indicates that the Auxiliary Feedwater system piping had not been evaluated for compliance with NRC MEB document "Interim Technical Position Functional Capability of Passive Piping Components for ASME Class 2&3 Piping Systems". It also indicates that, in the inspector's view, stresses at some points in the piping system exceed the minimum limits given in the technical position.

RESPONSE

The Auxiliary Feedwater system has since been evaluated and the piping system meets the function capability requirements of the technical position. The results of the evaluation indicated that no stress limits were exceeded and no modification was required.

UNRESOLVED ITEM 3-3

This item addresses the fact that stiffness calculations had not been performed for pipe support 0-AL04-C009/135Q, which utilizes a two-strut design in accordance with Hanger Engineering Standard (HES) 16. Additionally, this item notes that an evaluation had not been performed to verify that the strut stiffnesses met the requirements of Specification M-217 for the entire range of angles allowed by HES-16, revision 1.

RESPONSE

As a result of this item, and in order to demonstrate the acceptability of HES-16, revision 1, calculations were performed using varying strut restraint angles. The calculations demonstrate that the minimum stiffness requirements as specified in Specification M-217 were achieved when struts were separated by as little as a 22° - included angle.

The two-sway strut application is similar to a truss design in which the structural members experience only axial loading; i.e., the members do not experience any bending or shear loading.

As axial deflections are generally not significant in overall stiffness calculations, the omission of sway strut stiffness contribution to overall stiffness calculations would not have a significant effect.

Bechtel has concluded that two strut applications such as the one addressed in this item in accordance with HES-16, revision 1, meet the minimum stiffness requirements specified in Specification M-217 and further utilized in piping stress analysis. The evaluation is available for NRC review in Bechtel's Gaithersburg Office.

UNRESOLVED ITEM 3-4

This item addresses the lateral vibrations of struts and rods which was not considered for the SNUPPS project. No criteria were available for evaluating the frequency of supports in the unrestrained direction. FSAR Section 3.7(B).3.7 stated that the seismic design of piping included the effects of the seismic response of supports. This item contends that significant lateral vibration of the support would reduce its buckling capacity and could affect the response of the piping system. This question should be addressed to determine whether it has any effect on the design.

RESPONSE

The SNUPPS FSAR states that the seismic design of piping systems "included the effect of the seismic response of the supports..." The design of struts and rods considered appropriate effects of the seismic response of these elements by specifying axial stiffness criteria which preclude amplification of seismic loads in the direction of loading. Since struts and rods are not intended to transfer lateral seismic loads, no amplification in these directions need be considered.

In response to this item, Bechtel has performed a two-fold evaluation of the effects of lateral vibration. The study addresses the following:

1. The ability of sway struts and spring supports to function while subjected to lateral vibration.
2. The effect of dynamic loads resulting from support lateral vibration on the piping system.

The study indicates acceptable results for both of the above noted areas of concern.

FINDING 3-7

RIII

This finding indicates that support AL01-R005/135Q was not intended to provide vertical support; however, the field inspection of the support indicated that there was no clearance at the bottom of the pipe and the pipe motion would be restrained in the vertical direction. This was indicated to be a nonsystematic error that was not picked up on the detail checking.

RESPONSE

Revision 3 of the support drawing was issued on January 6, 1983 to remove the discrepancy between the dimensions shown in the Bill of Materials and the support detail. This support will be reworked to obtain the proper vertical clearance.

Bechtel concurs with the NRC inspector that this was a nonsystematic error. As noted in the audit finding discussion, this condition would most likely have been observed and corrected as a result of the IE Bulletin 79-14 walkdown.

FINDING 3-8

This finding indicates that the stress analysis stiffness input did not consider the contribution of component support (snubbers, sway struts, etc.) flexibility and, in essence, assumes the snubbers involved to be rigid. In the opinion of the inspector this omission constituted a violation of Bechtel Specification M-217. It also indicated that the inclusion of the snubber stiffness value in support 0-FC01-R020/135Q would have resulted in an overall stiffness value less than that used in the input to stress analysis problem 60. The inspector further noted that snubber stiffness characteristics in general were not being checked for compliance with M-217. This finding together with unresolved items 3-3, 3-4 and 3-6 indicates need for improved guidance in this area.

RESPONSE

Bechtel Specification M-217 was not explicit regarding the applicability of stiffness criteria to various classes of supports. As noted in the response to Unresolved Item 3-6, Specification M-217 has been revised to reflect the current policy which is summarized as follows:

> For ASME Class 1 piping analysis, the pipe support stiffness value will encompass the contribution of all elements in the pipe support assembly including component standard supports. For ASME Class 2 and 3 and ANSI B31.1 piping analysis, the stress analysis input will consist only of the minimum stiffness values established in Specification M-217. The stiffness values are calculated based on the stiffness of the structural pipe support members only, assuming that the component standard supports are infinitely rigid.

The basis for the above policy is that component standard supports are normally loaded axially and are therefore significantly stiffer than the associated support structural members. Therefore, the omission of component support stiffness contribution from the pipe stress analysis input does not generally affect the validity of the result.

To provide an example of how Bechtel's design practice ensures the piping system's ability to meet code requirements, Bechtel has performed a study wherein one restraint stiffness in a piping stress analysis was modified to include the stiffness value of a typical snubber attached to a pipe support designed in accordance with M-217 stiffness criteria. The study utilized normal frequency design considerations and evaluated the effect of the worst case snubber/pipe support combination. The results indicate that seismic response of the piping system is not significantly affected and that pipe support loading and pipe stresses would increase slightly. The full text of this study is available for NRC review at Bechtel's Gaithersburg office. A draft of the revised section of Specification M-217 has been attached for information. The responses to unresolved items 3-3 and 3-6 are also addressed by the attachment. The findings noted above and unresolved items 3-3, 3-4, and 3-6 did not indicate any deviation from Bechtel standard design criteria. As such, the need for further guidance in the area of pipe support stiffness applications is unnecessary. However, the revision to Specification M-217 will serve to further document Bechtel's current position.

DRAFT

C. The stiffness of a support in the restraining direction will be determined as follows:

1. For supports on Nuclear Class 1 Stress Problems the total stiffness will be calculated using the individual component stiffnesses (e.g., clamp stiffness, strut stiffness, frame stiffness, etc.).

2. For all other supports (excluding Non-Q, Non-II/I, and Non-Seismic) the support stiffness shall only include the stiffness of any supplementary pipesupport steel (e.g. frame stiffness, beam stiffness, etc.). However, the stress analysis group may require the total support stiffness for specific stress problems or supports. In such cases the total support stiffness will be calculated using the method described in Section 4.2.C.1.

In neither case shall the support stiffness include the stiffness of any building steel or building structure or any structure outside the jurisdictional boundary established in the ASME Code Subsection NF.

UNRESOLVED ITEM 3-5

This item identified that the ASME Code stress intensification factor was used to reduce the collapse moments when designing boundary anchors in the vicinity of fittings. The general acceptability of this practice is questionable, since the code stress intensification factors would not generally correlate with section collapse properties.

RESPONSE

It should be noted that the SIF reduction provision of TB-011 has had limited usage on SNUPPS. Only three anchors have been designed utilizing the reduced SIF. These anchors were all within three pipe diameters of elbows. There are no instances where the SIF reductions were applied to other fittings.

The use of pipe collapse loads for the design of seismic boundary anchors assumes total collapse of the adjoining non-seismic portion of the pipe and therefore reflects an extremely conservative design approach. For some boundary anchors located within three (3) pipe diameters of a fitting, the collapse loads are reduced by application of the stress intensification factor, which accounts for lower strength and, hence, lower collapse loads at weaker points in the piping system. In order to approximate the actual section collapse properties, the stress intensification factors are reduced by 25%. The 25% reduction factor was previously determined by comparison of the test data referenced in TB-011 with calculated stress intensification factors. In light of the hypothetical worst load case event postulated, Bechtel has concluded that the present seismic boundary anchor design practices are acceptable.

UNRESOLVED ITEM 3-6

This item addressed the approval of the design modification requested in Field Change Request (FCR) 2FC-1191-MH without an evaluation of the contribution of the building's structural member to the support's overall stiffness computation. It was noted that the method of attachment to the I-Beam would offer minimal resistance to rotation and could affect the design stiffness of the support.

RESPONSE

As a result of this item, Specification M-217 has been revised to further clarify the position that only structural members designed by the pipe support group are to be considered in overall stiffness calculations. This revision indicates that building structural members are to be assumed as infinitely rigid and not included in the stiffness calculations. The basis for this revision is as follows:

1. Building structural members are normally significantly larger and more rigidly framed than the associated pipe support structure. As such, they do not contribute appreciably to the overall support stiffness.

2. Many structural members (such as the structural member in question) are composite sections which are mechanically connected to the adjacent reinforced concrete slab. Structural members in this configuration undergo minimal deflection or rotation and do not contribute significantly to the overall stiffness calculation.

3. Limitations must be placed on the scope of stiffness calculations. This limit is selected to be the building structural steel (the point where additional structural elements do not significantly alter the stiffness). It is not feasible to consider all structural deflections beyond this point.

In summary, Bechtels evaluation of FCR 2FC-1191-MH was performed in accordance with the normal procedure. The revision to Specification M-217 clarifies and justifies the Bechtel design practice.

UNRESOLVED ITEM 3-7

This finding addressed the design adequacy of the angle supports for the AFP Turbine control panel shown in the Terry Corporation Qualification Report. The finding indicates that an unsymetrical bending analysis using appropriate analytical methods should have been performed on the angle supports to properly predict the stresses in the supports.

HE.

RESPONSE

The subject angle supports will not be installed in the plant. The control panel will be mounted on a rectangular frame which will be rigidly connected to the auxiliary building wall. The supports shown in the Qualification Report were used to mount the panel to the shaker table. The panel was mounted to the test supports in the same manner that it will be supported to the frame which will be attached to the auxiliary building wall. This frame is symetrical and rigid. Based on the above considerations, which were not presented to the author of this finding, this issue is considered to be closed and no analysis is required.

UNRESOLVED ITEM 3-8

This finding addressed a potential inadequacy in stress problem 60 wherein a nozzle was assumed to act as a rigid point at the boundary of the stress problem. The AFP turbine test report results indicated that several points within the pump/turbine package had low natural frequencies which could invalidate the assumption that the nozzle is rigid.

RESPONSE

The assumption that treats the nozzle as a rigid point is potentially unconservative. The AFP test report indicates that the turbine casing is rigid and that selected appurtenances on the skid have low natural frequencies. Stress problem 60 will be revised so the the problem is terminated at the rigid turbine casing. The analysis will consider the trip and throttle valve and include the valve frequency.

FINDING 4-1

Corrected.

The Union Electric review in 1973 of the Bechtel Civil-Structural Design Criteria Specification C-0 was conducted prior to issuance (in March 1974) of Union Electric Procedure QE-303 governing design document review. The inspector noted this to be a procedural oversight which was corrected with issuance in 1974 of the referenced procedure.

RESPONSE

As noted by the inspector, this oversight was corrected with issuance of Union Electric Procedure QE-303 in March, 1974. Review comments generated prior to that date with respect to Specification C-0 were verified to have been properly dispositioned. Design document review activities subsequent to March 1974 have been carried out in accordance with written and approved procedures subject to QA audit and surveillance.

FINDING 4-2

The training and experience records for a civil/structural engineer employed by NPI from June 1975 to May 1976 could not be located. This was indicated to be a record keeping error without impact on the design.

RESPONSE

An updated copy of the engineer's education, training and work experience records have been obtained and placed in the NPI personnel files. A check of these files confirms this to be an isolated record keeping error. Qualification and training records were verified to be on hand at NPI for current and previously employed professional/technical staff.

FINDING 4-3

Bechtel procedure EDPI 4.37-01, Section 4.2, which requires all calculations to be microfilmed by the 15th day of the month following approval, was violated due to a delay in processing Auxiliary Building seismic analysis calculations for microfilming. This was a procedural matter that had no apparent effect on the design.

RESPONSE

The calculation in question (13-08F) involves large amounts of computer generated data which must be microfilmed with the calculation. The computer output was cross-referenced in the parent calculation to facilitate retrieval. All computer data microfilm records were verified for proper cross-referencing prior to forwarding the parent calculation for microfilming. This task was necessary to ensure the absence of operator error during microfilming, and was performed as the schedule permitted due to the extensive data involved. The calculation in question has been microfilmed.

The subject matter of the calculation (floor response spectra) was critical to ongoing design tasks. Therefore, review and approval by the Civil group supervisor was expedited to allow its use during the cross-reference verification process. This practice was limited to the calculations generated for seismic related analysis, and is of a unique nature due to the extensive computer generated work associated with the seismic analysis. The timing prescribed by the procedure applies to calculations in general and does not recognize extraordinary circumstances such as exist in this case.

Although a technical violation of EDPI 4.37-01, Section 4.2 is acknowledged, this process did not affect the technical content of the calculation and was, in fact, intended to ensure the accuracy of the final record.

UNRESOLVED ITEM 4-1

In the design of an electrical raceway support involving the use of clip angles connecting a vertical steel tube to a base plate, assumptions regarding a hinged connection at the base were questioned. The design did not account for partial fixity developed at this connection. It was requested that the welds and angles be evaluated in terms of actual fixity of the attachment to determine whether or not adequate strength exists.

RESPONSE

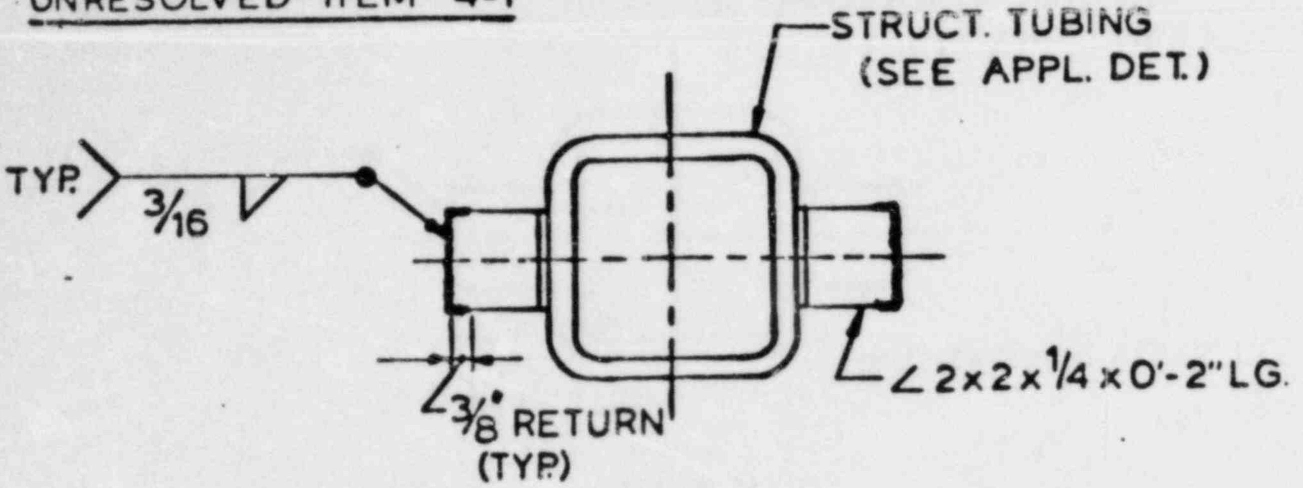
The subject connection detail was utilized in the design of cable tray supports located within the Auxiliary and Control buildings involving tubular steel members spanning between floors. The detail in question consists of two, 2" x 2" x ¼" steel angles, two inches in length, field welded to the steel tube and a surface mounted or embedded base plate at the floor surface. The details are shown on the design drawings as follows:

Det. 17, Dwg. C-0418
Det. 14, Dwg. C-0419
Det. 22, Dwg. C-0420

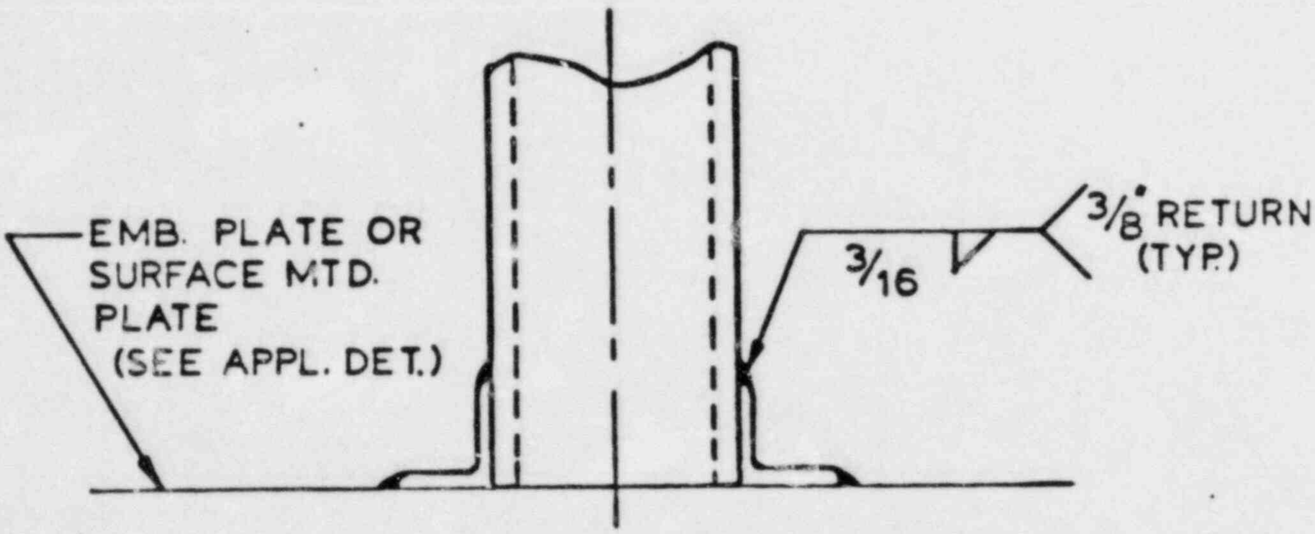
The three details referenced above (see attached sketch), specify a 3/16" fillet weld to the base plate and the steel tube along the length of the angle, with a 3/8" long weld return at each end. This weld configuration allows the end of the steel tube to rotate without damaging the weld by allowing the legs of the angle to bend. This rotation can readily be developed even in the absence of a gap between the end of the tube steel and base plate. Therefore, although the connection attracts some moment when the tube is loaded in the horizontal direction (seismic loading), this moment is immediately relieved upon rotation of the joint, approaching a hinged connection. In addition, the assumption of a hinged boundary yields conservative design moments for the tube section being connected.

We therefore maintain that the assumptions made in the design of there connections are consistent with standard design practices and do not require further evaluation.

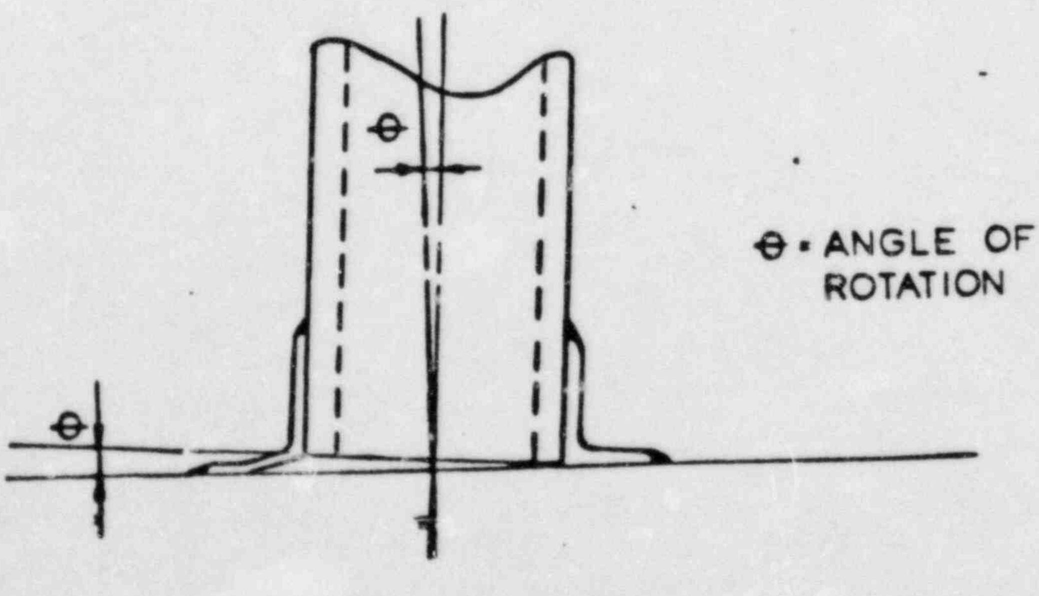
UNRESOLVED ITEM 4-1



PLAN



ELEVATION



ROTATED POSITION

FINDING 4-4

Certain findings and questions identified in the course of the inspection lead to a conclusion that, although subunit interfaces are generally understood, established project practices indicate certain inconsistencies. Consequently, the inspection team concludes there is need for more formal and precise methods for controlling subunit interfaces and training to enhance the effectiveness of the subunit interface control.

RESPONSE

Engineering Department Project Instructions (EDPI's) are utilized by the architect-engineer to provide design and design interface controls applicable to all disciplines on the SNUPPS Project. Specific requirements regarding preparation of design criteria; drawing and specification control, preparation, and review; control of engineering calculations; design change control, processing of nonconformances, field changes, and supplier deviations; and off-project design reviews are prescribed in these project procedures. These procedures are supplemented by Bechtel division-wide design guides and standards; special scope and desktop procedures; engineering checklists; and formal indoctrination and training sessions of cognizant engineering department personnel. These controls are further enchanced by use of a Correspondence Control Book issued to all Project Engineers and Group Supervisors and utilized by each design discipline within Bechtel Project Engineering. This book provides a reference index of applicable procedures, letters, interoffice memos and directives, and flow charts to be utilized by the discipline in performing the day-to-day design function and assuring effective coordination and communication within and between the design disciplines. We believe these interface controls have, in general, been effective in assuring a satisfactory technical product; a conclusion which appears to be reflected by the inspection team's findings and conclusions stated throughout the NRC inspection report; e.g. Section 5.1, Auxiliary Feedwater Components; Section 4.4, Generic Embedded Plate Program; Section 4.5, Pipe Supports, Hangers and Restraints Pgs. 4-15 and 4-18) and Section 4.6, Control of Design Changes.

It is recognized, however, that with the myriad of interface possibilities which exist in a project of the scope and complexity of SNUPPS, there are areas which would benefit from improved definition and communication, including those that relate to internal and subunit design interfaces. The inspection team's findings reinforce the Project's recognition of the need for improved definition and coordination in a number of activities which rely heavily upon inter and intradisciplinary design interfaces. This understanding of need has led to management actions to provide improved procedural controls to assure effective management of design interfaces. These procedural controls have and will continue to be supplemented by formal indoctrination and training sessions and monitored by internal audit and surveillance. Examples of actions that have been taken in recent months to strengthen design interface controls and are as follows:

1) IE 79-14 Walkdown Procedures: Two procedures issued in February and April, 1983, provide details for performing and documenting walkdown inspections at each site, for identifying uncertainties and deviations, and specifying methods by which the "as-built" data is examined against the approved seismic analysis.
2) Plant Design Interface Logic: This flow diagram displays design activities and interrelationships for piping design as carried out by subunit design disciplines. This flow diagram logic was issued on 1-31-83 and is presently in use.
3) As Built Drawing Criteria: This document specifies criteria to be used by each design discipline in preparing "as built" design drawings to reflect departures or waivers from the standard plant design. An initial version of the criteria was issued in March, 1983 and is to be finalized in May or June, 1983. This criteria document will be supplemented by desktop procedures to be prepared for each design discipline. These supplemental procedures will be available for use this July. Informal and formal training sessions are planned to assure proper understanding among the various engineering disciplines.
4) Procedure to Analyze/Reanalyze Stress Problems: This procedure, issued 1-17-83, identifies various tasks and checks necessary in performing piping stress analysis. Special emphasis is placed on information interfaces.
5) Environmental Review Desktop Procedures: This procedure, issued in 1982, provides detailed instructions and guidance for undertaking a project engineering review of all environmental equipment qualification reports prepared by SNUPPS equipment vendors. This procedure was supported by indoctrination and training for cognizant personnel.

In addition to project-wide procedures, special purpose or supplemental desktop procedures, and subunit (discipline) training, heavy emphasis will continue to be placed on the quality and closeness of supervision. The NRC inspection team was able to see first-hand that the design supervisor functions in a continuing and direct fashion to assure that day-to-day design work is carried out effectively and efficiently. The Project Management organization is structured to enhance first-line supervision by providing avenues for interdisciplinary and subunit coordination and resolution of interface items. This on-the-job supervision assures procedural controls are clearly understood and are functioning properly to manage all aspects of the design process including design interfaces. The need for additional procedures and interface guidance for the final stages of design will be continually assessed and actions taken where more specific definitions are considered necessary.

UNRESOLVED ITEM 4-2

Pipe anchor FB01-A002/135 was designed by the civil group to attach to a split base plate by straddling the two halves of the plate. However, actual field conditions had the anchor relocated within pipe support location tolerances so that it was attached on only one of the plate halves. This as-built condition would not normally have been detected in subsequent system walkdowns. This specific condition was determined to be adequate based on revised calculations performed during the inspection. However, further evaluation should be conducted to determine if similar instances of mismatch between hanger group tolerances and civil load paths exists.

RESPONSE

The only pipe supports attached to split base-plates are civil-designed pipe anchors, and are limited to the following six (6) supports:

EJ01-A001/132
FB01-A002/135
EF05-A005/121
EJ02-A001/132
EG02-A003/132
EC03-A001/121

Anchor FB01-A002/135 has been reviewed and found to be adequate attached to one plate. The remaining anchors will be reviewed and modified as necessary to insure that the design requirements are satisfied. In addition, all other civil-designed pipe anchors will be reviewed to insure consistency between the civil design load path and the plant design installation tolerances.

Design load paths for all pipe hangers and anchors designed by the hanger group are reviewed by the civil group taking installation tolerances into consideration by controlling attachment point locations. If a hanger or anchor is installed outside these tolerances, they are documented by the constructor on a Deviation Notice for supports attached to embedded plates, surface-mounted plates, and structural steel. These Deviation Notices are submitted to Bechtel and reviewed by the civil group for final acceptance of the redefined load paths. Therefore, except for the civil-designed anchors defined above, mismatches between hanger group tolerances and civil group load paths are controlled and evaluated using existing project procedures.

FINDING 4-5

The design drawing for isolation restraint FC02 was issued for construction prior to final approval of the design calculations, as required by EDPI 4.37-01 and 4.46-01.

RESPONSE

The design calculations for isolation restraint FC02 were prepared, checked and reviewed by the group leader prior the the issue of the design drawing for construction. The signed and dated pages of the calculation were reviewed by the NRC inspector during the inspection at Bechtel in November, 1982. However, final signature approval of the calculation did not occur until after issue of the design drawing because part of the computer output attached to the calculation was misplaced during processing of the calculation. The computer analysis was rerun in mid-November, 1982 and attached to the calculation. The calculation was then approved and processed in accordance with project procedures.

This finding is a technical violation of Bechtel project procedures, which had no adverse effect on the final design product. The approved calculation is retained in the project calculation file.

FINDING 4-6

No specific design calculations exist to document the basis for selection of embedded plates as well as their placement on the design drawings. The lack of documented analysis for each plate is contrary to EDPI 4.37-01 which requires such design calculations be made. However, the team was able to conclude that a controlled process for these selections had been in effect.

RESPONSE

The design of embedded plates, utilized on the SNUPPS Project for connection of structures and system supports to concrete walls and slabs, is well documented by design calculations generated and maintained on project. These calculations provide the basis for standard load capacities assigned to each plate type (i.e., maximum moments, shear, pullout and combinations thereof). The selection process utilized to identify the type of plate required to transfer the system design loads to the concrete structure merely involves a comparison of system design loads to the plate capacity. Nomographs based on plate design interaction equations are utilized for quick reference in the plate selection process involving repetitive cases, such as small pipe hangers. These nomographs represent a graphic solution of the interaction equations and are properly documented in project calculations. Where standard plate capacities are exceeded due to unusually large loads, such as those associated with pipe whip restraints, special plates are designed to transfer the loads. The design for these special plates is included in the applicable system support/restraint structure calculation.

With regard to documentation for placement of embedded plates on the design drawings, having determined the type of standard plate to be used from a load capacity consideration, its location is determined in order to coincide with the support configuration and location defined by the system layout drawings or hanger detail drawing. Deviations from the design intent regarding the support or restraint member and embedded plate interface are documented by the field via Middle Third Deviation Notices (MTDNs) and reviewed by engineering on a case by case basis. This serves as a second check on the placement of the plate versus its attachment location.

In summary, a documented analysis for the selection of each specific embedded plate is not necessary, since the parameters involved in standard plate selection and location are retrievable and can be verified with relative ease, and since adequate tracking exists to ensure proper embedded plate/support member interface. The intent of EDPI 4.37-01, therefore, has been satisfied.

UNRESOLVED ITEM 4-3

It was noted that the exterior wall penetration at Elevation 1991'0" in the Auxiliary Building was not constructed as detailed on the Bechtel design drawings. No information such as an FCR or DCN was available to address this change.

RESPONSE

A later review of records confirms that the condition noted by the inspector was previously documented (by the Constructor) on Nonconformance Report (NCR), No. 2SN-0955-C, and processed to Bechtel for review and disposition in 1979. The deviation noted was subsequently approved by Bechtel on a "use-as-is" basis on 9/25/79. Copies of the NCR are available on-site for the inspector's review and information.

FINDING 4-7

Imperfections (honeycombing) in concrete placement 2C135W01 on 7/12/77 were first reported on an NCR on 7/27/83. This is contrary to the requirements of Specification C-103 which specifies that..."imperfections in formed concrete requiring repair shall be repaired as soon as practical after removal of forms and shall be completed without delay..." The inspector noted that the delay in NCR initiation may have impacted NCR trending analyses performed by the Constructor.

RESPONSE

Constructor practice was to accumulate inspection results until a determination could be made of the extent of the honeycombing (i.e., chipping down to solid concrete to determine the size of the honeycombed area). After this determination was made, project procedures were followed which resulted in the NCR. A re-examination of the pour records and the referenced NCR indicate the delay had no substantive impact on the quality and acceptability of the repair. Discussions with Bechtel design personnel indicate the nature of the imperfections cited are not unusual for this type of construction and do not infer an absence of controls at the time of concrete placement. Bechtel further indicates that resolution of the reported imperfections through the use of non-shrink grout is a standard and technically acceptable repair process permitted per design specification.

Although this specific case involved an unusually long time to make a determination of reportability, we do not believe it constitutes a deficiency in the implementation of project procedures.

FINDING 5-1

The capability of the Motor Control (MCCs) to withstand fault currents has not been addressed or assured in the design process. Information from the MCC qualification report indicated that the controllers could withstand fault currents of 5,000 A with limited damage. Potential fault current in this application is 10,000 A or more.

RESPONSE

The MCC qualification report was submitted to Bechtel for review and approval. We concur that the review of this report did not detect the fact that the short circuit test reported in the qualification report was at a fault level less than that to which the SNUPPS MCCs were applied. This omission was in conjunction with the incomplete review cited in Finding Number 5-3 concerning MCC configuration.

We do not concur with the conclusion that this incomplete review of the qualification report demonstrates that the capability of the MCCs to withstand fault current has not been assured in the design process. Review of the MCC qualification report is one of many documents reviewed in the course of the design to verify the equipment capability. The MCC technical specification requires that the MCCs have a symmetrical short circuit capability of 25,000 A, RMS. Confirmation that the MCCs can meet their required interrupting capability was obtained by engineering review of the MCC design drawings, the circuit breaker specifications published by the supplier and a test certificate provided by the supplier.

The test certificate, reviewed by the inspector and listed in the report as satisfactory to demonstrate that the circuit breakers can interrupt the maximum available short circuit, does in fact state that the test was done on combination starters, i.e. breakers with controllers. Thus it also demonstrates that the SNUPPS MCC controllers can withstand the fault current interrupted by the breaker.

FINDING 5-2

Revised Floor Response Spectra (FRS) curves were forwarded to the Electrical Group from the Civil Group with a request that their impact on equipment qualification be examined. No evidence could be found documenting that the impact of the revised FRS curves on the Motor Control Centers (MCCs) had been evaluated and no systematic tracking was in place to assure that such revised spectra were addressed.

RESPONSE

In September of 1978, revised FRS curves for the Callaway ESW Pumphouse were transmitted to the Electrical Group from the Civil Group. The revised curves affected two kinds of electrical equipment located in the subject pumphouse: Load Centers and Motor Control Centers.

Upon receipt of the revised FRS curves, the Electrical Group reviewed and forwarded them to the Load Center Supplier (General Electric) via a revised technical specification. As noted by the inspector, the revised curves were not forwarded to the MCC Supplier. It was not possible from examining project files to positively determine that this inaction resulted from a conscious engineering decision based on engineering evaluation that the revised curves had been examined and found to be enveloped by the Supplier's Test Response Spectra (TRS) curves.

During the course of the inspection, the enveloping of the revised FRS curves by the Supplier TRS curves was confirmed and documented. Consequently there is no need to transmit the revised FRS curves to the Supplier.

The discipline group supervisors have been instructed to ensure that future revisions of seismic response spectra are examined for impact and followed up as appropriate.

FINDING 5-3

The short circuit testing documented in the MCC qualification report is based on a configuration different from that specified for use on SNUPPS. The supplier qualification report indicates that the test controllers were protected with current-limiting fuses whereas the SNUPPS controllers are protected with molded case circuit breakers. This finding, in connection with the fault current finding (No. 5-1), indicates a weakness in the review an approval of environmental qualification reports.

RESPONSE

The MCC environmental qualification report was submitted for Bechtel review and approval. The Bechtel review did not identify that the configuration of the MCC units used in the test was different from the configuration utilized in the SNUPPS MCC design and that the 5000 A fault current test was also less than SNUPPS design values, as identified in finding 5-1.

However, in view of the fact that the capability of the MCCs to withstand fault currents was adequately assured in the design process, as outlined in the response to finding 5-1, the consequences of this incomplete review are minimal. Molded case circuit breakers and current limiting fuses are both widely accepted by industry for the protection of motors, controllers, circuits and personnel. Industry standard UL-508, which governs the testing of Industrial Control equipment, provides specific acceptance criteria for both cases of protection. These criteria do not differ significantly from each other, indicating that the use of either circuit breakers or fuses is acceptable and that both provide adequate fault protection. Both fuses and circuit breakers are documented in the MCC qualification report as being qualified to IEEE 323 and could, if desired, be used interchangeably. Therefore, the selection of either fuses or circuit breakers does not impact equipment qualification capacity in any manner. A clarifying statement to this effect will be provided as a supplement to the MCC Qualification Report.

To strengthen the total equipment qualification effort, Bechtel has had in place, since June 1982, a qualification specialist review group set up to re-examine all equipment qualification reports, including those previously reviewed and approved. This re-examination covers specific input criteria, equipment configuration, test results, specification requirements, industry and regulatory requirements, FSAR commitments and necessary related parameters as delineated in NUREG-0588 and which are pertinent to evaluate the acceptability of the reports. The group's activities are specifically designed to uncover any inconsistencies of the type described in this finding and to initiate appropriate corrective action. To date, the group has reviewed 31 specifications and qualification reports and conducted one supplier qualification audit. They have uncovered discrepancies which have been documented to the NRC via SLNRC 83-0015, dated March 19, 1983. These findings are being tracked for project follow-up action. This added effort will assure that the design goals of the review group are being fulfilled.

FINDING 6-1

This finding notes certain logic diagrams were not submitted to SNUPPS and the SNUPPS Utilities for review prior to initial issuance as required by EDPI 4.41-01.

RESPONSE

Early in the design process it was considered helpful for SNUPPS and the SNUPPS Utilities to review logic diagrams before they were issued for construction. This was done to assure Utility concurrence with basic design concepts and philosophy prior to development of the detailed circuitry design shown on the electrical schemetics. As the design progressed, logic diagrams became more and more repetitious and generally reflected additions or changes to systems included in the original design. For example, the same logic approach for controlling a motor-operated valve installed in a specific system would be used over and over again as additional valves were added to other systems. Consequently, review of plant logics in later systems was largely redundant and of lesser technical value. In addition, changes or additions of a substantive nature were reflected in System Descriptions, P&IDs, SNUPPS/Utility correspondence and were generally reviewed with the SNUPPS Staff/Technical Committee at regularly scheduled meetings.

A 100% review was carried out to identify all the logic diagrams that had not been forwarded to SNUPPS for review prior to their "Issue for Construction". This list was reviewed with SNUPPS Staff and with the SNUPPS/Utility Technical Committee and it was determined that continuing review of logic diagrams before their issuance for construction was no longer necessary for the reasons noted above. Administrative procedures are in process of revision to reflect the SNUPPS/Utility position in this matter. It should be noted, however, that SNUPPS and the SNUPPS Utilities are forwarded copies of all issues of logic diagrams and thus they are available for review and comment at any time.

FINDING 6-2:

Logic diagram J02AL01 was noted to be incorrect. Specifically, the logic diagram indicated that the AFW pump would start given a coincidence of signals whereas the FSAR and electrical schematic E-03AL01B correctly notes that the pump would start given any of the signals. The sample reviewed by the inspector was not sufficient to determine whether this was an isolated or systematic error.

Corrected.

RESPONSE

The discrepancy noted in this finding between the logic diagram and the schematic had been identified previously through the normal internal review process prior to the start of the NRC inspection. This inconsistency has since been corrected. All logic diagrams, after preparation by the Control System group, are coordinated with the Electrical and Mechanical group. The Electrical group has the responsibility for issue of the schematic diagram based on input from the logics. As all logics are reviewed and signed off by the Electrical group, this assures consistency between the two design documents. This checking and coordination is a standard feature of project engineering design controls and assures occasional design document inconsistencies are identified and corrected. The fact that the error noted between the logic and the schematic was subsequently detected and corrected attests to the effectiveness of the review process.

FINDING 6-3

This finding involves a discrepancy identified during the inspector's review of the emergency backup nitrogen accumulator system. Specifically, it was noted that single check valves are provided to prevent bleeding pressure from the accumulator in the event of a pressure loss in the nonsafety grade control air system instead of double check valves described in FSAR Section 9.3.1.2.3. The inspector concluded that system requirements could be met even with loss of one accumulator system and that no regulatory requirements exist for use of double check valves.

RESPONSE

The description of double check valves isolating the safety-related air system from the nonsafety-related air system was included in the initial draft of the FSAR section before design of the system was completed. The final design of the safety-related air supply system incorporates completely independent air systems for each steam generator, thus permitting use of a single check valve for isolation. Consequently, the functional requirements of the system are satisfied as was indicated by the inspector. The final design configuration was reflected in FSAR Figure 9.3-1 (sheet 5). However, FSAR paragraph 9.3.1.2.3 was overlooked and consequently not updated to reflect the final design. This paragraph has since been updated in FSAR Revision 11 issued on 3/10/83.

FINDING 6-4

A discrepancy was noted in that Calculation J-435 (Reference 6.41) has not been checked (computer input check) and approved prior to issuing the purchase specification as required by section 3.4 of Bechtel procedure EDPI 4.37-01 (Reference 1.16). Although a procedure violation had occurred, a review of the latest calculations indicated that the flow elements identified in the purchase specification were correct and the discrepancy noted had no apparent effect on the final design.

RESPONSE:

The computer calculations were performed for orifice plate sizing before issue of the specification for purchase. The flow rates and orifice sizing information were included in the purchase specification, which was reviewed, checked and signed off by an independent design engineer. The situation noted in the finding occurred because the calculations were not signed by a checker and entered into the calculation file before placing the purchase order.

It is normal design practice and direction was given by the Group Supervisor to perform final computer calculations on orifice plates after process design parameters are finalized. This calculation is then used to determine the calibration of the differential pressure transmitter associated with the orifice plate and is entered into the calculation file.

Our normal project practice is to have calculations completed and signed by a checker before issue of a purchase specification. This is an isolated incident where the procedure was not strictly followed. A memo has been issued to all Project Personnel emphasizing the requirement for checking and approving calculations before issue of purchase specifications.