The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

November 29, 1983

ST-HL-AE-1027
File No: D27/G25

Mr Darrell G Eisenhut, Director
Division Of Licensing
Office Of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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SOUTH TEXAS PROJECT
DOCKET NOS. STN-50-498; STN-50-499
ENGINEERING ASSURANCE PROGRAM

Dear Mr Eisenhut:

This letter confirms our discussions with members of the NRC staff on September 17, 1983, and responds to your letter of October 21, 1983, which commented favorably on the Houston Lighting & Power Company (HL&P) Engineering Assurance Program and indicated that it would be appropriate to submit documentation describing our program for formal NRC review and approval.

Enclosed for your review are various documents (Attachments 1-3) describing our Engineering Assurance Program and its implementation. Also enclosed are the reports of the first two Engineering Assurance reviews (Attachments 4 and 5). Particularly in light of the complete review of the design of the South Texas Project that was performed by Bechtel when it assumed responsibility as Architect/Engineer, we believe that the ongoing HL&P Engineering Assurance Program can serve as the additional verification program which the NRC has found useful as a prerequisite to issuing an operating license to NTOL applicants. We would appreciate receiving NRC endorsement of the Program as fulfilling that objective.

With regard to providing NRC reports of the individual engineering assurance reviews, these reports are routinely forwarded to the NRC Resident Inspector at the South Texas Project site immediately upon issuance by HL&P, and to date we have issued the two reports enclosed with this letter. We intend to continue the practice of promptly sharing this information with the NRC.

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Houston Lighting & Power Company

Mr Darrell G Eisenhut, Director

November 29, 1983

ST-HL-AE-1027
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Included as attachments are: (1) HL&P Engineering Program Description; (2) The HL&P/Stone & Webster Engineering Corporation letter agreement which establishes the conditions to ensure Stone & Webster's "independent" role in the program and provide for the full disclosure of findings resulting from their participation in engineering assurance reviews; (3) the HL&P Nuclear Engineering & Construction Policy No. 201, Engineering Assurance Program; (4) Report of Independent Technical Assessment 83-1, Soil Structure Interaction Analysis and Seismic Design, along with the STP responses and the Engineering Assurance final evaluation; and (5) Report of Design Process Review 83-2, RHR/Safety-Injection System along with the STP responses and the Engineering Assurance evaluation of corrective actions taken to date.

We would appreciate your early advice as to the acceptability of our program. Should you have any questions or additional comments, please forward them to the undersigned or phone me at (713) 486-3828.

Very truly yours,

J. H. Goldberg

J H Goldberg, Vice-President
Nuclear Engineering and
Construction Department

MRW/aks
Attachments (5)

cc: J. T. Collins (NRC)
A. Vietti (NRC)
D. P. Tomlinson (NRC)
M. D. Schwarz (Baker & Botts)
J. R. Newman (Lowenstein, Newman, Reis, & Axelrad)
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Citizens for Equitable Utilities, Inc.
c/o Ms. Peggy Buchorn
Route 1, Box 1684
Brazoria, Texas 77422

Introduction

Houston Lighting & Power Company (HL&P) has established its engineering assurance program to provide independent technical review of the design and engineering activities for the South Texas Project. This program description summarizes the main features of the program.

Purpose

The purpose of the engineering assurance program is to provide increased confidence in the technical adequacy of the design and engineering work for the South Texas Project. To this end, the HL&P Engineering Assurance Department undertakes appropriate objective reviews of design and engineering work.

The reviews consist of thorough technical assessments of selected design features and processes. These assessments are in addition to the measures performed by Bechtel and others to satisfy design control and design verification requirements specified in the QA program.

Additional calculations or analyses are performed as part of an EA review when appropriate to confirm adequacy of design.

Using the "vertical slice" methodology, EA also reviews design control and design verification measures used by Bechtel to produce the design. This involves detailed technical examination of the design process for a selected portion of the plant, starting with the design input and tracing through the development of design to the output of each of the major disciplines.

Organization and Resources

Two equally important criteria were considered in setting up the Engineering Assurance Department, competence and independence.

Organizationally, the EA Department reports to the HL&P Vice President, Nuclear Engineering & Construction. The Manager, Engineering Assurance Department, is accountable to the VP, Nuclear Engineering & Construction, for establishing and implementing the engineering assurance program. It is, therefore, separate and independent from the South Texas Project organization, which also reports to the VP, Nuclear Engineering & Construction.

The Engineering Assurance Department consists of five engineering positions plus one manager. Emphasis in staffing the department has been placed on experience in nuclear plant design. Personnel performing in the Engineering Assurance role, whether they are HL&P or contract employees, must have had no prior involvement in design work for the South Texas Project.

To provide additional technical support, a contract has been established with the Stone & Webster Engineering Corporation. This assures that an adequate review staff of experienced engineers is available. The HL&P Manager, Engineering Assurance, reviews and approves proposed personnel assignments from Stone & Webster to ensure that our experience and independence criteria (see Attachment 2) are met.

The Chief Executive Officers of Bechtel (the architect-engineer for the South Texas Project) and Stone & Webster have both given their personal support to our engineering assurance program concept for the South Texas Project.

Types of Reviews

The two types of reviews performed are differentiated by who has responsibility for technical leadership. When the necessary technical expertise is present in the HL&P Engineering Assurance staff, HL&P assumes the leadership

role. Alternatively, Stone & Webster is assigned leadership responsibility when the HL&P staff does not possess the appropriate detailed expertise in a particular engineering area.

Subjects to be Reviewed

Table 1 lists the current subjects to be reviewed under this program. The list is periodically updated as necessary to feature review of significant industry and project problem areas. The following criteria were used in selecting subjects for review:

- Select areas that represent known technical problem areas in the industry.
- Select areas that represent unique project design features or areas of known or suspected HL&P and/or contractor difficulties.

Three to four subjects are reviewed each year. Scheduling of specific review areas is determined by project status. In general, the intent is to review a particular subject at a time when sufficient design information is available to permit a meaningful review, but early enough so that any problems uncovered can be corrected before completion of substantial engineering or construction. A typical review involves the expenditure of 3,000-4,000 man-hours of effort plus the supporting service costs.

Reporting Results

Results of reviews are documented in formal written reports to responsible management of HL&P and are provided to the NRC. These reports, which are approved by the Vice President, Nuclear Engineering & Construction,

include all concerns identified, an assessment of the significance of concerns, and specific recommendations for further assessment. Action items are tracked to completion and are ultimately closed out by the HL&P Engineering Assurance Department.

Table 1

Review Subjects

- soil-structure interaction analysis
- ASME III pipe stress analysis
- ASME III pipe support design
- design and analysis of pipe break restraints and jet impingement shields
- environmental qualification of equipment
- fuel handling
  - rapid
  - fuel elevators and transporters
- single failure criteria
  - separation of trains
  - Appendix R implications
- containment analysis (LOCAs and other high energy breaks)
- AC power supply (off-site)
- medium-voltage AC system
- design control and design verification
- feedback of industry experience
- feedback of manufacturers' bulletins on maintenance and modification requirements

February 14, 1985

Attachment 2
ST-HL-AE-1027

MEMORANDUM OF UNDERSTANDING BETWEEN HOUSTON LIGHTING & POWER COMPANY AND STONE & WEBSTER ENGINEERING CORPORATION REGARDING CONDUCT OF INDEPENDENT TECHNICAL REVIEWS OF THE SOUTH TEXAS PROJECT

BACKGROUND

The South Texas Project is a two-unit (1250 MW each) Westinghouse pressurized water nuclear-powered electric generating station. The project is being designed by Bechtel Power Corporation, Constructed by Ebasco Services, Inc., and managed overall by Houston Lighting & Power Company (HL&P) acting as project manager for itself, the City of San Antonio, the City of Austin, and Central Power & Light Company. The project schedule currently projects completion dates (fuel load) of December 1986 and December 1988 for Units 1 and 2, respectively.

HL&P as project manager maintains a project staff of engineers and constructors to provide programmatic direction and oversee the activities of its contractors, Bechtel and Ebasco. Additionally, HL&P has established an Engineering Assurance Department staffed with experienced and qualified specialists to perform independent technical reviews of project engineering activities of both Bechtel and HL&P. HL&P's Engineering Assurance Department will from time to time supplement its resources from outside sources to conduct the independent technical reviews. Stone & Webster Engineering Corporation (SWEC) is one of the organizations that will participate in this endeavor. Independent technical reviews may consist of audits of design process; assessments of design, which will be under the direction of HL&P Engineering Assurance Department; or third-party design assessments, which shall be under SWEC direction. In some instances, SWEC may provide HL&P with personnel to work under HL&P Engineering Assurance Department supervision during the performance of a technical audit or technical assessment.

POLICY

The independent technical reviews shall be conducted by personnel not previously involved with the design or engineering activities of the South Texas Project.

The independent technical review teams will be staffed predominantly with engineers having prior proven records of related industry experience who are able to provide an objective, dispassionate technical review and make judgements on the basis of technical merit.

When selecting any SWEC individual for the independent technical review, the following shall be considered:

1) The individual shall not have participated in design or engineering activity for the South Texas Project.

2) The individual shall not control or own a significant amount of Houston Industries stock.

3) The individual shall not have a relative employed by Houston Industries in a senior management capacity or other position that could lead to a direct conflict of interest.

SWEC's obligation to fulfill this requirement shall be considered satisfied by its obtaining signed statement, in the format of the attachment, from each individual assigned to independent technical review.

The conclusion of all reports, including interim reports, generated by a review team that deal with safety-related matters will be shared by HL&P with the Nuclear Regulatory Commission.

When SWEC personnel work under the supervision of HL&P Engineering Assurance Department in the performance of audits of design process or assessment of design, HL&P will maintain total control and responsibility for these activities. In all cases, SWEC, consistent with its technical views and independent role, shall report such conclusions as its personnel may develop during the course of their work, including instances in which such views may differ from those of HL&P.

P. A. Wild
Senior Vice President
Director of Engineering
Stone & Webster Engineering Corporati

J. H. Goldberg
Vice President, Nuclear Engineering &
Construction
Houston Lighting & Power Company

February 14, 1983

INDEPENDENT
TECHNICAL REVIEW
SOUTH TEXAS PROJECT
HOUSTON LIGHTING & POWER COMPANY

Statement Regarding Potential or Apparent
Conflicts of Interest

TO: Stone & Webster Engineering Corporation

Whereas, the undersigned employee ("Employee") understands that he or she is assigned as a participant to provide services to Houston Lighting & Power Company with respect to Independent Technical Review of the South Texas Project; and

Whereas, Employee understands that it is necessary that the participants be screened for any potential or apparent conflicts of interest with respect to this assignment;

Therefore, for the above stated purposes Employee makes the following representations to Stone & Webster Engineering Corporation:

1) The Employee has not participated in design or engineering activity for the South Texas Project.

2) The Employee does not control or own significant amount of Houston Industries stock.

3) The Employee does not have a relative employed by Houston Industries in a senior management capacity or other position that could lead to a direct conflict of interest.

Dated_____

Signature_____

Print Name_____

HOUSTON LIGHTING & POWER COMPANY

Nuclear Engineering & Construction	TEXT
	POLICY NO. 201 / REVISION 1
TITLE: POLICIES AND PRACTICES	SHEET 1 OF 11
SUBJECT: ENGINEERING ASSURANCE PROGRAM POLICY	DATED 11-9-83

* INDICATES CHANGE OR ADDITION

The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

*1

ENGINEERING ASSURANCE
STATEMENT OF POLICY

The technical adequacy of the engineering and design of the South Texas Project (STP) is of paramount importance to the executive management of Houston Lighting & Power Company. To provide maximum confidence that the project's engineering and design activities are being carried out consistent with our licensing commitments to the NRC as well as industry good engineering practices, we have established the Engineering Assurance Department.

The Engineering Assurance Department is directed to undertake appropriate objective reviews of the STP engineering and design activities. Engineering Assurance can best serve the interests of our company and the project by identifying in a forthright manner any concerns with the activities reviewed. All reports generated containing findings relative to these reviews will be provided expeditiously to our cognizant management and the NRC Region IV Resident Inspector's office.

My office shall be kept informed of concerns identified by the Engineering Assurance Department, complete with actions required, action party designation(s), and required corrective action completion dates.

G. W. Oprea, Jr.
Executive Vice President
Nuclear Group

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1.0 Purpose

The purpose of the engineering assurance program is to provide confidence in the technical adequacy of the engineering and design work performed by HL&P and its major contractors.

2.0 Introduction

The HL&P engineering assurance program consists of activities specifically directed at assessing the adequacy of the technical aspects, as well as the methods of control, of the engineering and design activities of HL&P and its major contractors in producing a quality engineering product. This is accomplished by independently sampling the design activities and products for confirmation by analytical techniques. Accordingly, the engineering assurance program functions independently of the HL&P nuclear quality assurance program.

3.0 Organization

The engineering assurance program is established and implemented by the Engineering Assurance Department. The organization of Engineering Assurance is shown in Figure I. The Manager, Engineering Assurance Department, reports directly to the Vice President, Nuclear Engineering & Construction, to provide an independent overview of the technical activities of the organizations performing engineering and design functions. The Vice President, Nuclear Engineering & Construction, oversees the engineering assurance program to ensure that it is adequately defined and that it is being properly implemented. Engineering Assurance is staffed by personnel having extensive engineering and design experience in their assigned disciplines and, in order to ensure technical independence, no prior involvement in design or engineering work for the South Texas Project. * *1 *

4.0 Program Procedures

The engineering assurance program procedures are approved by the Manager, Engineering Assurance Department. These procedures describe the various Engineering Assurance activities, including assignment of responsibilities, methods of implementation, and methods of coordinating activities with other organizations.

5.0 Program Activities

The activities of the engineering assurance program include design process reviews, independent technical assessments, and third-party design assessments described below. Engineering Assurance in effect will verify that plant equipment, structures, and systems assessed will perform to design criteria and performance requirements established for the plant. Effort will not be made to

identify modifications or improvements of the features assessed, unless the design will not perform its intended function or satisfy the design criteria. The technical subjects and design features will be evaluated against good engineering practice and the commitments contained in the FSAR. As a minimum, the specific elements of the design process as listed in the Appendix will be verified.

Selection of review/assessment topics is based on the following general guidelines: *

- Select areas of review that represent known technical problem areas in the industry. *
- Select areas that represent of known or suspected HL&P and/or contractor difficulties. *
- Select representative samples from systems, the design and engineering of which are essentially complete, to determine that design of these systems from conception to final acceptance has been carried out in a controlled manner and that the system design meets its intended purpose. *1
- Select activities that require significant interface with the NSSS supplier and other major vendors. *
- Select topics for design process review in a manner that addresses the various aspects of the design process (i.e., design input, interface, process, output, and changes) and provides a reasonable data base by which to judge the adequacy of the design process. *
- Select any other topics of management concern. *

5.1 Design Process Reviews

Design process reviews are performed by personnel assigned to Engineering Assurance. The objective of these reviews is to develop information by which to judge the adequacy of design controls on the basis of whether the results of the design activities of HL&P and its major contractors are correct and consistent with licensing commitments and represent good engineering practice. These reviews are conducted on a sampling basis and are directed at the technical substance of the design process, in contrast to quality assurance audits, which examine procedural compliance. Design process reviews are conducted by experienced engineers who, by examining the technical aspects of the design, can evaluate whether design activities are being properly conducted. For example, such reviews can evaluate whether correct and current design inputs are used by affected design

organizations and whether design changes are properly evaluated and incorporated into the design. As a result of these reviews, judgments can be made as to how well the design activities are controlled by the organizations involved. The HL&P Engineering Manager coordinates any necessary corrective action related to concerns identified as a result of these reviews.

5.2 Independent Technical Assessments

Independent technical assessments are performed by personnel assigned to Engineering Assurance. These assessments are designed to be independent verifications of designs. They do not take the place of normal design verification activities performed by the organizations responsible for the design, but are done to provide additional confidence in the technical adequacy of the design. Independent technical assessments are conducted on a sampling basis and are directed at critical and complex design features as well as areas of known or suspected HL&P, contractor, or industry problems. These assessments are conducted by experienced engineers who evaluate and verify the design through a review of the design, using alternate analyses as needed. Where additional manpower is required to perform a comprehensive technical assessment, additional engineering personnel will be contracted from outside HL&P to work under the supervision and direction of the HL&P Engineering Assurance discipline leader(s). Engineering Assurance will verify that appropriate corrective action related to concerns identified as a result of these assessments is undertaken in a timely fashion by the project.

5.3 Third-party Design Assessments

Third-party design assessments are coordinated by personnel assigned to Engineering Assurance but are actually performed by an independent outside engineering organization. These assessments are designed to provide a completely independent assessment of the adequacy of design work performed by HL&P and its major engineering and design contractors. Topics for third-party design assessment are designated by the Manager, Engineering Assurance Department, and approved for implementation by the Vice President, Nuclear Engineering & Construction. The design assessment approach (i.e., sampling or complete verification) and the specific design features that are reviewed are jointly selected by Engineering Assurance and the third-party engineering organization. The design assessment methods used (e.g., use of alternate calculations) are determined by the third-party engineering organization.

5.4 Results of Reviews and Assessments

The results of these reviews and assessments are reported directly to the Manager, Engineering Assurance Department, and include all concerns identified, an assessment of the significance of the concerns, and specific recommendations for further assessment of any concerns judged to have potentially significant implications.

6.0 Program Implementation

Engineering Assurance plans and develops schedules for design process reviews, independent technical assessments, and third-party design assessments.

6.1 Design Process Reviews

Design process reviews are implemented as follows:

- A review plan is prepared that defines the purpose, scope, special concerns, checklists to be utilized, and any other information pertinent to conducting the review.

- Personnel and organizations to be assessed are notified of the schedule and scope of the review a reasonable time in advance of the review.

- Review checklists are prepared and utilized that identify the procedures governing the activities being assessed and the specific attributes to be evaluated for those activities.

- A pre-review meeting is held with the management of the organization being reviewed to identify key personnel contacts, discuss the scope of the review, and determine the level of activity in the areas to be reviewed.

- A post-review meeting is held with the management and personnel of the reviewed organization to present and clarify review results.

- A formal review report is prepared, which includes the purpose and scope of the review, results, identification of review participants, and specific observations. Any necessary corrective action is requested from the reviewed organization. The report is approved by the Vice President, Nuclear Engineering & Construction, prior to transmittal to the reviewed organization.

- Responses to review observations describing the extent of problems noted and corrective action are submitted to Engineering Assurance by the

reviewed organization. Engineering Assurance evaluates each response to ascertain whether the committed actions are commensurate with the review results. If the response is considered unsatisfactory, it is returned to the reviewed organization for revision.

- Engineering Assurance reviews committed action to verify that such action has been taken.

6.2 Independent Technical Assessments

Independent technical assessments are implemented as follows: *1

- An assessment plan is prepared defining the purpose, scope, special concerns, and areas to be covered in the assessment.

- The project team is notified of the schedule and scope in advance of the assessment time and provides current design information and documentation to the assessment team.

- A pre-assessment meeting is held between Engineering Assurance and the project team (and contractor as necessary) for information exchange, identification of personnel contacts, and definition of level of activity anticipated in the assessment.

- Clarification of design philosophies, misunderstandings, system operational philosophy, questions, etc., between assessment and project teams may take place as design verification proceeds.

- A post-assessment meeting is held between the assessment team and project team (and contractor as necessary) to discuss results of the review.

- A formal report is prepared, which includes the purpose and scope of the assessment and results and identification of observations. Also, the report includes a list of documents reviewed and alternate calculations performed in addition to the elements outlined above for a design process review report.

- Engineering Assurance reports to the HL&P Engineering Manager the need for further evaluation of the extent of the conditions found. He determines any necessary corrective action (i.e., design changes) and directs and coordinates the necessary actions with all affected organizations.

- Engineering Assurance reassesses the design when the corrective action has been completed.

6.3 Third-party Design Assessments

Third-party design assessments are implemented as follows:

- Engineering Assurance selects and obtains the services of an outside engineering organization to perform a particular assessment. Approval of the organization selected is obtained from the Vice President, Nuclear Engineering & Construction.

- Engineering Assurance provides a description of the topic to be assessed and defines the purpose of the assessment.

- Engineering Assurance selects and obtained copies of the specific design documents needed to perform the assessment. In conjunction with Engineering Assurance, the outside organization determines the design assessment approach (e.g., sampling methods) and the specific design features to be assessed, based on the complexity of the design, importance to safety, degree of standardization and similarity to previously proven designs, and degree of design completion shown by the documents being reviewed.

- The outside organization selects the specific design assessment methods (e.g., design review, use of alternate calculations) to be used and prepares an assessment plan defining the scope, methods to be used, special concerns, and other information pertinent to the assessment. A copy of the assessment plan is sent to Engineering Assurance for approval.

- A pre-assessment meeting is held to identify key personnel contacts, discuss the scope of the assessment, and determine the level of activity in the areas to be assessed.

- The outside organization performs the design assessment and documents the results.

- A post-assessment meeting of Engineering Assurance, the outside organization performing the assessment, and any other organizations as determined by HL&P is held to present and clarify assessment results.

- The outside organization prepares and transmits an assessment report to the Manager, Engineering Assurance Department, which includes the purpose and scope of the assessment, results, including comments as appropriate on the significance of the results, identification of assessment participants, and a list of documents reviewed and alternate calculations performed.

- Engineering Assurance reviews the report, determines if corrective action is necessary, and reports the results to the Vice President, Nuclear Engineering & Construction.

- Engineering Assurance reports to the HL&P Engineering Manager the need for further evaluation of the extent of the conditions found. He determines any necessary corrective action (i.e., design changes) and directs and coordinates the necessary actions with all affected organizations.

- Engineering Assurance reviews corrective action and performs a reassessment of the design upon completion of the corrective action.

7.0 Records

Engineering Assurance maintains sufficient records to demonstrate compliance with this program. In this regard, the following records will be retained:

- Review checklists, review reports, and corrective action recommendations and follow-ups

- Correspondence pertaining to reviews and assessments performed

- Procurement-related correspondence and documents and invoices for engineering services provided by others

- Assessment reports, documents reviewed, corrective action reports, and reassessment records

- Calculations, analyses, and other technical documents used or derived during the performance of an assessment that contributed substantially to conclusions reached

8.0 Appendix

Criteria for Engineering Assurance evaluations are as follows:

8.1 Design Commitment Control

Periodic reviews shall be conducted to ensure consistency between design activities and commitments made in technical specifications, licensing documents, or other regulatory requirements. Also, Engineering Assurance shall verify that an effective system exists for updating design commitments as changes occur due to design evolution, management decisions, or regulatory changes.

8.2 Design Inputs

Measures shall be established to verify the basis, use, and reasonableness of design inputs. Emphasis shall be placed on confirming the validity and applicability of input information for selected design features. Sources of the input data shall be identified. Calculations that produce results to be utilized as input data shall be verified. Engineering Assurance shall confirm that design input assumptions are technically valid and reasonable.

8.3 Design Methods

Measures shall be established to verify that the analytical methods used for design calculations are consistent with current industry codes and standards and sound engineering practice. Confirmation shall be made that computer programs, including subroutines, have been verified, prior to their use, as acceptable. Analytical modeling techniques shall be examined for reasonableness.

8.4 Design Control

Measures shall be established to verify that plant system interfaces and interactions have been properly addressed in the design process. Technical review shall verify that the system and components are designed to perform in all normal and transient modes in accordance with the design criteria. Review of the flow and documentation of selected design information shall be performed to assure that output to input between organizations is consistent with applicable design control requirements.

8.5 Design Verification

Measures shall be established to verify that design and design verification performed by others are technically adequate. Particular attention shall be given to assessing the adequacy of methods used for design verification and the qualifications of personnel performing design verification.

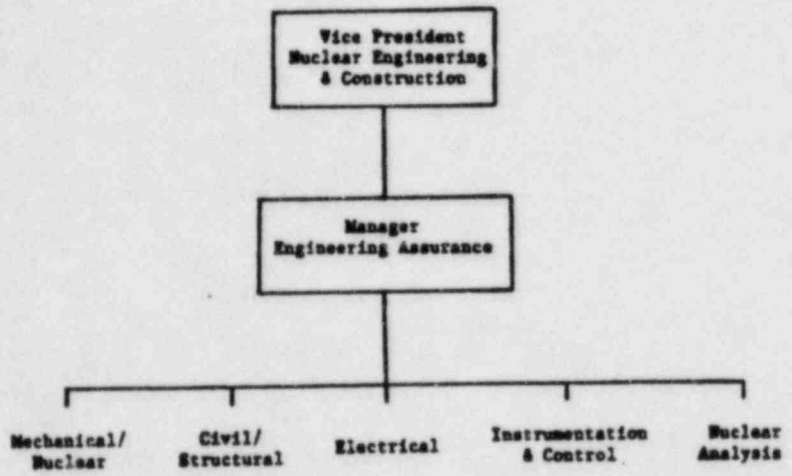
8.6 Design Changes

Measures shall be established for verifying the basis, necessity, and implementation of design changes. Particular emphasis will be placed on evaluating the system for control of design changes, proper coordination by affected disciplines, and incorporation into affected design documents.

8.7 Design Records

Measures shall be established to verify the adequacy of the system for identifying, collecting, storing, and retrieving design records. Consideration shall be given to ensuring that the design record system provides both adequate documentation and the ability to store and retrieve documentation during design activities. Careful attention shall be given to verifying that a system exists for creating an appropriate and accurate record of the as-built design configuration.

FIGURE I


Vice President
Nuclear Engineering
& Construction
Manager
Engineering Assurance
Mechanical/
Nuclear
Civil/
Structural
Electrical
Instrumentation
& Control
Nuclear
Analysis

Attachment 4
ST-HL-AE-1027

83-1

Houston Lighting & Power Company

OFFICE MEMORANDUM

June 14, 1983

To S. M. Dew

ST-HL-28146
File No.: D27

From R. A. Fraza

Subject Report of Independent Technical Assessment 83-1,
Soil-Structure Interaction Analysis and Seismic Design

Attached for your information and action are:
(1) the subject report, including Stone & Webster Engineering Corporation (SWEC) report,
(2) Action Item Forms resulting from the assessment,
(3) Action Item Reply Form,
(4) assessment checklist, and
(5) SWEC calculations 14475.01-SV-001 through 004 (ST-SK-HL-0013).

Each action item requires a response from Project Engineering in order for us to close out the item.

Please provide your response to all items by July 18, 1983, using the accompanying Action Item Reply Form. If a need to discuss the report or action items arises, please contact Dr. Chakravorty at 486-3787.

Your prompt attention is appreciated.

RAF:jog
Attachments

cc: J. H. Goldberg (with Attachment 1)
D. G. Barker (with Attachment 1)
J. E. Geiger (with Attachment 1)
STP RMS (with Attachments 1, 2, 3, and 4)

Document Number
83-1

Audit/assessment subject: Soil-structure interaction analysis and seismic design, South Texas Project Electric Generating Station

Date(s) of audit/assessment: November 17, 1982, to June 1, 1983

Prepared by: Manas K Chakravorty Date: 6-14-83

Approved by: _____ Date: 6-14-83
Manager,
Engineering Assurance Department

Approved by: J. H. Goldberg Date: 6-14-83
Vice President,
Nuclear Engineering & Construction

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3.0 Documents reviewed 2

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6.0 Conclusions. 16

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Appendix: SWEC repo t, Independent Technical Assessment No. 83-1, "Soil-structure Interaction Analysis and Seismic Design," South Texas Project Electric Generating Station, J.O. No. 14475.01, May 1983

ASSESSMENT REPORT
INDEPENDENT TECHNICAL ASSESSMENT 83-1
SOIL-STRUCTURE INTERACTION ANALYSIS AND SEISMIC DESIGN
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

1.0 Purpose and scope

The objective of this review was to perform an independent assessment of the adequacy of seismic analysis and design, including soil-structure interaction (SSI) analysis, of South Texas Project (STP) Category 1 structures. Originally, as specified in the scope and schedule for Independent Technical Assessment 83-1 (Reference 1), this review was also intended to cover the adequacy of seismic qualifications of selected electrical and mechanical equipment. However, Assessment 83-1 did not include this effort because the documents required to review seismic qualifications of the selected equipment were not firm enough to support a design assessment at this time (Reference 2). This portion of the review has been rescheduled to be included in the scope of the independent technical assessment on equipment qualification.

Assessment 83-1 also did not cover verification of computer programs used for seismic design, since Bechtel Energy Corporation (BEC) will, in resolving the concerns identified in the Quadrex report, review the adequacy of all computer programs used for STP.

Assessment 83-1 was not intended as a substitute for the normal design verification activities performed by the STP, but this review provides an independent assessment as to the adequacy of the seismic analysis and design of STP.

Assessment 83-1 primarily covered soil-structure interaction analysis of STP Category 1 structures and in particular the seismic analysis of the mechanical-electrical auxiliary building (MEAB). Specifically, this assessment consisted of reviewing documents in the following areas:

a. seismic design criteria, seismic input in terms of design ground response spectra and time histories, and current project licensing plan and commitments on soil-structure interaction analysis

b. soil-structure interaction analysis

c. seismic model and analysis of MEAB

d. development of structural response and floor response spectra curves

e. seismic adequacy of main structural components of MEAB

Selected design and licensing documents entailing the above activities were reviewed to determine whether:

a. the design inputs and assumptions used in the SSI analysis of STP are valid;

b. the SSI analysis is adequate and meets NRC regulatory criteria and Final Safety Analysis Report commitments;

c. the seismic analysis and design calculations are adequate and conform to present building layout; and

d. the seismic output is reasonable compared to input and has been properly controlled and correctly translated for further use in the seismic design of structural components.

Documents reviewed for this assessment are listed in Section 3.0. Section 4.0 contains a summary of findings in each area investigated. The extent of the assessment and observations in each of the above-mentioned areas are presented in Section 5.0. Section 6.0 summarizes the conclusions of this assessment, and Section 7.0 lists areas of further assessment. A portion of this assessment was performed by Stone & Webster Engineering Corporation (SWEC); the results of their assessment are contained in the Appendix.

2.0 Participants and reviewers

The assessment consisted of reviewing the project design documents related to soil-structure interaction analysis for the STP. These documents were originated by a number of organizations, such as Brown & Root, Woodward Clyde, and Bechtel. This assessment was conducted under the direction of Dr. M. K. Chakravorty, Consulting Engineer in the Engineering Assurance Department of Houston Lighting & Power Company (HL&P). In support of the assessment, Stone & Webster Engineering Corporation provided assistance by independently reviewing the STP seismic analysis and design in selected areas. Specific tasks performed by SWEC are listed in Supplements 1 and 4 to HL&P purchase order ST-140158 (Reference 3).

3.0 Documents reviewed

The documents reviewed were those provided by STP Engineering in response to the Engineering Assurance Department's request for support of the assessment. During a pre-assessment meeting (Reference 4) and by means of the scope and schedule document for assessment 83-1 (Reference 1), project personnel were informed of the types of documents required for the assessment. Accordingly, it was assumed that the documents provided represented the status of STP seismic analysis and design at the time the documents were received. The conclusions of this assessment are based solely on these documents. Table 3.1 lists the specific documents reviewed to the extent necessary to satisfy assessment objectives.

Table 3.1
List of Documents Reviewed

1. STP FSAR Section 3.7, Seismic Design
2. GSDC, Section 8.1, Seismic Analysis, 5A369SD001-E
3. Work Package EC-100/EC-101, SSI/Seismic Analysis of Category 1 Structures, Transition Phase Final Report
4. Final report on SSI analysis reevaluation for HL&P South Texas Project, Bechtel Study No. S-001, September 1982
5. Responses to NRC review questions, Docket Nos. STN 50-498, STN 50-499, ST-HL-AE-919, December 31, 1982
6. Conference notes, SSI effects on seismic floor response spectra, ST-YB-HL-2452
7. Soil-structure interaction studies, South Texas Project Units 1 and 2, Y310XR069-W, Woodward-Clyde Consultant report
8. Strain compatible spring constant and damping ratios for Diesel Generator and Mechanical-Electrical Auxiliary Buildings, Y310XC601AWC, WCC 9025-15
9. Computations of spring and damping coefficients for Category 1 structures, South Texas Project Units 1 and 2, Woodward-Clyde Consultants, Y310XR1398WC, April 1980
10. SSI seismic reanalysis of power block buildings, Bechtel calculation no. CC-9150, South Texas Project, 1-10-83
11. Seismic analysis of mechanical-electrical auxiliary building (MEAB), calculation no. 3M011SC089, South Texas Project
12. Seismic analysis of MEAB, calculation no. 3M011SC089-2B
13. Seismic shear stress, calculation no. 3M021SC082-5C
14. MEAB-foundation analysis, 3M051SC067
    (a) seismic load, SC067-11B
    (b) stability check for overturning, floating and sliding, SC-067-16A

4.0 Summary of observations

The summary of comments and observations presented in Table 4.1 is developed from an extensive review of documents listed in Table 3.1 as well as the independent calculations performed by Stone & Webster. It should be noted here that Bechtel Energy Corporation (BEC), the present architect-engineer, has already performed a detailed review of STP seismic design and identified the areas that will require further analysis and verification (item 3, Table 3.1). Therefore, observations presented in Table 4.1 do not include those identified by BEC. Table 4.1 lists only those comments and observations requiring further clarification and response from STP. Although the observations summarized in Table 4.1 are the result of a detailed assessment of seismic analysis of the MEAB, it should be recognized that any deficiencies as a result of these observations need to be assessed in the context of seismic analysis/design of all Category 1 structures.

The conclusion is that proper implementation of the present STP seismic design criteria, as specified in various design and licensing documents as well as the tasks identified in the BEC work package review, together with an acceptable resolution of comments specified in Table 4.1, will result in an adequate seismic design for STP.

In particular, based on SWEC's independent assessment of the MEAB, the conclusion was reached that the design basis response spectra curves (for the MEAB) are adequate and that the elastic half space soil-structure interaction analysis performed by BEC is acceptable.

Table 4.1

Subject: SSI Analysis & Seismic Design, STP

Assessment no.: 83-1 Prepared by M. K. Chakravorty

item no.	comments/observations
1	In view of the recent commitments to the NRC (ST-HL-AE-919) regarding the SSI and seismic design and evaluation of STP, all STP seismic design criteria documents as well as FSAR Section 3.7 should be revised. Design criteria documents should also clearly specify methods used to perform SSI analysis for all Category 1 structures. As an example, from the documents reviewed it was not evident what method of SSI analysis and reverification will be employed for essential cooling water intake and discharge structures and the condensate storage tank.
2	Independent calculation performed by SWEC (Appendix) indicates that response spectra developed from STP design ground time histories do not meet the requirements of Reg. Guide 1.60 spectra at frequencies less than 0.4 cps. Also, for the vertical time history, response spectra for the 4% damping case fall below Reg. Guide 1.60 spectra at the following frequencies: 1.1, 2.2, 2.5, 3.2, 6.4, and 8.0 cps. Although these discrepancies are not significant enough to affect STP seismic design, STP should review them and, if required, clarify the licensing position.
3	Statistical independence of STP horizontal and vertical time histories was not verified. Hence, they should not be used in a three-dimensional time history dynamic analysis where responses are combined algebraically as implied in FSAR Section 3.7.3.6. From the documents reviewed it was also not evident whether, for seismic analysis of all Category 1 unsymmetric structures, regulatory position C1 of Reg. Guide 1.122 has been complied with. Accordingly, BEC should review these concerns and assure that regulatory requirements are met.
4	Since the STP design basis SSI analysis is based on the 2-step finite element analysis (which is not very reliable for addressing effects of changes in structural configuration) it is not clear what SSI reanalysis will be employed to address significant changes in the structural configuration. BEC should develop an analytical basis to address this concern.
5	The finite element SSI approach used by WCC was adequate; however, the finite element structural models they used were developed by EDS Nuclear during 1975. Therefore, BEC should review the finite element superstructure model to determine any possible impact on the results and conclusions of WCC's finite element SSI analysis due to any significant changes in the structural configuration made subsequent to WCC's analysis. For example, for the MEAB the thickness of the finite elements representing the mat was assumed to be 4'0", whereas the actual mat thickness is 6'0".

item no.	comments/observations
6	During the review of WCC's finite element analysis, it was observed that some discrepancies exist between the maximum relative displacements specified in the response to NRC question 220.09 (ST-HL-AE-919) and those computed by WCC (WCC calculation Y310XR069-W1). STP should verify that relative displacements used for seismic design are adequate.
7	A review of the calculations for evaluation of safety factors during OBE and SSE events for the MEAB indicated compliance with standard engineering practice and Standard Review Plan requirements. However, no calculation was observed addressing bearing stress developed under the foundation mat of the MEAB during a seismic event. BEC should review this concern and determine that bearing stresses developed during an SSE meet the acceptance criteria.
8	The method for determining distribution of the seismic load in major load-carrying walls of the MEAB complies with standard engineering practice. However, existing design documents pertaining to calculations of actual seismic shear stress and seismic loads for mat design do not reflect use of the latest seismic loads and configuration for the MEAB. Also noted was that these calculations did not address consideration of SSE. BEC should revise these design documents to reflect the current seismic analysis for both OBE and SSE. In revising these calculations it is suggested that accidental torsion as specified in Standard Review Plan Section 3.7.2.II.11 should be accounted for.
9	The design basis floor response spectra (FRS) curves for STP did not meet the frequency intervals specified in Reg. Guide 1.122. Subsequently, BEC assessed the impact on STP FRS curves of using the frequency intervals of Reg. Guide 1.122. However, from the design documents reviewed it was not evident whether the reanalysis using the elastic half space (EHS) method complied with regulatory position C1 of Reg. Guide 1.122 regarding the combination of 3-components of earthquake response. BEC is requested to verify that the EHS analysis meets the intent of this regulatory position.
10	Design basis vertical FRS curves as issued did not include local effects of floor flexibility. It is suggested that BEC develop an action plan to address this concern.
11	Design basis FRS curves have been issued as a controlled drawing document; accordingly, BEC Engineering Department procedure EDP 4.46 will be used to control these curves. However, the issued FRS curves do not refer to the EHS response spectra, which will also be used to verify adequacy of all prior and future seismic designs and qualifications. In order to ensure adequate consideration of EHS response spectra for future seismic qualification and/or modification of systems and components, BEC should also issue the EHS response spectra as a controlled document for STP assessment.

item no.	comments/observations
12	It was observed that the procedure for verifying seismic qualification with respect to the FRS augmented by EHS SSI analysis (Attachment 1 to response to NRC Question 220.08) did not specify the approach for assessing the Nuclear Steam Supply System (NSSS). Since in the containment structure the design basis FRS curves do not fully envelop the EHS response spectra, it is essential that STP develop an NSSS/Balance of Plant seismic design interface procedure to assess NSSS adequacy.
13	Section 5.0 of the SWEC report (Appendix) contains the specific conclusions and recommendations resulting from SWEC's review. BEC should review this report and the associated recommendations and should provide a response regarding these recommendations.

5.0 Methods of assessment and observations

Generally the assessment was performed in accordance with Engineering Assurance Department Procedure EAD-3, Design Process Technical Audits and Independent Technical Assessments. Existing design documents (specified in Section 3.0) were reviewed and, where necessary, an alternate calculation was performed to the extent required to determine the adequacy of STP seismic analysis and design. To accomplish the objectives set forth in the scope and schedule for assessment 83-1 (Reference 1), review activities were structured into five major tasks, review of:

- seismic design criteria (task 1),
- soil-structure interaction analysis (task 2),
- MEAB dynamic model and seismic analysis (task 3),
- structural response and floor response spectra (task 4), and
- seismic design of MEAB (task 5).

For each of the above tasks, checklists (Reference 1) were prepared, and items listed in the checklists were specifically addressed. For each area of review, objectives, extent of review, specific findings, and conclusions are summarized as follows:

5.1 Seismic design criteria (task 1)

Objectives:

The objectives of this task were to define the STP seismic design criteria, which formed the basis for further assessments, and to ascertain the adequacy of seismic input used for STP.

Observations:

We reviewed items 1-6 as specified in Table 3.1 to determine the STP seismic design basis, which consists of designing all Category 1 structures, systems, and components for a safe shutdown earthquake (SSE) with a peak ground acceleration of 0.1 g and an operating basis earthquake (OBE) with a peak ground acceleration of 0.05 g. Since all the Category 1 structures at STP are soil-supported, a soil-structure interaction (SSI) analysis was performed as specified in Section 3.7 of the FSAR. The design basis seismic response and response spectra were developed using a 2-step finite element (FE) SSI analysis which, in the first step, consisted of developing a set of interaction time histories at the foundations of the Category 1 structures using a planar finite element analysis of the integrated soil-structure system and, in the second step, consisted of calculating the structural response and floor response spectra from a detailed lumped mass dynamic model excited by the interaction time histories computed in the first step. In the finite element analysis performed during the first step, the soil-structure interface of a Category 1 structure was represented by a number of node points, whereas in the dynamic model of the superstructure used in the second step, the foundation-soil interface was represented by a single node point. This required averaging interaction time histories obtained at several locations on the foundation mat in the first

step of the analysis. The average interaction time histories were then applied as a single excitation at the base of the lumped mass model of the superstructure in the second step.

Because of averaging the interaction time histories (which may result in some loss of phasing between the translational and rotational interaction time histories, causing improper participation of SSI modes in the second step of the analysis) and because the superstructure models used in both steps of the finite element analysis were not identical, the design basis floor response spectra are artificially dominated by the fixed base structural modes and thus are very conservative at fixed base structural frequencies. On the other hand, the two-step finite element analysis also underestimated the spectral response at soil-structure interaction frequencies. In the first step of the two-step finite element analysis, the control motion, the spectra of which generally envelop Regulatory Guide 1.60 spectra anchored at site-specific OBE/SSE acceleration values, was applied in the free field at grade level. Application of control motion at grade level generally results in de-amplification of seismic input to foundations of deeply-embedded structures. Present regulatory criteria require seismic input to be specified in the free field at foundation level. (See SRP Section 3.7 and NRC Question on STP 220.08.)

Of the original two-step finite element SSI analysis, the first step was performed by Woodward Clyde Consultants (WCC) and the second by Brown & Root, Inc. (B&R). Subsequently, Bechtel Energy Corporation (BEC), now the architect-engineer for STP, has assumed design responsibility for STP. During the transition phase of assuming engineering responsibility from B&R, BEC assessed in detail the SSI/seismic analysis performed by WCC and B&R. The result of BEC's review is documented in items 3 and 4 of Table 3.1. In order to address concerns raised by the NRC as well as by BEC's review, BEC initiated the SSI analysis by the elastic half space (EHS) method with free field input motion applied at the base of all Category 1 structures without resorting to any reduction due to embedment of structures in soil.

In summary, therefore, the present STP seismic design basis consists of:

a. The STP seismic design basis SSI analysis was performed by two-step finite element analysis.

b. BEC has already performed an SSI analysis by EHS method with free field input motion applied at the base of the reactor containment building, MEAB, fuel handling building, and diesel generator building for the OBE event.

c. A complete set of floor response spectra curves for OBE and SSE will be developed based on SSI analysis by EHS without any reduction of input motion to account for foundation embedment.

d. Adequacy of all prior and future seismic design and/or qualifications based on original STP floor response spectra will be verified for new floor response spectra developed by the EHS analysis.

e. STP will implement a program to systematically evaluate the impact of the new EHS response spectra.

Conclusion:

The following summary of this portion of the assessment is based on the review of STP seismic design basis:

a. The current STP seismic design basis, established on the original STP floor response spectra augmented by the EHS solution, is conservative and consistent with the present NRC position of applying earthquake motion at the foundation of Category 1 structures.

b. Based on the EHS SSI analysis performed by BEC for OBE, it can generally be concluded that the original two-step finite element spectra envelop the EHS spectra at fixed base structural frequency range, which is important for plant design and qualification.

c. In some buildings corresponding to soil-structure interaction frequencies, the EHS spectral response exceeds the original two-step finite element response spectra. The degree to which this is true for the containment structure is significant. For the MEAB, however, the EHS spectra in general are enveloped by the two-step finite element spectra.

d. Because the EHS spectral peak occurs at low frequency (less than approximately 4.0 cps) and the magnitude of peak EHS spectral as well as zero-period accelerations do not exceed those used in the original design, the structures, systems, and components with natural frequencies greater than approximately 4 cps that are qualified by analysis for original response spectra are not expected to be affected by EHS spectra.

e. The present STP seismic design basis is contained in various documents (e.g., FSAR, GSDC 5A369SD001-E Sec. 8.1, BEC document S-001, EC-100/101 and ST-HL-AE-919). In order to maintain consistency between these documents, all seismic design criteria documents as well as FSAR Section 3.7 should be updated to reflect the present seismic design/evaluation basis. The design criteria document should also clearly specify the type of SSI and seismic analysis used for calculating the OBE and SSE seismic response and response spectra for all Category 1 structures.

f. Independent calculation (SWEC Report, Appendix) performed by SWEC indicates that vertical and horizontal response spectra generated from the STP design ground time histories generally

comply with the requirements of Reg. Guide 1.60 and the FSAR. However, at very low frequencies (less than .4 cps) the calculated response spectra do not meet the requirements of Reg. Guide 1.60 response spectra. For the vertical time history, response spectra for the 4% damping case fall below the Reg. Guide 1.60 spectra at the following frequencies: 1.1, 2.2, 2.5, 3.2, 6.4, and 8.0 cps (Appendix). Although these discrepancies are not significant enough to affect STP seismic design, STP should formally assess the effect of these deviations and if necessary clarify the licensing position.

g. STP horizontal and vertical time histories are not statistically independent; hence, they should not be used in a three-dimensional time history dynamic analysis where responses are combined algebraically as implied in FSAR Section 3.7.3.6. From the documents reviewed it was also not clear whether, for all Category 1 unsymmetric structures, regulatory position C1 of Reg. Guide 1.122 has been complied with.

h. Since the STP design basis SSI analysis is based on the 2-step finite element analysis (which is unreliable for addressing effects of changes in structural configuration), what SSI re-analysis will be used (if required due to significant changes in structural configuration) is not clear.

5.2 Soil-structure interaction (SSI) analysis (task 2)

Objectives:

The objectives of this task were to review implementation of the SSI analytical process for the MEAB and to determine whether SSI analysis is adequate and in conformance with established STP seismic design criteria and regulatory requirements.

Observations:

Because the design basis 2-step finite element SSI analysis yields conservative spectra at fixed base natural frequencies, and the results from WCC's finite element SSI analysis have been used to provide further assurance of adequacy of STP seismic design, this task was primarily focused on assessing the adequacy of WCC's finite element SSI analysis as well as the confirmatory EHS analysis performed by BEC and did not cover review of B&R's analysis in the second step of the 2-step finite element SSI analysis. Specifically, this task consisted of reviewing items 7-10 as set forth in Table 3.1.

WCC conducted a finite element SSI analysis for three site cross sections, shown in Figure 5.1, which included the main Category 1 structures. The analyses were made using the finite element technique in which soil and structure in a given cross section were modeled by two-dimensional elements. The free field control motions were applied at ground surface. Parametric soil property variations

were conducted in the SSI analyses for cases involving the horizontal components of the OBE. The basic cases were for "average" soil properties. Parametric variations consisted of a 50% increase in shear modulus values and a 40% decrease in shear modulus values. This relatively large variation in magnitude of soil properties was necessary to satisfy the NRC criteria for SSI existing at the time of the analysis, which required that the envelope of response spectral values at foundation elevations in the free field, from analysis using average upper-bound and lower-bound soil properties, should be not less than 60% of spectral values specified at finished grade level in the free field, and hence conservatively bounded the actual variations observed from data measurements. The analyses adequately considered variations of soil properties with expected earthquake strain level as well as soil depth. Sensitivity studies were performed to establish boundaries of the finite element soil-structure model. Mesh size of the model was adequate to transmit major frequencies of the earthquake.

After WCC performed the finite element SSI analysis, the NRC has taken the position that an SSI analysis should also be performed using the elastic half space (EHS) method with the control motion applied at the foundations of Category 1 structures. BEC has performed an EHS SSI analysis using the soil spring and damping values developed by WCC for OBE. The input OBE was applied at foundations of Category 1 structures. The confirmatory EHS SSI analysis was reviewed in detail by SWEC for the MEAB (Appendix) through an independent calculation consisting of calculating the frequency-dependent compliance functions for strain-dependent soil properties with the effect of layering included.

Conclusions:

The following summary of this portion of the assessment is based on the review of pertinent STP documents and the independent assessment performed by SWEC:

a. The finite element SSI analysis method used by WCC is adequate. The analysis adequately accounted for effects of uncertainties in soil properties, extent of embedment, layering of soil strata, strain dependence of soil parameters, and effects of adjacent structures. Boundaries of the finite element model were properly established through sensitivity studies. Mesh size of the model was adequate to transmit significant earthquake frequencies. Note that thickness of finite elements representing the mat of the MEAB was assumed to be 4'0", whereas actual mat thickness of the MEAB is 6'0". Therefore, the finite element superstructure model should be formally reviewed to determine any possible impact on results and conclusions of WCC's finite element SSI analysis.

b. During the review of WCC's finite element analysis, some discrepancies were observed between the maximum relative displacements specified in the response to NRC question 220.09 and those computed by WCC (item 7 of Table 3.1).

c. In order to verify the EHS SSI analysis, an independent analysis was performed by SWEC (Appendix) for the MEAB. Frequency-dependent compliance functions using the strain-compatible subgrade properties and a simplified dynamic model of the MEAB were developed by SWEC. The results of this dynamic analysis indicated that the EHS SSI analysis performed by BEC is adequate.

5.3 MEAB dynamic model and seismic analysis (task 3)

Objectives:

The objectives of this task were to assure that current seismic analysis of the MEAB is adequate and reflects the latest plant layout and that the analysis method complies with FSAR commitments.

Observations:

This portion of the review was performed by SWEC (Appendix) and specifically consisted of:

a. review of existing calculations,
b. comparison of existing calculations with the present configuration,
c. independent calculations of selected inertia and stiffness properties, and
d. independent calculation of a simplified MEAB dynamic model.

Note that the MEAB dynamic model developed by B&R was used in both the B&R and the BEC seismic analyses. SWEC's review, therefore, was directed to assess the adequacy of the MEAB model developed by B&R.

Conclusions:

The following summarizes this portion of the assessment (for details of observations, refer to Appendix):

a. Cross-sectional properties and flexural moments of inertia for the members checked by SWEC's independent calculations are in good agreement with B&R calculations.

b. SWEC's review of the MEAB model structural arrangement shown in B&R's calculation versus the present configuration as represented by the drawings did not indicate any significant difference that would affect the dynamic response of the building.

c. Some discrepancies existed between the shear areas, shear centers, and mass properties computed by SWEC and those developed by B&R. In order to assess the effect of these discrepancies on the final result, SWEC developed a simplified dynamic model of the MEAB. This was used along with independently calculated

soil compliance functions to calculate seismic response. The result of this analysis indicates that the effect of these discrepancies is not significant for the MEAB.

5.4 Floor response spectra (FRS) for the MEAB (task 4)

Objectives:

The objectives of this review were to ascertain that FRS curves were properly developed and that adequate control exists in developing and updating FRS curves.

Observations:

For the MEAB, design basis FRS curves were determined from seismic analysis of the MEAB (item 11, Table 3.1) based on 2-step finite element analysis, which considered effects of variations in soil parameters as well as effects of coupling due to unsymmetrical behavior of the structure. The design basis FRS curves did not comply with the frequency intervals prescribed in Reg. Guide 1.122. However, the effect of this discrepancy has been studied by BEC, and the plan to incorporate the effects of Reg. Guide 1.122 frequency interval for STP is considered adequate.

As part of the confirmatory study, BEC developed another set of FRS curves using the EHS analysis (item 10, Table 3.1). FRS curves corresponding to EHS analysis were developed for average soil properties. The variation in soil properties in this analysis was accounted for by broadening the FRS curves by ±15%. Whether the EHS analysis complied with regulatory position C1 of Reg. Guide 1.122 was not clear from a review of calculation documents. Alternate calculations were also performed by SWEC (Appendix) to verify the FRS curves developed by EHS analysis. Figures 15 and 16 (Appendix) compare FRS curves developed by BEC and SWEC. Taking into account the differences in EHS methodology used by SWEC and BEC, this comparison is considered adequate.

For design use, BEC has issued only the FRS curves developed from a 2-step finite element analysis as individually controlled drawing documents (drawings no. 4N169S-3900 through -39146). However, these documents do not refer to the EHS FRS curves developed by BEC for design assessment. Since the design basis FRS curves for all Category 1 structures do not fully envelop the FRS curves derived from EHS analysis, it may be necessary to formally issue the EHS FRS curves as a controlled document to ensure its consideration in the seismic qualification of systems and components.

The design basis FRS curves, as issued, did not include effects of nonrigid floor (Quadrex concern) in the vertical direction. This has already been recognized by BEC as a concern from the Quadrex review.

Conclusions:

The following summarizes this portion of the assessment:

a. For the MEAB the floor response spectra curves have been developed by EHS and finite element analysis. In general for the MEAB, the design basis FRS curves envelop the FRS curves developed from an EHS analysis.

b. The effect of Reg. Guide 1.122 frequency intervals on STP FRS has been considered by BEC. However, whether the EHS analysis performed by BEC considered regulatory position C1 of Reg. Guide 1.122 was not clear.

c. The design basis FRS curves have been issued as a controlled drawing, and accordingly BEC engineering department procedure EDP 4.46 defines the requirements for their control. However, these issued FRS curves do not reference the FRS curves based on EHS analysis. In order to ensure adequate consideration of EHS FRS curves for future seismic qualification or modification of systems and components, it may be necessary to formally issue the EHS FRS curves as a controlled document.

d. The design basis vertical FRS curves as issued did not include the effects of nonrigid floor.

5.5 Seismic design of the MEAB (task 5)

Objectives:

The objectives of this task were to assess overall stability of the MEAB during design basis seismic events, to ascertain that proper seismic load as obtained from seismic analysis of the MEAB has been used in design, and to ascertain that methods used to distribute these loads among different structural members are adequate.

Observations:

This portion of the assessment consisted of reviewing items 12-14 as specified in Table 3.1.

Calculations were reviewed to verify the factor of safety for overturning and sliding of the MEAB during design basis seismic events. Calculations adequately considered load combinations and acceptance criteria specified in Standard Review Plan Section 3.8.5. The 1.12 minimum factor of safety against sliding occurred during an SSE event. Peak accelerations used to determine seismic overturning and sliding forces were consistent with those determined from seismic analysis of the MEAB.

Calculations pertaining to seismic shear and overturning force distribution for the MEAB were reviewed. Seismic forces at major load-carrying members were obtained from results of transient

dynamic analysis. Seismic shear stress distribution in each wall component was obtained for 100-kip loads in two orthogonal horizontal directions and for a torsional moment of 100,000 kip-feet. The method used to obtain shear stress distribution is consistent with conventional engineering practice. However, calculations to compute actual seismic shear stresses in individual walls (3M051SC082-5C) and to determine seismic loads on the foundation of the MEAB (3M051SC082-11B) for foundation mat analysis were not updated to reconcile the design for the latest seismic forces as obtained from seismic analysis of the MEAB (3M011SC089) of 12-8-82.

Conclusions:

The following summarizes this portion of the assessment:

a. The factor of safety for overturning and sliding of the MEAB during an OBE and SSE event is adequate and meets SRP requirements. However, no calculation was observed addressing bearing stress developed under the foundation.

b. The method for determining seismic shear stress in major load-carrying walls of the MEAB was found acceptable. However, existing design documents pertaining to calculations of actual seismic shear stress as well as to determination of seismic loads for mat design do not reflect use of the latest seismic loads and configuration for the MEAB.

   These design documents (3M051SC082-5C and 3M051SC082-11B) also do not address what consideration was provided to account for the design basis SSE event.

6.0 Conclusions

From review of the STP seismic design basis and SWEC's independent evaluation, the following conclusions have been reached:

6.1 Ground acceleration time histories for STP meet the intent of the FSAR commitments. However, observations discussed in Section 4.0 of this report regarding enveloping of design spectra should be addressed in plant licensing for clarification.

6.2 Current seismic design criteria for STP are conservative and consistent with present regulatory requirements. FSAR Section 3.7 should be revised to reflect the current seismic design basis.

6.3 Soil compliance functions used by BEC in the EHS analysis reasonably represent soil-structure interaction effects of the subgrade. In BEC's EHS analysis, input motion was conservatively applied at the foundation level of the Category 1 structures.

6.4 For the MEAB, the discrepancies noted by SWEC in calculation of the MEAB mass and stiffness properties do not have a significant effect on final results, since the response is dominated by soil motion.

6.5 For the MEAB, the design basis response spectra represent a conservative plant seismic design basis for equipment located within the MEAB.

6.6 Horizontal response spectra developed by BEC's EHS analysis are adequate for the MEAB.

6.7 Because in the reactor containment building the design basis response spectra do not envelop EHS response spectra, it is essential that STP develop an NSSS/BOP seismic design interface procedure to assess adequacy of the NSSS.

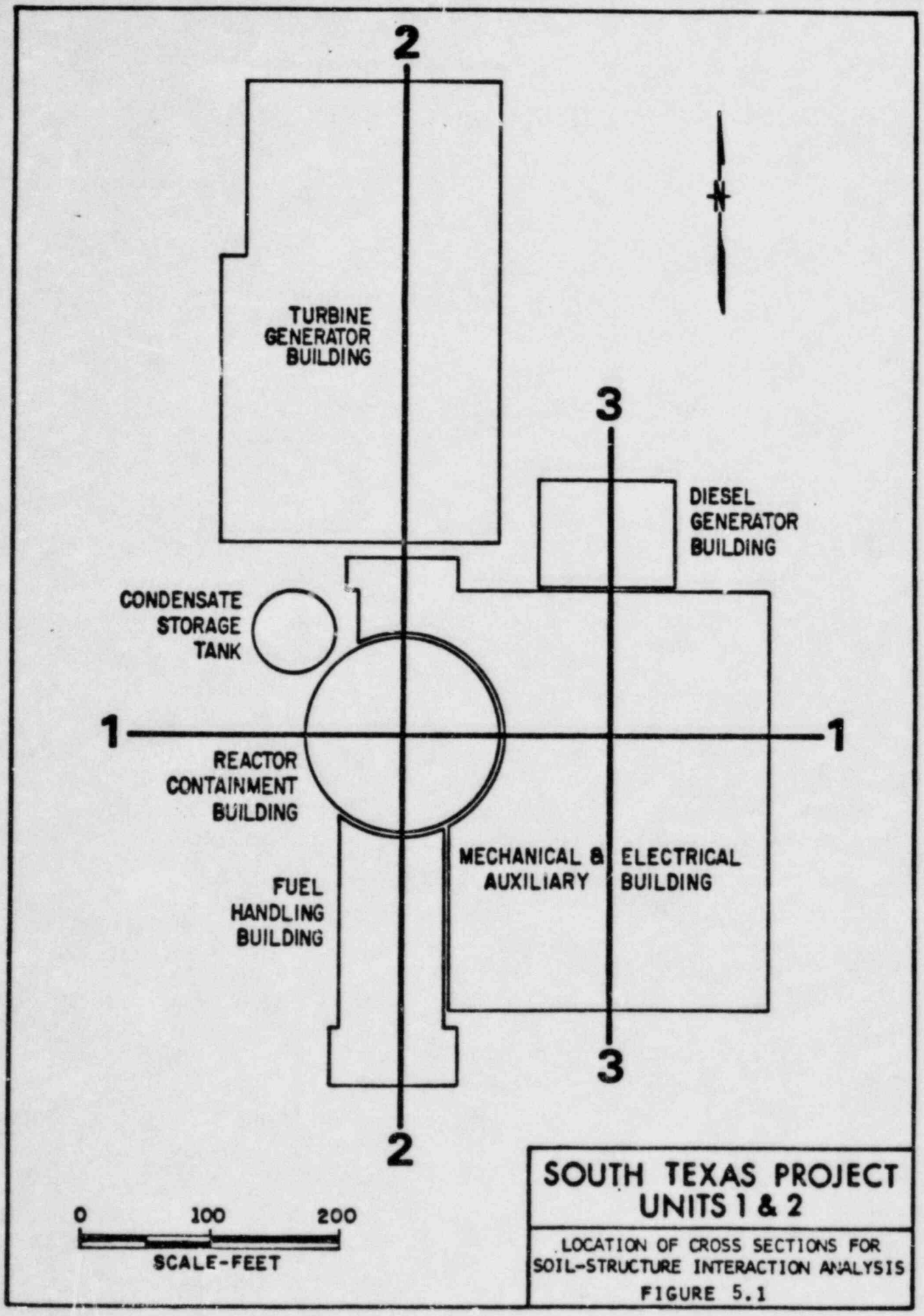
6.8 Existing structural design documents should be reviewed to assure that proper seismic load has been used if the structural configuration has significantly changed since completion of the design.

7.0 Areas of further assessment

In addition to verification of the resolution of action items specified in Section 4.0 of this report, further assessments/audits are recommended in the following areas:

7.1 Review of seismic qualifications of selected equipment

7.2 Review of NSSS/BOP seismic interface


2
TURBINE GENERATOR BUILDING
N
3
DIESEL GENERATOR BUILDING
CONDENSATE STORAGE TANK
1
1
REACTOR CONTAINMENT BUILDING
MECHANICAL & AUXILIARY
ELECTRICAL BUILDING
FUEL HANDLING BUILDING
3
2
0
100
200
SCALE-FEET
SOUTH TEXAS PROJECT
UNITS 1 & 2
LOCATION OF CROSS SECTIONS FOR SOIL-STRUCTURE INTERACTION ANALYSIS
FIGURE 5.1

References

1. Scope and Schedule for Independent Technical Assessment 83-1, Soil-structure Interaction Analysis and Seismic Design, South Texas Project Electric Generating Station

2. Bechtel letter ST-YB-HL-2429, dated December 15, 1982

3. Supplements 1 and 4 to HL&P purchase order ST-140158

4. Pre-assessment meeting notes, dated December 22, 1982, ST-HL-26046

Action Item Cover Sheet

Review/assessment subject title: SSI Analysis & Seismic Design, STP

Document no.: 83-1 Review/assessment no.: 83-1

1. Action items prepared by Manas K Chakravorty 6-14-83
   Engineering Assurance Department engineer — Date

   N/A
   Engineering Assurance Department engineer — Date

2. Action items reviewed by
   Manager, Engineering Assurance Department — 6-14-83 Date

3. Actions pertaining to review/assessment 83-1 have been implemented.
   Manager, STP Engineering — Date

4. Implementation of actions has been verified.
   Engineering Assurance Department engineer — Date

   Engineering Assurance Department engineer — Date

5. All concerns pertaining to review/assessment no. 83-1 have been resolved.
   Manager, Engineering Assurance Department — Date

Action Item Form

Review/assessment subject title: SSI Analysis & Seismic Design, STP

Review/assessment no.: 83-1 Prepared by M. K. Chakravorty

item no.	description of condition(s)
1	In view of the recent commitments to the NRC (ST-HL-AE-919) regarding the SSI and seismic design and evaluation of STP, all STP seismic design criteria documents as well as FSAR Section 3.7 should be revised. Design criteria documents should also clearly specify methods used to perform SSI analysis for all Category 1 structures. As an example, from the documents reviewed it was not evident what method of SSI analysis and reverification will be employed for essential cooling water intake and discharge structures and the condensate storage tank.
2	Independent calculation performed by SWEC (Appendix) indicates that response spectra developed from STP design ground time histories do not meet the requirements of Reg. Guide 1.60 spectra at frequencies less than 0.4 cps. Also, for the vertical time history, response spectra for the 4% damping case fall below Reg. Guide 1.60 spectra at the following frequencies: 1.1, 2.2, 2.5, 3.2, 6.4, and 8.0 cps. Although these discrepancies are not significant enough to affect STP seismic design, STP should review them and, if required, clarify the licensing position.
3	Statistical independence of STP horizontal and vertical time histories was not verified. Hence, they should not be used in a three-dimensional time history dynamic an[illegible]re responses are combined algebraically as implied i[illegible]SAR Sec[illegible]7.3.6. From the documents reviewed it was [illegible]ot evident [illegible] for seismic analysis of all Category 1 [illegible]symmetric structures, [illegible]latory position C1 of Reg. Guide 1.122 has been complied with. Accordingly, BEC should review these concerns and assure that regulatory requirements are met.
4	Since the STP design basis SSI analysis is based on the 2-step finite element analysis (which is not very reliable for addressing effects of changes in structural configuration) it is not clear what SSI reanalysis will be employed to address significant changes in the structural configuration. BEC should develop an analytical basis to address this concern.

Action Item Form

Review/assessment subject title: SSI Analysis & Seismic Design, STP

Review/assessment no.: 83-1 Prepared by M. K. Chakravorty

item no.	description of condition(s)
5	The finite element SSI approach used by WCC was adequate; however, the finite element structural models they used were developed by EDS Nuclear during 1975. Therefore, BEC should review the finite element superstructure model to determine any possible impact on the results and conclusions of WCC's finite element SSI analysis due to any significant changes in the structural configuration made subsequent to WCC's analysis. For example, for the MEAB the thickness of the finite elements representing the mat was assumed to be 4'0", whereas the actual mat thickness is 6'0".
6	During the review of WCC's finite element analysis, it was observed that some discrepancies exist between the maximum relative displacements specified in the response to NRC question 220.09 (ST-HL-AE-919) and those computed by WCC (WCC calculation Y310XR069-W1). STP should verify that relative displacements used for seismic design are adequate.
7	A review of the calculations for evaluation of safety factors during OBE and SSE events for the MEAB indicated compliance with standard engineering practice and Standard Review Plan requirements. However, no calculation was observed addressing bearing stress developed under the foundation mat of the MEAB during a seismic event. BEC should review this concern and determine that bearing stresses developed during an SSE meet the acceptance criteria.
8	The method for determining distribution of the seismic load in major load-carrying walls of the MEAB complies with standard engineering practice. However, existing design documents pertaining to calculations of actual seismic shear stress and seismic loads for mat design do not reflect use of the latest seismic loads and configuration for the MEAB. Also noted was that these calculations did not address consideration of SSE. BEC should revise these design documents to reflect the current seismic analysis for both OBE and SSE. In revising these calculations it is suggested that accidental torsion as specified in Standard Review Plan Section 3.7.2.II.11 should be accounted for.

Action Item Form

Review/assessment subject title: SSI Analysis & Seismic Design, STP

Review/assessment no.: 83-1 Prepared by M. K. Chakravorty

item no.	description of condition(s)
9	The design basis floor response spectra (FRS) curves for STP did not meet the frequency intervals specified in Reg. Guide 1.122. Subsequently, BEC assessed the impact on STP FRS curves of using the frequency intervals of Reg. Guide 1.122. However, from the design documents reviewed it was not evident whether the re-analysis using the elastic half space (EHS) method complied with regulatory position C1 of Reg. Guide 1.122 regarding the combination of 3-components of earthquake response. BEC is requested to verify that the EHS analysis meets the intent of this regulatory position.
10	Design basis vertical FRS curves as issued did not include local effects of floor flexibility. It is suggested that BEC develop an action plan to address this concern.
11	Design basis FRS curves have been issued as a controlled drawing document; accordingly, BEC Engineering Department procedure EDP 4.46 will be used to control these curves. However, the issued FRS curves do not refer to the EHS response spectra, which will also be used to verify adequacy of all prior and future seismic designs and qualifications. In order to ensure adequate consideration of EHS response spectra for future seismic qualification and/or modification of systems and components, BEC should also issue the EHS response spectra as a controlled document for STP assessment.
12	It was observed that the procedure for verifying seismic qualification with respect to the FRS augmented by EHS SSI analysis (Attachment 1 to response to NRC Question 220.08) did not specify the approach for assessing the Nuclear Steam Supply System (NSSS). Since in the containment structure the design basis FRS curves do not fully envelop the EHS response spectra, it is essential that STP develop an NSSS/Balance of Plant seismic design interface procedure to assess NSSS adequacy.
13	Section 5.0 of the SWEC report (Appendix) contains the specific conclusions and recommendations resulting from SWEC's review. BEC should review this report and the associated recommendations and should provide a response regarding these recommendations.

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.

Date action(s) scheduled to be complete: _____

_____ _____

Manager, STP Engineering Date

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
1.0	STP seismic design criteria		
1.1	Consistency of STP seismic design criteria with FSAR and licensing commitments	C	Present STP seismic design basis is contained in a number of documents (e.g., FSAR, GSDC 5A369SD001-E Sec. 8.1, BEC documents S-001, EC 100/101, and ST-HL-AE-919). The current FSAR Section 3.7, Amendment 30, does not reflect the present STP design basis. FSAR 3.7 is required to be updated.
1.2	Consideration of applicable Regulatory Guides (1.60, 1.61, 1.92, 1.122)	I	STP design complied with requirements of Reg. Guides 1.60 (with the exception of frequencies less than 0.4 cps), 1.61, and 1.92. The effect of Reg. Guide 1.122 frequency interval was assessed. However, the extent of compliance with requirement C-1 of Reg. Guide 1.122 was indeterminate.
1.3	Adequacy of SSE and OBE time histories to envelop design ground response spectra	A	Stone & Webster's independent calculation (Appendix 1) indicates that the response spectra corresponding to design time histories generally envelop the Reg. Guide 1.60 spectra with some minor exceptions that are not expected to affect the seismic design.
2.0	Soil-structure interaction (SSI) analysis		
2.1	Use of strain-compatible soil properties	A	Woodward-Clyde has used strain-compatible soil properties in the finite element SSI analysis. (See Appendix C of Report Y310XR069-W1.)

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
2.2	Finite element model for SSI analysis; adequacy of mesh size; sensitivity studies to establish boundaries of finite element model and variation of soil properties with depth	A	Woodward-Clyde performed a number of parametric studies to justify adequacy of mesh size and boundaries of finite element model. Model is adequate to transmit approximately 20 cps, which is considered adequate for seismic analysis (Appendix D of Report Y310XR069-W1).
2.3	Consideration of uncertainties in estimation of soil properties	A	Finite element SSI analysis performed by Woodward-Clyde adequately considered uncertainties in soil parameter estimation (Appendices E and C of Report Y310XR069-W1).
2.4	Base interaction time histories that constitute input to detailed MEAB model	NA	Base interaction time histories used by Brown & Root in the second step of the two-step finite element analysis were not reviewed because the conservatism of the two-step finite element analysis at building frequencies was justified by the EHS SSI analysis and Woodward-Clyde's finite element analysis.
2.5	Adequacy of confirmatory EHS analysis	A	The confirmatory EHS analysis performed by BEC for the MEAB was independently verified by Stone & Webster (Appendix 1). Based on this assessment, the conclusion is that the EHS analysis method for STP is adequate.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
3.0	MEAB dynamic model and seismic analysis		
3.1	Adequacy of mass distribution, number of degrees of freedom, consideration of equipment mass	A	Masses have been lumped at major floor elevations, and there are six degrees of freedom corresponding to each mass (calculation no. 3M011SC089). An independent analysis performed by SWEC (Appendix 1) indicated that the mass properties were overestimated, but this did not have any significant effect on the seismic response because on a soil site the response is primarily influenced by the SSI frequencies.
3.2	Criteria used for decoupling a system from subsystem	A	Subsystem masses were lumped at major floor elevations. In the MEAB the effect of coupling between the structure and the subsystems is not expected to be significant. It should, however, be noted that the dynamic model of the reactor containment building included a simplified model of the nuclear steam supply system.
3.3	Consideration of coupling between various degrees of freedom	A	The dynamic model used for the MEAB had six degrees of freedom at each mass point, which is considered adequate to account for the coupling effect between the different degrees of freedom

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
3.4	Appropriateness of stiffness characteristics	A	BEC's review of Brown & Root's MEAB model (calculation no. CC-9150) indicated that cross-sectional areas used to calculate axial stiffness of shear walls were adequate. However, there were some discrepancies between the shear areas calculated by BEC and those calculated by Brown & Root. In order to assess the effect of these discrepancies, SWEC has performed an independent calculation (Appendix 1). Based on SWEC's evaluation, the conclusion is that these discrepancies do not affect the seismic response.
3.5	Proper consideration of center of mass and center of rigidity in model	A	See comment in item 3.4.
3.6	Adequacy of natural frequencies, mode shapes, and modal damping	A	Although the fixed-base natural frequency calculated by SWEC was higher than the natural frequency of the MEAB model used for the design, this discrepancy did not have any impact on seismic response, because on a soil site structural response is dominated by SSI frequencies, which were reasonably predicted by BEC's EHS analysis.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
3.7	Consideration of effect of nonrigid floors	I	MEAB dynamic analysis was performed assuming that floors were rigid. As a result of a previous review, STP is already aware of this concern. However, it is suggested that STP develop appropriate criteria to systematically evaluate effects of floor flexibility on STP seismic design.
3.8	Verification of adequacy of dynamic analysis of MEAB; consideration of 3-components of earthquake motion, number of modes considered, and MEAB responses	A	Dynamic analysis of the MEAB has been verified to be adequate by an independent analysis by SWEC.
4.0	Floor response spectra for MEAB		
4.1	Adequacy of frequency intervals used in generation of FRS	A	The design basis response spectra for the MEAB did not fully meet the frequency interval requirement of Reg. Guide 1.122. However, studies performed by BEC and SWEC indicate that for the MEAB the impact of Reg. Guide 1.122 frequency interval is insignificant.
4.2	Verification that FRS peaks are broadened	A	FRS curves for the MEAB indicated compliance with peak broadening criteria of the Standard Review Plan, Section 3.7.
4.3	Verification of acceptability of FRS curves and zero-period accelerations	A	FRS curves generated from the EHS analysis were adequate and reasonably predicted the SSI frequencies as verified by SWEC.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

Checklist for Independent Technical Assessment 83-1

Soil-structure Interaction Analysis and Seismic Design

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
4.4	Adequacy of control procedures for distribution and updating of FRS curves	I	The design basis FRS have been issued as controlled documents (drawings no. 4N169S-3900 through 3946). However, these documents do not include the EHS response spectra, which will also be used for future seismic qualification and/or modification of systems and components.
5.0	Seismic design of the MEAB		
5.1	Verification of safety factors against sliding and overturning during SSE and OBE; maximum bearing stress	I	A review of STP calculation no. 3M051SC067-16 on the stability check for overturning, floating, and sliding of the MEAB indicated compliance with standard engineering practice and Standard Review Plan requirements. However, no calculation was observed addressing bearing stress developed under the foundation mat of the MEAB during an SSE.
5.2	Adequacy of method used to calculate seismic forces in structural members (walls, columns, pedestal, mat, etc.) of the MEAB	I	The method for determining distribution of seismic shear stresses in major shear walls appears reasonable. (See calculation no. 3M011SC089-2B.) However, existing design documents for calculating actual seismic shear stress (3M021SC082-5C) and for determining seismic loads for the MEAB mat design (3M051SC067-11B) do not reflect use of the latest seismic loads and configuration for the MEAB.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

INDEPENDENT TECHNICAL ASSESSMENT NO. 83-1

"SOIL-STRUCTURE INTERACTION ANALYSIS AND SEISMIC DESIGN"

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION
J.O.No. 14475.01

Prepared for

Houston Lighting & Power Company

by

Stone & Webster Engineering Corporation

May 1983

Project Engineer

5/16/83
Date

B14/20E

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SECTION 1

INTRODUCTION

This report presents the results of engineering reviews performed by Stone & Webster Engineering Corporation (SWEC) for the Engineering Assurance Department of Houston Lighting & Power Company (HL&P). This review was performed to support the independent technical assessment (83-1) of the Soil-Structure Interaction Analysis and Seismic Design of the South Texas Project Electric Generating Station.

In support of HL&P's Engineering Assurance Department's independent review, SWEC was requested to review specific areas of the seismic analysis of the Mechanical-Electrical Auxiliary Building in order to verify the technical approach used in each area. Section 2 of this report describes the specific areas reviewed. Section 3 describes the method of review with the findings of the review presented in Section 4. SWEC's conclusions and recommendations are presented in Section 5.

SECTION 2

SCOPE

As requested by HL&P under Purchase Order ST-140158 Supplements Nos. 1 and 4, SWEC's scope has been limited to performing the four specific tasks described below.

2.1 Verification of Safe Shutdown Earthquake (SSE) Time Histories

For the horizontal and vertical SSE ground acceleration time histories provided by HL&P (Item 1, Att. A), SWEC will generate for 2 percent and 4 percent damping levels, the response spectra that would be produced by these time histories. In addition, SWEC will verify that the response spectra produced by the SSE time histories envelope the smoothed ground design spectra as specified in the FSAR, and provided by HL&P (Item 2, Att. A).

2.2 Verification of Mechanical-Electrical Auxiliary Building (MEAB) Dynamic Model

SWEC will review the calculations (Items 3 and 4, Att. A) prepared to develop the MEAB dynamic model to determine that they are consistent with the present structural arrangement as presented in the design drawings (Item 5, Att. A). In addition, SWEC will prepare independent calculations of selected members and masses to determine the adequacy of the stiffness and inertial properties used in the MEAB dynamic model.

SWEC will prepare an independent calculation for a simplified beam model of the MEAB in order to determine the floor response spectra described in Section 2.4.

2.3 Verification of Elastic Half-Space (EHS) Soil Compliance Functions

SWEC will review the soil compliance functions (stiffness and damping) used in the EHS analysis (Item 6, Att. A) to determine their adequacy in representing dynamic characteristics of the MEAB subgrade.

SWEC will also prepare independent calculations to determine adequacy of soil compliance functions.

2.4 Verification of Floor Response Spectra

SWEC will generate floor response spectra for 4 percent equipment damping, at the mat and one other point of the MEAB for comparison with the floor response spectra as generated by Bechtel Corporation (Item 4, Att. A). Floor response spectra generated by SWEC will be based on soil compliance functions and simplified MEAB dynamic model as prepared by SWEC.

Floor response spectra prepared by SWEC will be based on three (3) orthogonal components of ground motion applied separately, with the results combined by the square root of the sum of the square (SRSS) method at selected frequencies.

SECTION 3

REVIEW METHODOLOGY

The following describes SWEC's review in each of the four (4) tasks that HL&P requested SWEC assistance.

3.1 Safe Shutdown Earthquake (SSE) Time Histories

SWEC's review in this area consisted of three activities:

1. Review of FSAR Commitments.

2. Generation of Smoothed Ground Design Spectra and Time History Ground Spectra.

3. Comparison of Smoothed and Time History Spectra.

3.1.1 Review of FSAR Commitments

SWEC reviewed the South Texas Project (STP) FSAR text regarding the basis of the design spectra (Item 2, Att. A) against the smoothed ground design spectra illustrated in the FSAR. This review determined that in accordance with the FSAR, the STP has committed to Regulatory Guide 1.60, Rev. 1, as the basis of the smoothed ground design spectra with the exception that the peak vertical ground acceleration will be two-thirds of the peak horizontal ground acceleration.

3.1.2 Generation of Smoothed Ground Design Spectra and Artificial Time History Ground Spectra

Smoothed ground design spectra for the SSE were generated and plotted using in-house SWEC computer programs for 2 percent and 4 percent damping for both the vertical and horizontal directions (Fig. 1-4). These spectra are based on the control points and amplification factors of R.G. 1.60, Rev. 1.

Using SWEC computer programs, response spectra were generated for 2 percent and 4 percent damping (Fig. 1-4) for the SSE ground acceleration artificial time histories provided by HL&P. Spectral calculations were performed for the oscillator periods specified by HL&P in Attachment C.

3.1.3 Comparison of Smoothed and Time History Spectra

The smoothed and time history spectra plotted on the same sheets were examined to determine how frequently the time history spectra dropped below the smoothed spectra and if so, how far below.

3.2 Mechanical-Electrical Auxiliary Building (MEAB) Model

SWEC's review to verify the MEAB model consisted of three activities:

1. Review of Existing Calculations.

2. Comparison of the Existing Calculations with the present configuration (Item 5, Att. A).

3. Independent Calculations of selected inertia and stiffness properties.

4. Independent Calculation of a simplified MEAB Dynamic Model.

3.2.1 Reviewing Existing Calculations

The seismic analysis calculations of Brown & Root (Item 3, Att. A) and Bechtel (Item 4, Att. A) were reviewed to determine what differences, if any, existed between the structural models in the separate analyses. The inertia properties, member cross-sectional properties, and centers of stiffness were compared between the two calculations. It was determined by this review that Bechtel in its seismic (EHS) analysis utilized the MEAB structural model as developed by Brown & Root. Therefore, further review

by SWEC of the MEAB dynamic model was based solely on the Brown & Root calculations. SWEC findings, as discussed in Section 4, refer solely to the MEAB model developed by Brown & Root.

3.2.2 Comparison of Existing Calculations With Present Configuration

The configuration of the MEAB, as represented by the Structural drawings (Item 5, Att. A), were reviewed against the structural arrangement of walls shown in the Brown & Root calculation (Item 3, Att. A) to determine if there were any significant changes that would affect the dynamic properties as developed by Brown & Root.

3.2.3 Independent Calculation of Selected Inertia and Stiffness Properties

Since the Brown & Root inertia property calculations could be readily followed, it was decided at the start of this phase of the review that it would be more meaningful to review their calculations in detail for each mass point, rather than spot check one or two mass points by independent calculations.

Consequently, each of the Brown & Root mass point calculations were reviewed in detail.

This review included the verification of slab and wall thicknesses used with those shown on the drawings, lumping of walls above and below the mass point with the slab mass, inclusion of equipment mass in the inertia properties, mass center calculations, and mass moments of inertia calculations.

To check the stiffness properties of the model cross-section properties (area, shear areas, moments of inertia, axial stiffness centers, and shear centers) were calculated by SWEC, using in-house computer programs, for Members 1 and 13 of the Brown & Root model.

Calculations for Member 1 were based on actual wall arrangements.

Calculations for Member 13 were based on simplified wall arrangements, not including minor walls, so that an approximate check of the stiffness centers and shear areas could be obtained.

3.2.4 Independent Calculation of a Simplified Model of MEAB

SWEC independently calculated a simplified dynamic stick model of the MEAB. SWEC's model reflects a more realistic mass contribution from miscellaneous equipment. Structural member stiffnesses were generated using SWEC computer program FORCEO with shear flow considered as discussed in Section 4.2. SWEC believes this behavior to be more appropriate for a building with the dimensions of the MEAB.

3.3 Elastic Half-Space (EHS) Soil Compliance Functions

SWEC reviewed the basis of the EHS soil compliance functions used in the Bechtel confirmatory seismic analysis (Item 4, Att. A). The objective of SWEC's review was to verify the correctness of the compliance functions used.

3.3.1 Review of EHS Analysis and Springs

The confirmatory EHS seismic analysis performed by Bechtel (Item 4, Att. A) was reviewed to determine what soil springs were used. This review indicated that the soil springs used by Bechtel were frequency independent, and obtained from the Woodward-Clyde Consultants (WCC) calculations (Items 6 and 11, Att. A). The Woodward and Clyde compliance function calculation developed soil stiffness and damping coefficients based on average strain compatible soil properties.

It was not possible to establish the validity of the WCC averaging technique for layered media without comparing their results to a more exact solution. SWEC, therefore, independently calculated the frequency dependent compliance functions for strain dependent soil properties with the effect of layering included.

3.3.2 Independent Compliance Function Calculation

Using the SWEC computer program REFUND and the OBE strain compatible soil properties listed in the WCC SSI study (Item 11, Att. A), SWEC computed the frequency dependent values of soil stiffness and damping.

The REFUND computer program computes the impedance functions of a rigid, massless foundation supported on a viscoelastic layered stratum. Strain compatible material damping, shear modulus, and Poisson's ratio, as well as unit weight and layer thickness, may be specified for each layer. REFUND will then evaluate the subgrade dynamic stiffness matrix for all six degrees of freedom by applying unit horizontal and vertical loads at the foundation axis.

The SWEC calculated compliance functions were then compared to the frequency independent soil properties utilized by Bechtel in the EHS analysis and WCC frequency dependent compliance functions based on their average soil properties.

SWEC's analysis is based on an idealized equivalent rectangular foundation on the surface of the subgrade since the effects of embedment were considered to be negligible.

3.4 Floor Response Spectra

SWEC generated 4 percent (equipment damping) floor response spectra at the top of the MEAB foundation mat, El. +10'-0" and El. 86'-0", for comparison to the floor design spectra.

These spectra were generated using a simplified dynamic model of the MEAB developed by SWEC as discussed in Section 3.2.4.

The structure was analyzed using the SWEC computer program FRIDAY which performs the solution of the equations of motion in the frequency domain. Frequency-dependent soil compliance functions calculated independently by SWEC (Section 3.3.2) were used to represent the subgrade. Floor spectra

were generated for OBE ground acceleration time histories, since only soil properties compatible with OBE strain levels were available. The OBE ground time histories used were obtained by ratioing downward, based on peak ground acceleration, the SSE ground acceleration time histories provided by HL&P (Item 1, Att. A).

Three floor response spectra (N-S, E-W, and VERT) were generated for each direction of excitation. To combine the effects of three directions of excitation, the ordinates of the floor spectra, from each separate direction were combined by the method square root of the sum of squares (SRSS).

SECTION 4
REVIEW FINDINGS

This section presents SWEC's findings for each task resulting from the review as described in Section 3.

4.1 SSE Time Histories

SWEC found the smoothed ground spectra presented in the FSAR to be in compliance with the FSAR commitment with one exception. Due to an apparent error in plotting one of the control points in Fig. 3.7-13 of the FSAR, the smoothed ground design spectra for vertical excitation is lower than R.G. 1.60, Rev. 1. The R.G. defines an acceleration of .333 g at a frequency of 3.5 cps. Fig. 3.7-13 appears to be .3 g at a frequency of 3.7 cps.

The FSAR includes response spectra plots for the time histories calculated at frequencies starting at .5 cps. R.G. 1.60 spectra are defined to a frequency of .1 cps. As shown in Fig. 1-4, the SSE artificial time history spectra do not envelope the smoothed spectra in the .1 to .4 cps range.

Section 3.7.1.1 of the FSAR requires that the time history spectra not fall below the smoothed spectra at more than five points and that no point shall fall below by more than 10 percent of the smoothed spectra. With the exception of the .1 to .4 cps range, both of these criteria are met for the smoothed design spectra as shown in the FSAR. For the smoothed spectra generated by SWEC, no point falls below the smoothed spectra by more than 10 percent. However the 4 percent vertical SSE spectra, produced by the time history falls below the smoothed spectra (Fig. 5) at six (6) locations (1.1, 2.2, 2.5, 3.2, 6.4, and 8.0 cps). This is not apparent in the FSAR due to the lowering of the smoothed vertical spectra to .3 g at 3.7 cps as discussed above.

SWEC does not believe that these observations have a significant impact on the station design; however, project licensing positions may need to be clarified.

4.2 MEAB Dynamic Model

As stated in Section 3.2, SWEC's review determined that the dynamic model of the MEAB developed by Brown & Root was used in both the Brown & Root and Bechtel seismic analysis. Therefore, the following observations from our review refer to the MEAB model as shown in the Brown & Root calculations (Item 3, Att. A).

SWEC's review of the MEAB model structural arrangement shown in the original calculation versus the present configuration as represented by the drawings (Item 5, Att. A), did not disclose any significant difference in number or arrangement of structural walls that would affect the dynamic response of the building.

The review of Brown & Root's mass property calculations indicated that these items were calculated correctly and yielded reasonable results with the exception of the mass property calculation of miscellaneous equipment, piping, ducts, etc. It appears that the mass properties of these items were calculated based on the design live load acting over the entire slab area. This method tends to overestimate the mass properties for these items. In general, joint masses are overestimated by 40 to 50 percent and joint mass inertias are overestimated by 20 to 30 percent. Also for the case where slabs occur over only a portion of the structure, the center of mass is shifted as compared to the center of mass of the combined walls and slabs.

Brown & Root has calculated the I_{zz} inertia term from the relation that $I_{zz} = I_{xx} + I_{yy}$. While specifically correct only for a thin rectangular plate and closed sections, due to the large plan area of the MEAB compared to its height, $I_{zz} = I_{xx} + I_{yy}$ yields acceptable results in this case. Also, Brown & Root's inertia calculations neglect the height difference in calculating mass moments of inertia about a parallel axis. Again this is incorrect, but due to the short distance in height between joints, the inertias calculated ignoring the height differential are acceptable.

With regard to the stiffness properties caculated by Brown & Root, SWEC's review and independent calculations resulted in the following observations:

1. Cross-sectional area, area center and flexural moments of inertia for the members checked by SWEC independent calculations are in very close agreement with the Brown & Root calculations.

2. The shear areas calculated by SWEC are approximately twice those developed by Brown & Root.

3. The shear center as calculated by Brown & Root is analytically correct for long open members; however, it is not appropriate for the MEAB, a short, wide building. The Brown & Root calculation has, therefore, resulted in larger than real eccentricities between the shear center and the mass center of the structure, inducing a larger torsional mode of response. SWEC believes the lateral stiffness of the MEAB should be based on the individual lateral stiffness of the MEAB wall groups with no shear flow considered between wall groups. This will result in a more realistic location of the shear center, closer to the mass centers of he building.

Each of the discrepancies noted with regard to mass and stiffness properties of the MEAB may have an impact on the final results. These discrepancies will tend to produce lower fundamental frequencies than in reality occur. However, it is not possible to assess if any or all of these observations will have a significant effect on the final results. Therefore, SWEC recommended and HL&P agreed, that SWEC prepare a simplified MEAB dynamic model correcting these observations. This simplified model described in Section 3.2.4 was used along with independently calculated soil-compliance functions and the ground time histories provided by HL&P, to generate floor response spectra at selected locations.

4.3 EHS Soil Compliance Functions

SWEC independently calculated the soil compliance functions for the OBE strain compatible soil properties accounting for foundation layering. Plotted in Figures 6 through 11, for each of the degrees of freedom, are the stiffness portions of the compliance functions determined by SWEC and the frequency independent stiffnesses used by Bechtel in the EHS analysis (Item 4, Att. A). Also plotted for information are the frequency dependent stiffnesses determined by WCC (Item 11, Att. A) based on their average soil properties, although these were not used in the confirmatory EHS analysis.

As shown in these plots, above approximately 6 cps, a significant variation exists, for all compliance functions, between the SWEC compliance functions and the constant stiffness used by Bechtel.

The first structural mode frequency estimated by Brown & Root is at 5.8 cps. Since this is believed to be underestimated (see comments on the MEAB model in Section 4.2), the actual structural frequency will be in the range where compliance functions differ significantly from those used by Bechtel.

The vertical and rocking spring stiffnesses used by Bechtel differ significantly from the frequency dependent values over the whole frequency range. In the range of 0 to 6 cps, the horizontal and torsional stiffnesses used by Bechtel represent a reasonable approximation of a uniform elastic half-space. However, there are still differences in this range on the order of 2-3 between the elastic half-space solution and the solution accounting for layering as represented by the SWEC curves.

The imaginary part of the soil compliance functions has not been plotted since the final results (Section 4.4) determined that the deviations in soil compliance functions do not have a significant impact on the seismic response of the MEAB.

4.4 Floor Response Spectra

As discussed in Section 3.4, floor response spectra for the OBE excitation were generated at El. 10'-0" and 86'-0" of the MEAB (Figs. 12 to 17).

Brown & Root floor response spectra are plotted in the same figures for comparative purposes. Floor response spectra from the Bechtel EHS analysis were available only for horizontal response at El. 86'-0" (Figs. 15 and 16). As shown by these comparative plots, the Brown & Root and SWEC floor response spectra at El. 10'-0" (Figs. 12 to 14) are in close agreement with the Brown & Root spectra generally being slightly higher.

Such close agreement of the response spectra of the mat level verified adequacy of Brown & Root's representation of the subgrade in the seismic analysis of the MEAB.

Review of the floor response spectra calculated by Bechtel and SWEC at El. 86'-0" (Figs. 15 and 16) also shows excellent agreement. As expected for a concrete structure of the MEAB dimensions supported on relatively soft soil, the response at the higher elevations is essentially the same as at the mat. The structure responds essentially as a rigid body with the low frequency soil motion. The agreement between SWEC and Bechtel floor response spectra at El. 86'-0" verifies the Bechtel EHS analysis for horizontal response.

At El. 86'-0" there is poor agreement between the Brown & Root spectra and the spectra calculated by SWEC or Bechtel. The Brown & Root spectra essentially envelope the SWEC spectra at this elevation, by substantial margins at most frequencies. The reason for this lack of agreement is not apparent. However, because of Brown & Root's overprediction of response, these spectra will represent a conservative plant design basis.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

It is concluded from the work performed by SWEC that:

1. The ground acceleration time histories for the STP meet the intent of the FSAR licensing commitments.

2. The soil compliance functions utilized by Bechtel in the EHS analysis or by Brown & Root in the original seismic analysis reasonably represent the soil structure interaction effects of the subgrade.

3. The discrepancies noted by SWEC in the calculation of the MEAB mass and stiffness model properties do not have a significant effect on the final results since the response is dominated by soil motion.

4. The Brown & Root floor design spectra represent a conservative plan design basis for equipment.

5. Horizontal floor design spectra generated by Bechtel in the EHS analysis correctly predict the plant design basis for equipment.

5.2 Recommendations

It is recommended as a result of this review that:

1. The observations discussed in Section 4.1 of this report regarding the enveloping of the design spectra be addressed in the plant licensing for clarification.

2. HL&P verify the vertical Bechtel EHS spectra by comparison to the SWEC vertical spectra at El. 86'-0".

3. HL&P continue to use the Brown & Root spectra for equipment qualification, since they represent a conservative design basis.

4. HL&P determine if the effect of variation in soil properties (±33 percent) as required by the NRC Standard Review Plan was considered in the EHS analysis. No evidence that this was considered was found in the information provided.

ATTACHMENT A

LIST OF DOCUMENTS REVIEWED

Documents 1 through 10 were provided as Attachments 1 through 10 of the HL&P Supplement No. 1 to Requisition on Purchasing Department (RPD) No. 494932 dated January 26, 1983, Letter No. ST-HL-XX-1344.

1. Horizontal and vertical SSE time histories

2. South Texas Project FSAR Section 3.7, Seismic Design

3. Seismic analysis of mechanical-electrical auxiliary building (MEAB), Calculation No. 3M011SC089, South Texas Project

4. SSI seismic reanalysis of power block buildings, Bechtel Calculation No. CC-9150, South Texas Project, 1-10-83

5. a. General arrangement drawings MEAB half-size, 6M-18-9-N-5015, Rev. 0, through 6M-18-9-N-5045

   b. Concrete drawings, MEAB, half-size plan 9-C-4001 through 4004, 9-C-4006 through 4009, 9-C-4011 through 4022, 9-C-4024 through 4025, 9-C-4027 through 4028, 9-C-4030 through 4043, 9-C-4045 through 4050, 9-C-4052 through 4060, 0-M-0001, 9-C-4122, 1-C-4201, 1-C-4203 through 4207, and 1-C-4210 through 4211

   c. Concrete drawings, MEAB, half-size sections 9-C-4063 through 4066, 9-C-4070 through 4072, 9-C-4074 through 4075, 9-C-4077 through 4080, 9-C-4082 through 4084, 9-C-4086 through 4091, 9-C-4095 through 4096, 9-C-4101 through 4105, 9-C-4108, 9-C-4260 through 4263, 9-C-4269, 9-C-4271, 9-C-4275 through 4277, and 9-C-4282

6. Computations of spring and damping coefficients for Category 1 structures, South Texas Project Units 1 and 2, Woodward-Clyde Consultants, Y310XR1398CWC, April 1980

7. Final report on soil-structure interaction (SSI) analysis reevaluation for Houston Lighting & Power Company South Texas Project, Bechtel Study No. S-001, September 1982

8. Conference notes, soil-structure interaction effects on seismic floor response spectra, ST-YB-HL-2452

9. ST-HL-AE-919, responses to NRC review questions, Docket Nos. STN 50-498, STN 50-499

10. Soil-structure interaction studies, South Texas Project Units 1 and 2, Y310XR069-W, Woodward-Clyde consultant report

11. Letter ST-HL-XX-1368 (February 28, 1983) - Transmittal to SWEC from HL&P of Woodward-Clyde Consultants (WCC) Calculation No. 9025-15, "Strain-Compatible Spring Constants and Damping Ratios for Diesel Generator and Mechanical-Electric Auxiliary Buildings."

ATTACHMENT B

LIST OF SWEC CALCULATIONS

Calculation No.	Title
14475.01-SV-001	Verification of Time History
14475.01-SV-002	Verification of MEAB Dynamic Model
14475.01-SV-003	Verification of MEAB Soil Compliance Functions
14475.01-SV-004	Verification of MEAB ARS (Amplified Response Spectra)

ATTACHMENT C

FREQUENCY INTERVALS FOR CALCULATION OF RESPONSE SPECTRA

frequency range (hertz)	increment (hertz)
0.2 - 3.0	.10
3.0 - 3.6	.15
3.6 - 5.0	.20
5.0 - 8.0	.25
8.0 - 15.0	.50
15.0 - 18.0	1.0
18.0 - 22.0	2.0
22.0 - 34.0	3.0

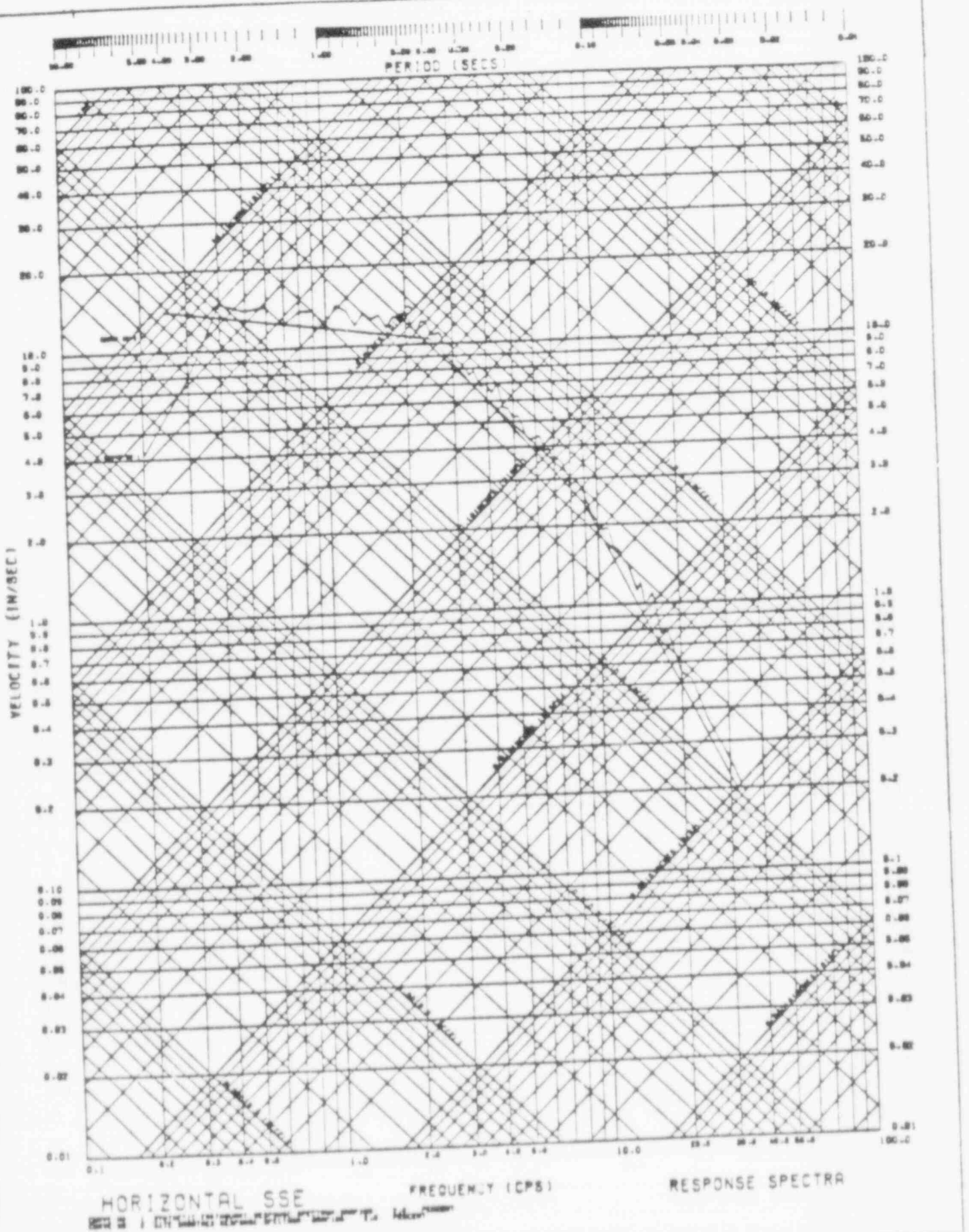

PERIOD (SECS)
VELOCITY (IN/SEC)
FREQUENCY (CPS)
HORIZONTAL SSE
RESPONSE SPECTRA

FIG. 1

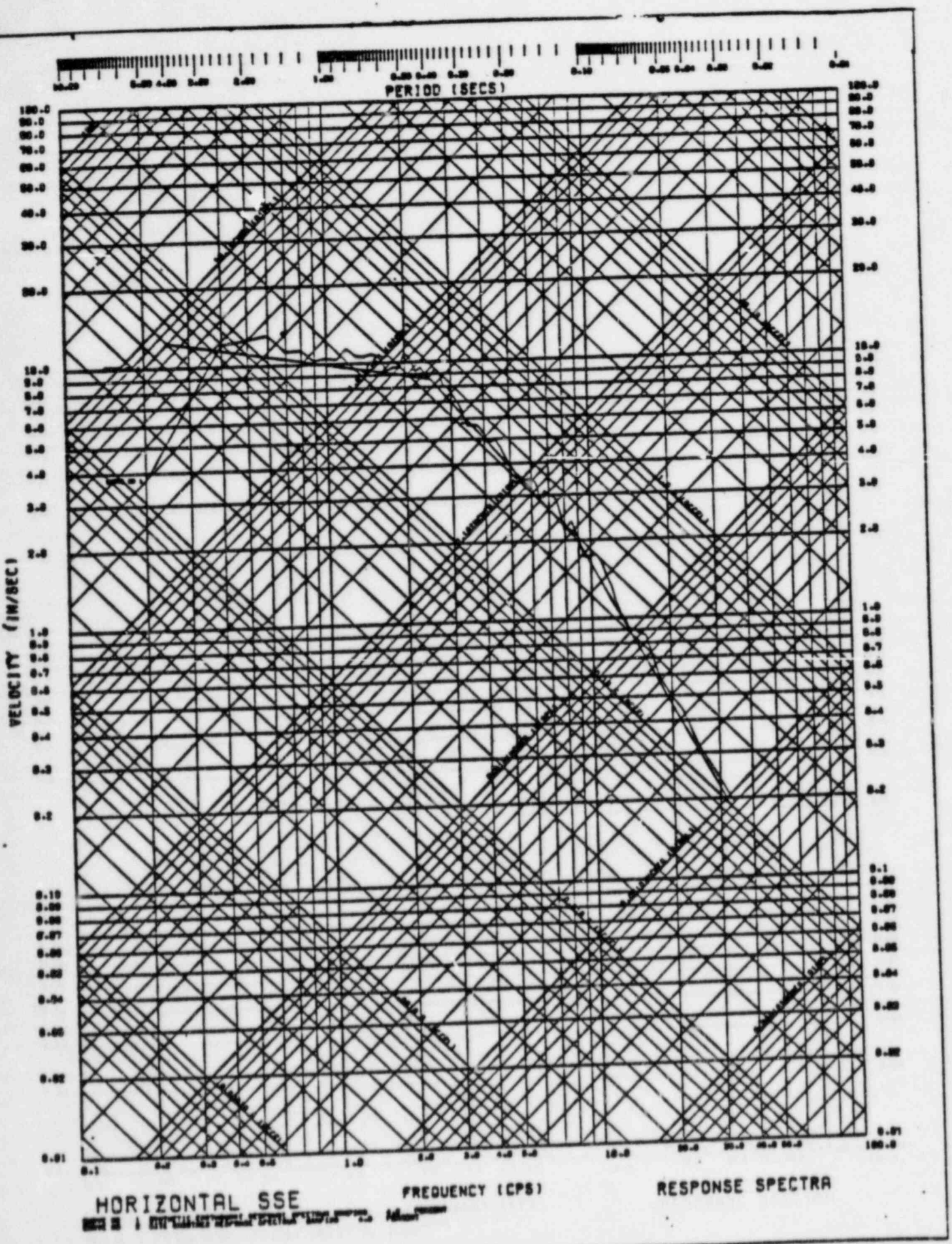

PERIOD (SECS)
VELOCITY (IN/SEC)
FREQUENCY (CPS)
HORIZONTAL SSE
RESPONSE SPECTRA

FIG. 2

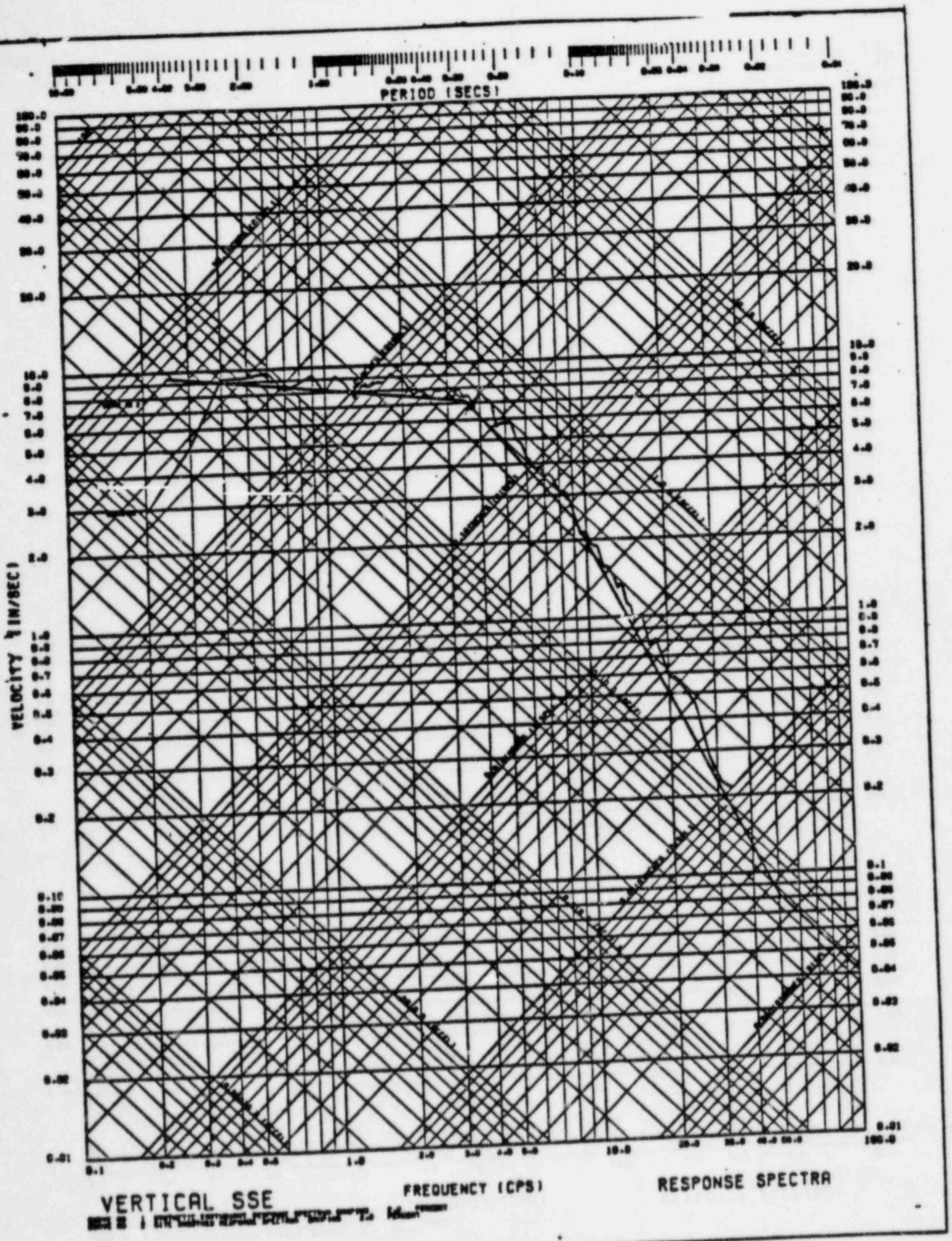

PERIOD (SECS)
VELOCITY (IN/SEC)
FREQUENCY (CPS)
VERTICAL SSE
RESPONSE SPECTRA

FIG. 3

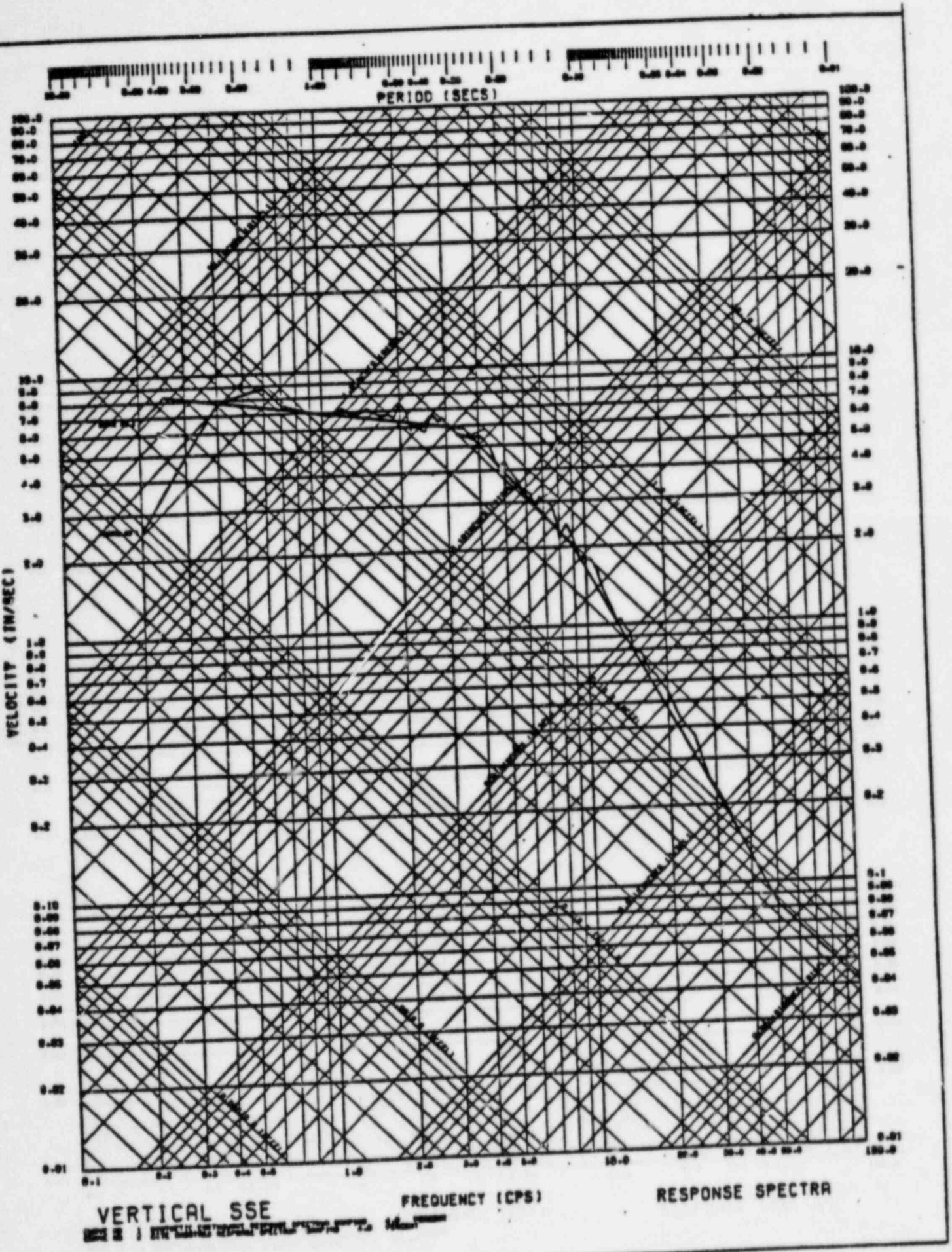

PERIOD (SECS)
VELOCITY (IN/SEC)
FREQUENCY (CPS)
RESPONSE SPECTRA
VERTICAL SSE

FIG. 4

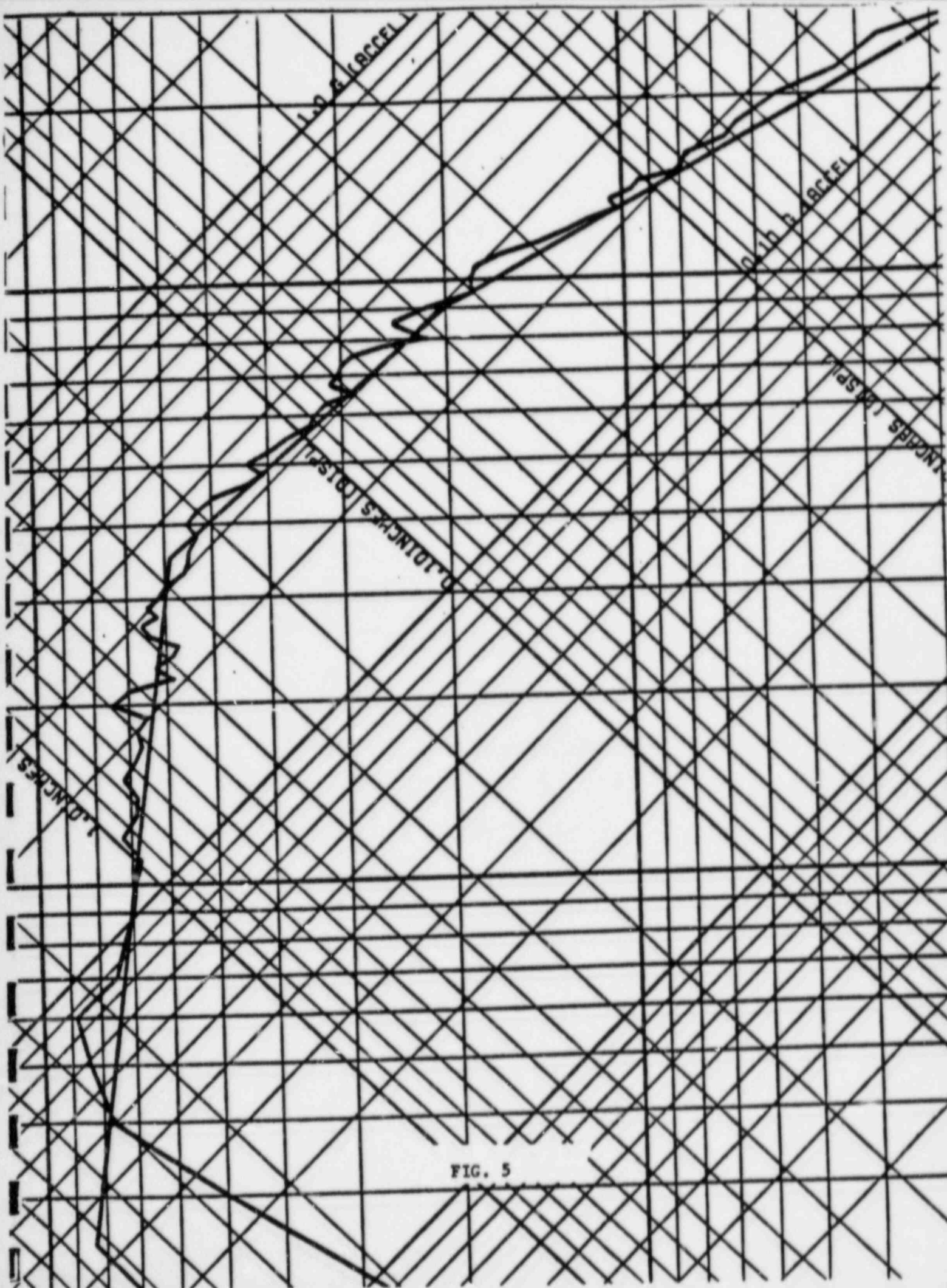


FIG. 5

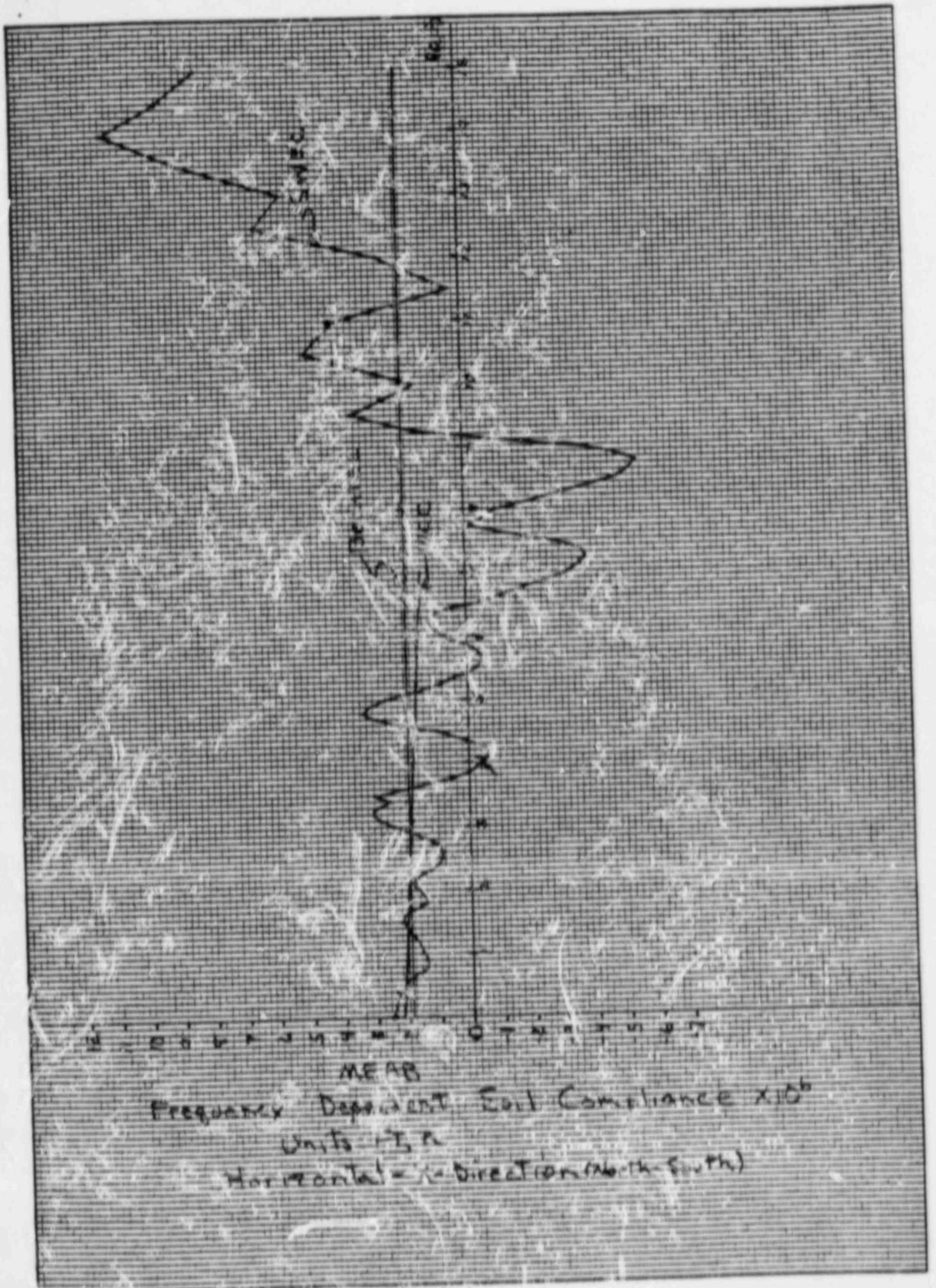

MEAB
Frequency Dependent East Compliance x10^6
Units in ft/lb
Horizontal = x-Direction (North-South)

FIG. 1

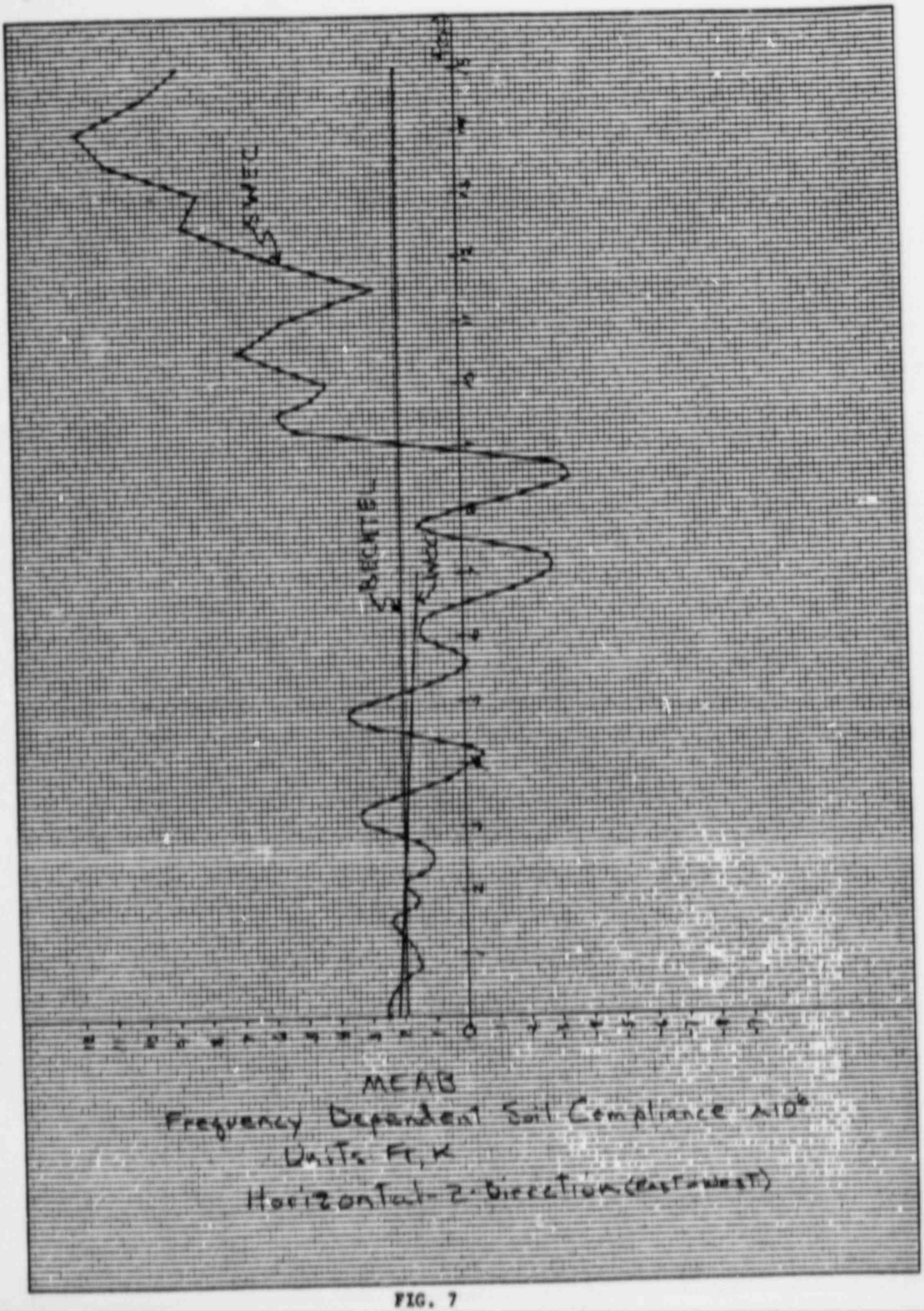
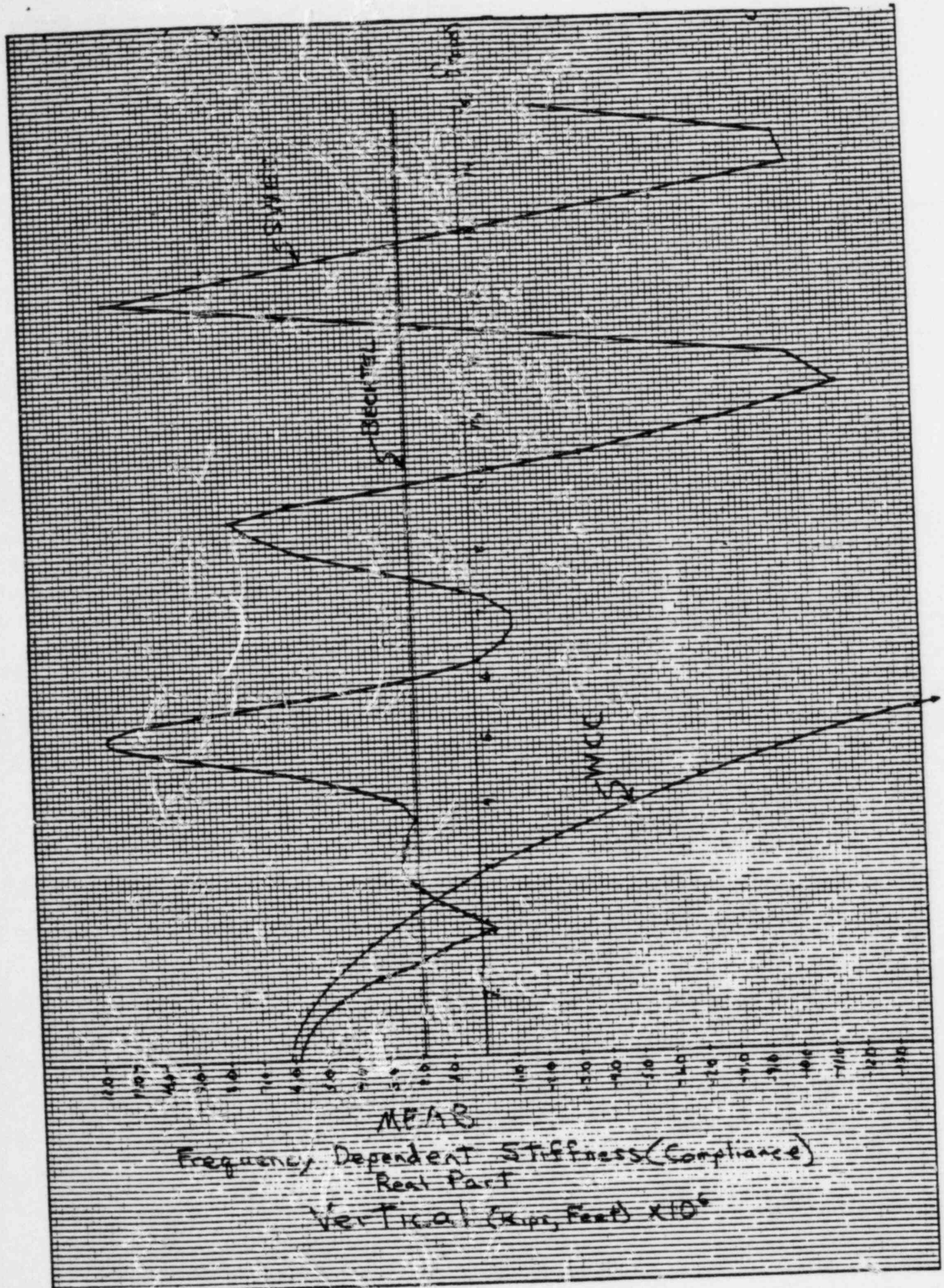

REACTOR
MEAB
Frequency Dependent Soil Compliance x10⁶
Units Ft, K
Horizontal-2 Direction (East-West)

FIG. 7



ME/AB

Frequency Dependent Stiffness (Compliance)
Real Part
Vertical (Kips/Feet) X10^{6}

Fig. 6

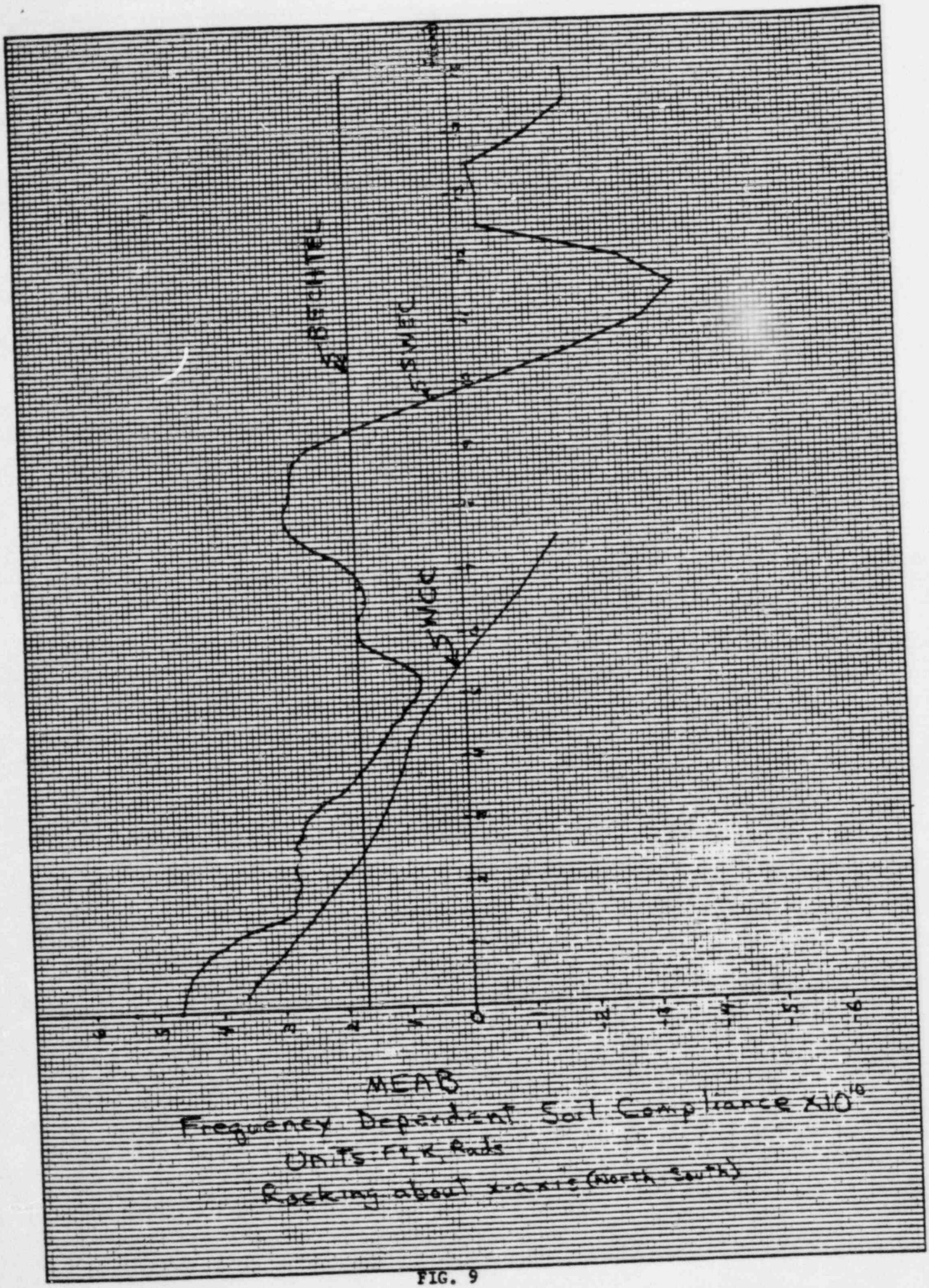

MEAB
Frequency Dependent Soil Compliance x10^10
Units: Ft, K, Rads
Rocking about x-axis (North South)

FIG. 9

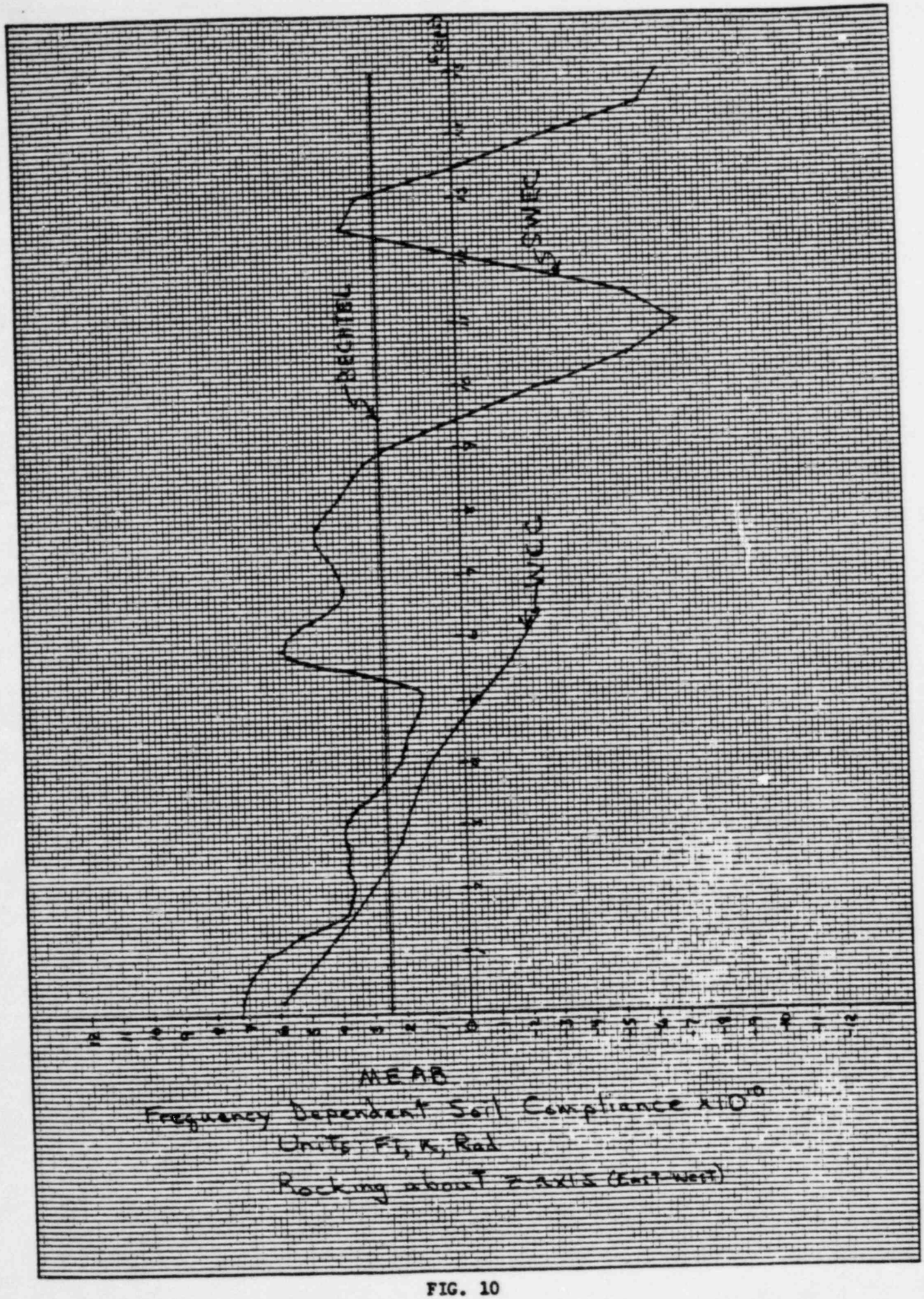

DECIBEL
REAL
IMAG
MEAB
Frequency Dependent Soil Compliance x10^10
Units: Ft, K, Rad
Rocking about Z-axis (East-West)

FIG. 10

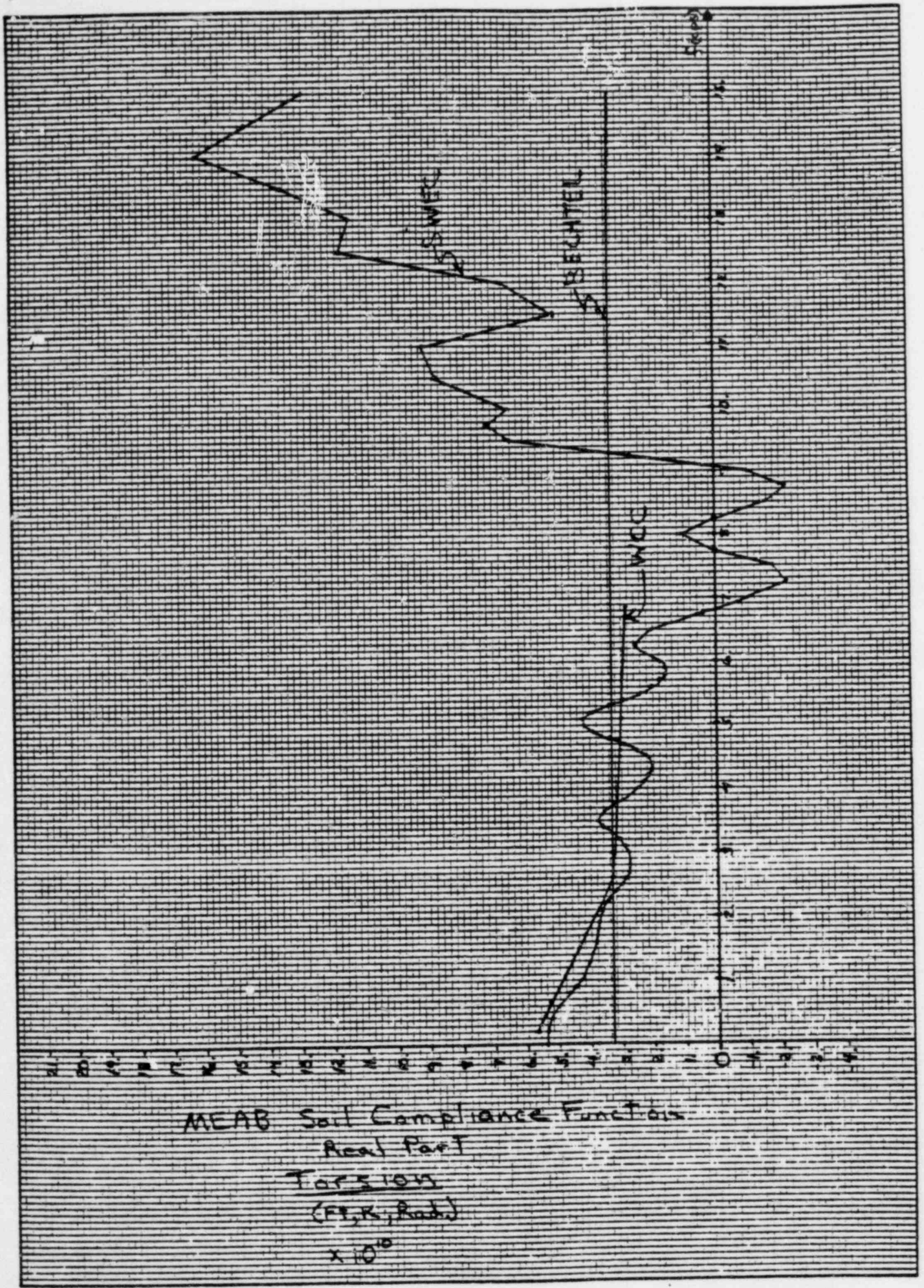

MEAB Soil Compliance Function
Real Part
For SIDS
(Ft, Rt, Rad)
x 10^-10

FIG. 11

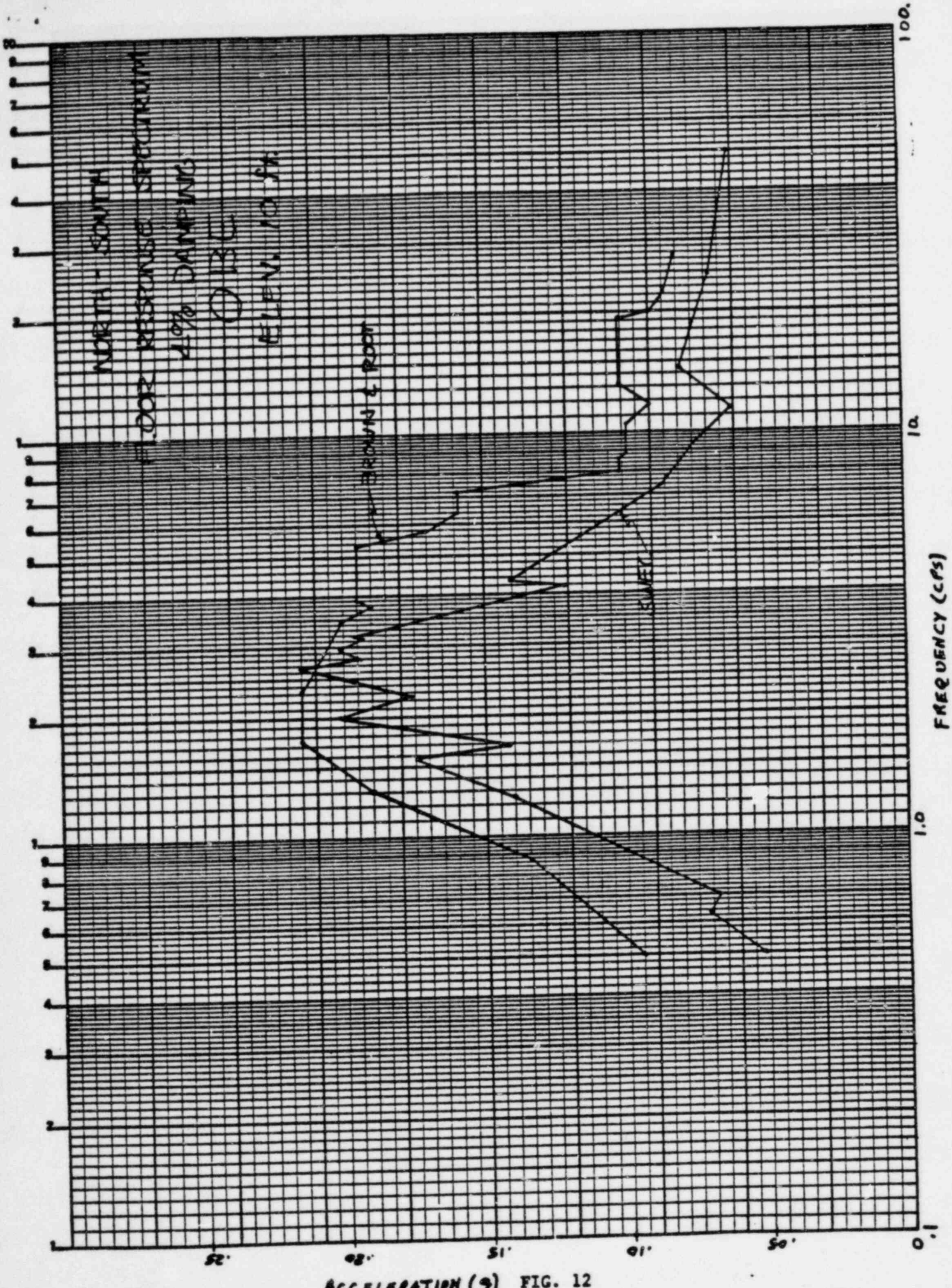
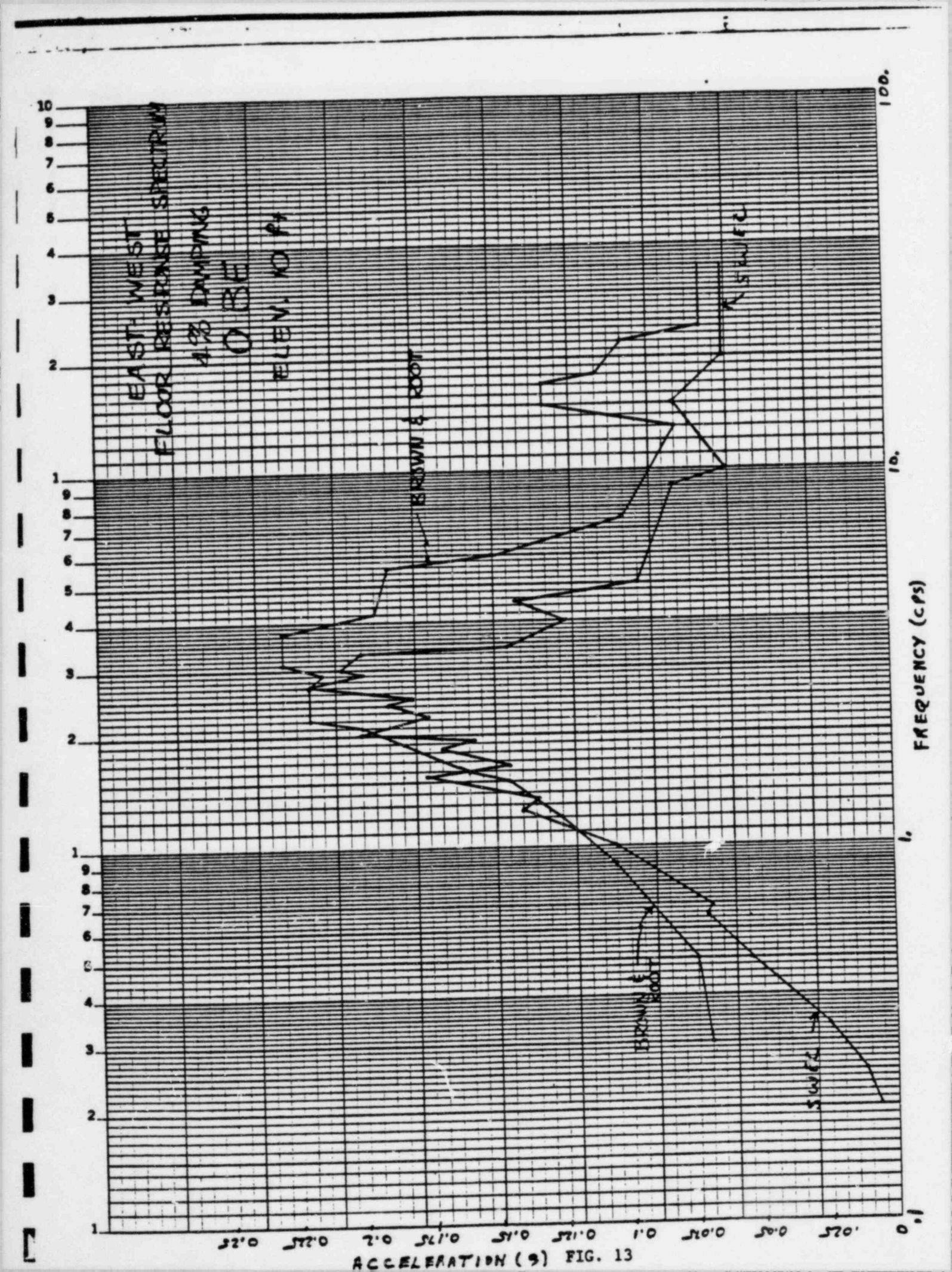

FLOOR RESPONSE SPECTRUM
NORTH-SOUTH
JOB DAM WC
ELEV. 10 FT.
BROUNT FROM
QUIET
100.
10.
1.0
0.1
FREQUENCY (CPS)
52.
08.
51.
01.
50.
ACCELERATION (g)

FIG. 12


EAST-WEST
FLOOR RESPONSE SPECTRUM
48 DAMPING
ELEV. NO. 4
BROWN & ROOT
BROWN & ROOT
FREQUENCY (CPS)
ACCELERATION (g)
FIG. 13

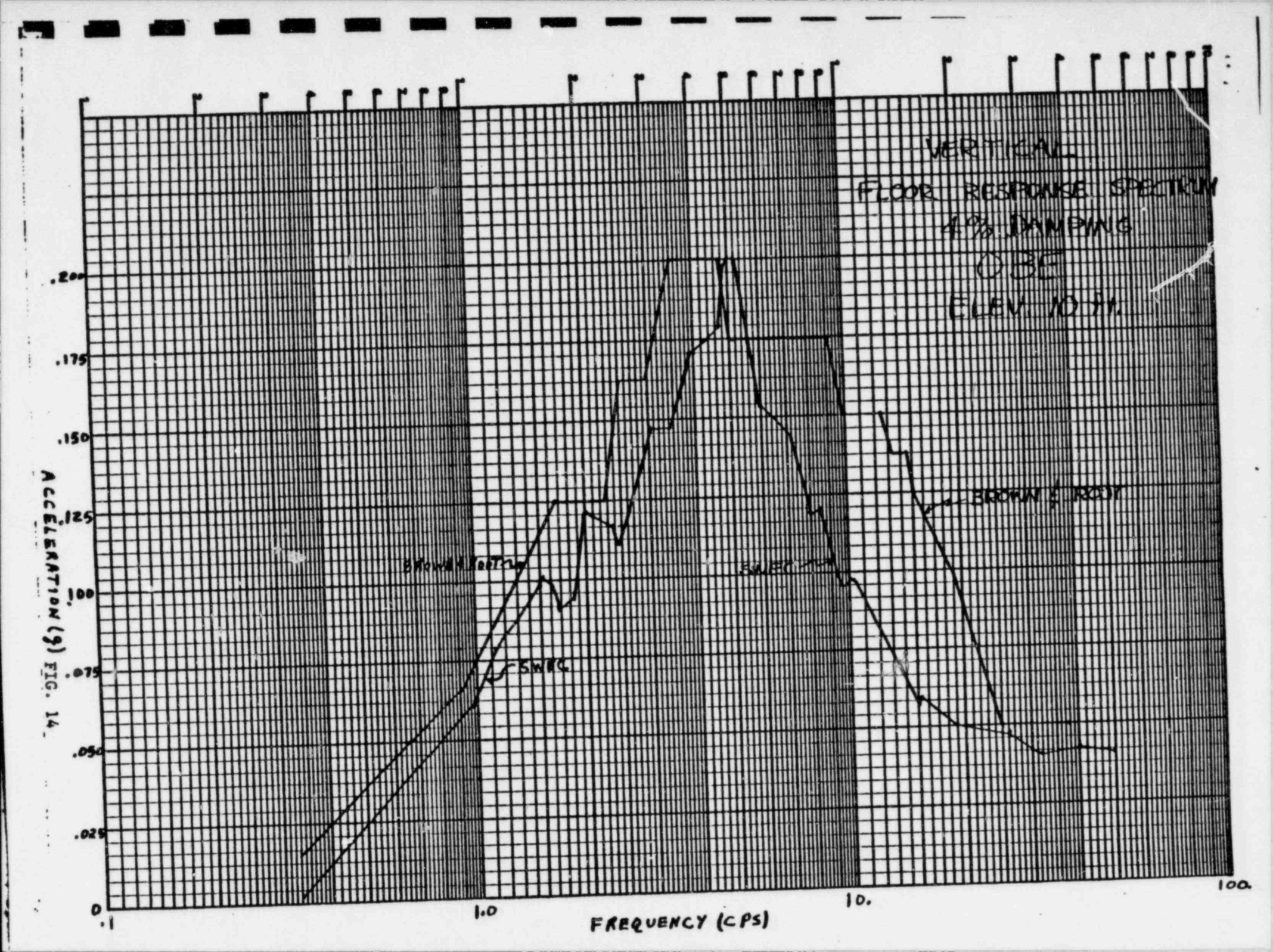

VERTICAL
FLOOR RESPONSE SPECTRUM
4% DAMPING
OBE
ELEV. 10 FT.
BROWN & ROOT
BECHTEL
BECHTEL
.200
.175
.150
.125
.100
.075
.050
.025
0
.1
1.0
10.
100
ACCELERATION (g)
FREQUENCY (CPS)

FIG. 14

Vibration Response Spectrum
Flight Test Data
Q = 10
Damping
Measured
Predicted
Frequency (cps)
Acceleration (g)
100
10.
1.
0.1

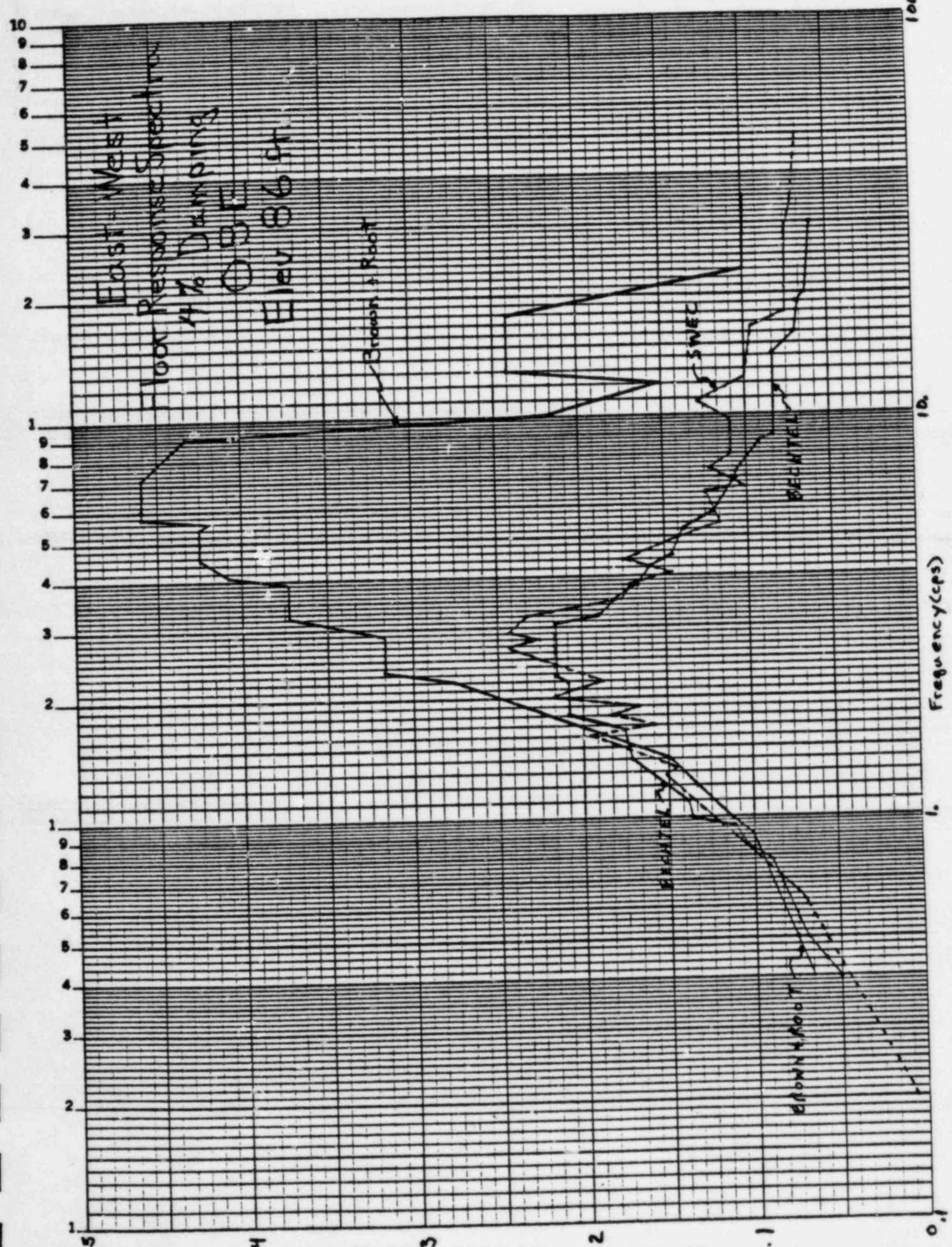

Frequency (cps)
100.
10.
1.
0.1
5.
4.
3.
2.
1.
Brown + Root
Brown & Root
Brown & Root
Brown & Root

FIG. 16

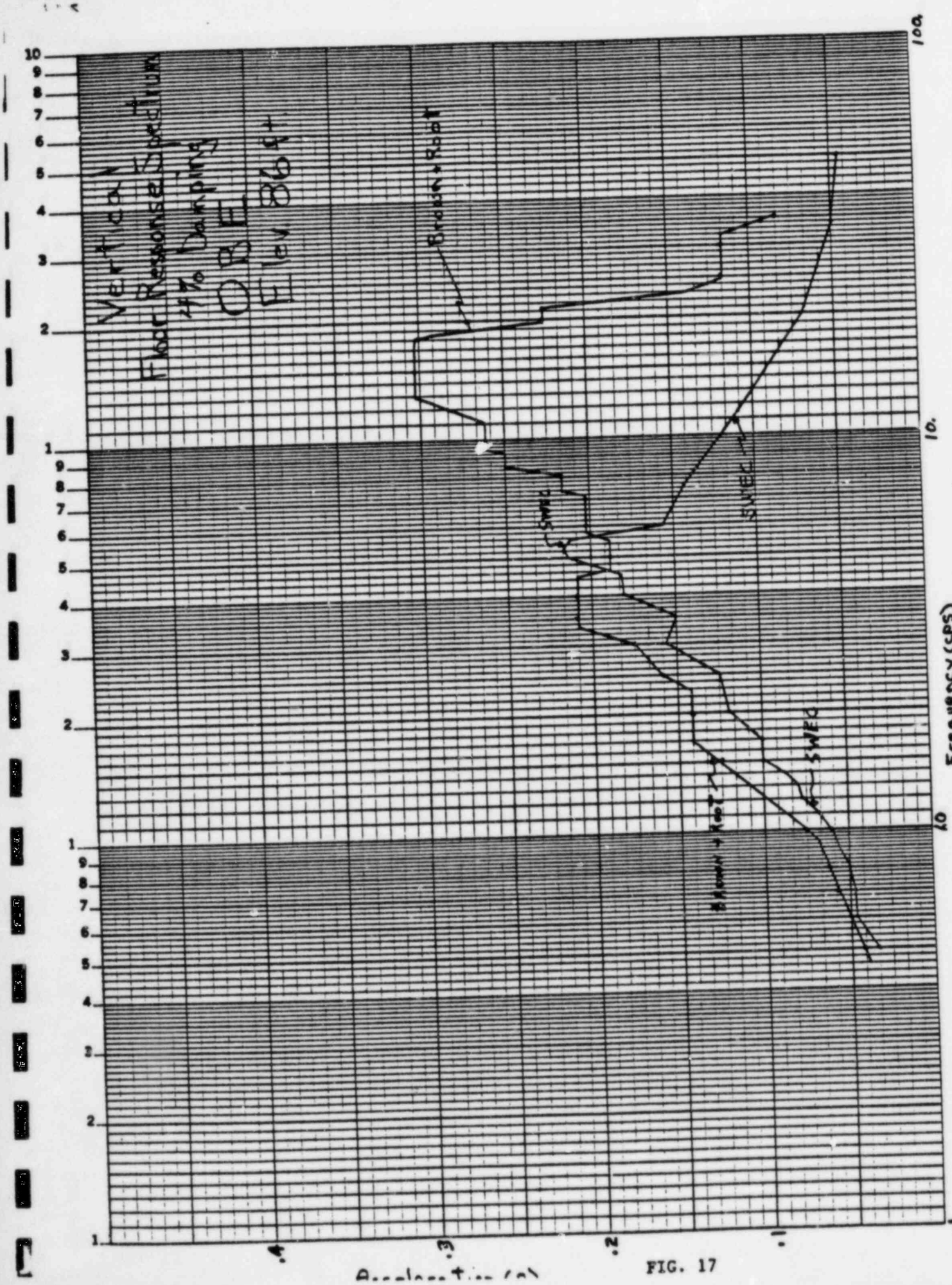


FIG. 17

HL&P 1008A (2-83)

Houston Lighting & Power Company

OFFICE MEMORANDUM

To R. A. Frazar

ST-HL-HL-29044
September 1, 1983
PFN: C 36.5
C 3.1
M 2.19

From S. M. Dew

Subject Engineering Design Assurance Report of Independent Technical Assessment 83-1; Soil-Structure Interaction Analysis and Seismic Design
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

Reference: Office Memorandum ST-HL-28146

Enclosed are our responses to the subject report as requested in the referenced memorandum. The thirteen action items and the responses are shown on the Action Item Reply Forms.

We hope these responses will able you to close out this item.

Should you have any questions or require additional information please contact R. M. Attar at 877-3164.

RMA/slb

Attachments

cc: M. G. Zaalouk
R. R. Hernandez
J. N. Bailey
J. L. Barker
J. G. White
STP Engineering File
STP RMS (2)

B133

Action Item Cover Sheet

Review/assessment subject title: SSI Analysis & Seismic Design, STP

Document no.: 83-1 Review/assessment no.: 83-1

1. Action items prepared by

Manas K Chakravorty 6-14-83
Engineering Assurance Department engineer — Date

N/A
Engineering Assurance Department engineer — Date

2. Action items reviewed by

[signature] 6-14-83
Manager, Engineering Assurance Department — Date

3. Actions pertaining to review/assessment 83-1 have been implemented.

Manager, STP Engineering — Date

4. Implementation of actions has been verified.

Engineering Assurance Department engineer — Date

Engineering Assurance Department engineer — Date

5. All concerns pertaining to review/assessment no. 83-1 have been resolved.

Manager, Engineering Assurance Department — Date

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
1	In view of the recent commitments to the NRC (ST-HL-AE-919) regarding the SSI and seismic design and evaluation of STP, all STP seismic design criteria documents as well as FSAR Section 3.7 should be revised. Design criteria documents should also clearly specify methods used to perform SSI analysis for all Category 1 structures. As an example, from the documents reviewed it was not evident what method of SSI analysis and reverification will be employed for essential cooling water intake and discharge structures and the condensate storage tank. Response: The FSAR Section 3.7 has been revised per Bechtel Safety Analysis Report Change Notice (SARCN) No. 226 and No. 271 (HL&P SARCN No. 250 and No. 262 respectively) to address the soil-structure interaction (SSI), seismic analysis and design, and related commitments to the NRC. The criteria for the verification of seismic qualification and design of equipment and components with respect to the EHS-augmented response spectra have been defined in the Bechtel Interdisciplinary Design Criteria No. 4A010SQ1004. The seismic SSI methods of analysis that were used for all Category I structures are presented in Table 3.7-2 of the FSAR per SARCN No. 271 and in the seismic design criteria (Section 4.9 of the Civil/Structural Design Criteria No. 5A360SQ1001). It is noted that the seismic design criteria will be augmented to address the current status of the seismic analyses bases.

Date action(s) scheduled to be complete: 11/18/83

Manager, STP Engineering — Date 8/26/83

B000

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
1	(Continued) Reverification of the SSI analysis for the ECW intake structure and the Auxiliary Feedwater Tank (Condensate Storage Tank) has been performed and presented, in the Civil/Structural Calculation No. CC-9100 and CC-9140, respectively.

Date action(s) scheduled to be complete: 11-18-83

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
2	Independent calculation performed by SWEC (Appendix) indicates that response spectra developed from STP design ground time histories do not meet the requirements of Reg. Guide 1.60 spectra at frequencies less than 0.4 cps. Also, for the vertical time history, response spectra for the 4% damping case fall below Reg. Guide 1.60 spectra at the following frequencies: 1.1, 2.2, 2.5, 3.2, 6.4, and 8.0 cps. Although these discrepancies are not significant enough to affect STP seismic design, STP should review them and, if required, clarify the licensing position. Response: The response spectra generated from the STP synthetic time-histories do not envelope the RG 1.60 spectra in the very low frequency range of less than 0.4 cps because such low frequencies could not be incorporated in the relatively short duration (10 seconds) of the accelerograms used. This variation has been addressed in Appendix A of the Woodward-Clyde (WCC) report (Y310XR069-WL dated January 5, 1976). The variation is considered to be of no concern since it is confined to very low frequencies which normally are insignificant for design.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
2	(Continued) The response spectra generated from the vertical synthetic time-history for 4% damping envelope the RG 1.60 spectra except at the cited 6 frequency points where the spectral response is below the RG 1.60 by only 3 to 4%. The SRP, in Section 3.7.1.II 1b, allows 5 points of the calculated spectra computed from the time history to be up to 10% below the RG 1.60 design spectra. Therefore, the vertical synthetic time-history is considered to be acceptable since it is essentially within the broad bounds allowed by the SRP. The corresponding clarification has been incorporated in the FSAR Section 3.7.1.2 per SARCN No. 271.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
3	Statistical independence of STP horizontal and vertical time histories was not verified. Hence, they should not be used in a three-dimensional time history dynamic analysis where responses are combined algebraically as implied in FSAR Section 3.7.3.6. From the documents reviewed it was also not evident whether, for seismic analysis of all Category 1 unsymmetric structures, regulatory position C1 of Reg. Guide 1.122 has been complied with. Accordingly, BEC should review these concerns and assure that regulatory requirements are met. Response: The STP horizontal and vertical time histories are not statistically independent. Accordingly, the SSI seismic analyses for each direction of excitation were performed separately as described in the FSAR Section 3.7.2.6. The algebraic summation of each time step response was used actually only for the combination of the modal response due to unidirectional excitation, and it was not used for the general combination of response as it is inferred from the original Sections 3.7.2.7 and 3.7.3.6. Modal response spectrum analyses, utilizing SRSS for the combination of response from the three directions of excitation, was the only method actually used for subsystem analyses. The corresponding clarifications have been incorporated in the FSAR Sections 3.7.3A.6 and 3.7.3B.6 per SARCN No. 226 and the superseding SARCN No. 271 which in addition revises Section 3.7.2.7.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
3	(Continued) Notwithstanding the admittedly contradictory statements in the cited Sections of the FSAR, the procedures used for generating the STP floor response spectra are in compliance with regulatory position C1 of RG 1.122.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
4	Since the STP design basis SSI analysis is based on the 2-step finite element analysis (which is not very reliable for addressing effects of changes in structural configuration) it is not clear what SSI reanalysis will be employed to address significant changes in the structural configuration. BEC should develop an analytical basis to address this concern. Response: It has been concluded from Bechtel's SSI study Reference (A) that for response spectra generated by the two-step finite element method (FEM) of analysis for SSI, the changes attributed to variations in structural configuration are inconsequential because: (1) The changes in spectral response are analytically originated by an artificial sensitivity related to the de-coupled fixed-base models used in the second-step of the SSI analyses performed in the time domain. (2) The surmised changes are confined to the structural frequency range where the over-conservatism of the spectral response effectively renders the changes as insignificant. This issue of structural-configuration revisions to the response spectra computed by two-step FEM has been presented to the NRC in Reference (B) and in the response to NRC Question 220.08, and is addressed in the revision of the FSAR Section 3.7.2.4 per SARCN No. 271.

Date action(s) scheduled to be complete: 9-28-84

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
4	(Continued) Accordingly, the original floor response spectra (B&R TRD, 3N160SR044-D) have been preserved as the design-basis spectra for the STP and the corresponding charts have been issued as controlled drawings indexed in drawing no. 4N169S-3915O. For a special case on the applicability of design-basis spectra refer to item 11 where the seismic analysis/design of piping in the MEAB is addressed. The changes in structural configuration will be taken into consideration and addressed only with respect to floor response spectra calculated on the basis of EHS and/or single-step FEM SSI analyses. These methods of analysis for SSI are devoid of the decoupled fixed-base structural models that introduce the artificial sensitivity of spectral response to structural configuration. A confirmatory-basis response spectra for the STP will be developed from the envelope of the EHS and single-step FEM solutions as described in the revised FSAR Section 3.7.2.4 per SARCN No. 271.

Date action(s) scheduled to be complete: ~~9-28-84~~

Manager, STP Engineering — Date: 8/26/83

B000

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
5	The finite element SSI approach used by WCC was adequate; however, the finite element structural models they used were developed by EDS Nuclear during 1975. Therefore, BEC should review the finite element superstructure model to determine any possible impact on the results and conclusions of WCC's finite element SSI analysis due to any significant changes in the structural configuration made subsequent to WCC's analysis. For example, for the MEAB the thickness of the finite elements representing the mat was assumed to be 4'0", whereas the actual mat thickness is 6'0". Response: The WCC finite element SSI analysis is a single-step FEM solution where soil-structure interaction decisively dominates the system response, and as stated under Item 4, the single-step FEM is not susceptible to structural-configuration over-sensitivity. Therefore, any changes in structural configuration, particularly changes in the thickness of a stiffened basemat, are not anticipated to have any significant effect on the resultant time-history response and calculated spectra. It is noted that the latest structural configuration will be incorporated in the EHS and the single-step FEM analyses used to develop the confirmatory-basis spectra described in the revised Section 3.7.2.4 of the FSAR.

Date action(s) scheduled to be complete: 9-28-84

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
6	During the review of WCC's finite element analysis, it was observed that some discrepancies exist between the maximum relative displacements specified in the response to NRC question 220.09 (ST-HL-AE-919) and those computed by WCC (WCC calculation Y310XR069-WL). STP should verify that relative displacements used for seismic design are adequate. Response: The two-step finite element method (FEM) for SSI analysis is the design-basis for the STP. The relative displacements given in the response to NRC Question 220.09 were obtained from that analysis performed as follows: (i) The maximum relative displacements at the foundation base were first obtained from the first-step analysis utilizing the LUSH computer code. (ii) In the second-step analysis, the fixed-base 3-dimensional lumped-parameter models of structures were used to compute the relative displacements at various locations between structures utilizing the STRUDL-DYNAL computer code. (iii) The resultant relative displacements were then obtained by the absolute summation of step (i) and step (ii) results. These are the displacements presented in the response to NRC Question 220.09.

Date action(s) scheduled to be complete: 8-31-84

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
6	(Continued) The maximum relative displacements shown in the WCC Report (Y310XR069-WL) were calculated from the intermediate step (i). It is agreed that such displacements, even though not obtained from the final step intended to be governing, should be recognized, particularly because of the acknowledged limitations inherent in the two-step FEM. However, because of the insufficient data presented in the WCC report and the limitations of the calculation due to the crude 2D plane-strain structural models used in the WCC first-step analyses, the WCC data should be verified and possibly replaced by the results from the ongoing single-step FLUSH analysis. The displacements thus obtained from a detailed single-step SSI analysis will be compared to the second-step results to determine the governing displacements. It is noted that adverse effects are not anticipated since the differential - settlement displacements are substantially higher and govern over the seismic relative displacements.

Date action(s) scheduled to be complete: ~~8-31-84~~

Manager, STP Engineering

8/24/83
Date

B000

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
7	A review of the calculations for evaluation of safety factors during OBE and SSE events for the MEAB indicated compliance with standard engineering practice and Standard Review Plan requirements. However, no calculation was observed addressing bearing stress developed under the foundation mat of the MEAB during a seismic event. BEC should review this concern and determine that bearing stresses developed during an SSE meet the acceptance criteria. Response: The computation of the bearing stresses (including seismically induced stresses) under the foundation mat of the MEAB are presented in Civil/Structural calculation 3M051SC067-15C. This B&R calculation has been reviewed and found acceptable by Bechtel.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
8	The method for determining distribution of the seismic load in major load-carrying walls of the MEAB complies with standard engineering practice. However, existing design documents pertaining to calculations of actual seismic shear stress and seismic loads for mat design do not reflect use of the latest seismic loads and configuration for the MEAB. Also noted was that these calculations did not address consideration of SSE. BEC should revise these design documents to reflect the current seismic analysis for both OBE and SSE. In revising these calculations it is suggested that accidental torsion as specified in Standard Review Plan Section 3.7.2.II.11 should be accounted for. Response: The changes in structural configuration are not considered to result in significant changes in structural seismic response, such as total base shear, if the response is properly calculated by single-step transient analyses as stated under item 5. However, it is acknowledged that the changes in structural configuration may affect the distribution of seismic loads among major load-carrying walls and possibly the base mat. Evaluation of these effects is a recognized activity within the C/S Discipline plan for confirmatory calculations. The activity has not been scheduled for early completion because, based on an initial assessment, the current design of the walls has ample margin and does not deserve the immediate attention that would be necessary if corrective work were imminent for the completed walls.

Date action(s) scheduled to be complete: ~~8-31-84~~

Manager, STP Engineering — Date 8/26/83

B000

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
8	(Continued) The present calculations do not address the SSE loading combination because the OBE loading combination invariably governs the design. Nevertheless, the appropriate clarification will be incorporated in the calculation. The effects of accidental torsion will also be considered as part of the future confirmatory calculation for shear walls.

Date action(s) scheduled to be complete: ~~8-31-84~~

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
9	The design basis floor response spectra (FRS) curves for STP did not meet the frequency intervals specified in Reg. Guide 1.122. Subsequently, BEC assessed the impact on STP FRS curves of using the frequency intervals of Reg. Guide 1.122. However, from the design documents reviewed it was not evident whether the reanalysis using the elastic half space (EHS) method complied with regulatory position C1 of Reg. Guide 1.122 regarding the combination of 3-components of earthquake response. BEC is requested to verify that the EHS analysis meets the intent of this regulatory position. Response: The following procedures were used for generating floor response spectra from the reanalysis by EHS method for SSI: (i) Two horizontal and one vertical time-history analyses were performed separately by unidirectional input of the free-field time-history acceleration records. (ii) For each unidirectional excitation, the floor response spectra were computed for the respective direction of input and the other orthogonal directions. (iii) The codirectional response spectra generated by the three unidirectional analyses were combined by the SRSS method.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
9	(Continued) (iv) The frequency intervals per RG 1.122 were used to compute the floor response spectra, and a ± 15% frequency-based broadening was applied to the computed spectra. Therefore, the procedures used in the EHS re-analysis are in compliance with the regulatory position C1 of RG 1.122.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
10	Design basis vertical FRS curves as issued did not include local effects of floor flexibility. It is suggested that BEC develop an action plan to address this concern. Response: The evaluation of the floor flexibility local effects on vertical floor response spectra, identified as Quadrex Concern No. 4.1.2.4. (u), from the onset has been recognized by Bechtel as a necessary confirmatory task. The planned approach is to establish by means of a parametric study the lower bound of floor subsystem natural frequency above which the spectral response is not affected by the floor flexibility. The natural frequencies of the governing floor elements will then be examined against the parametric study results in order to determine the effects on vertical spectral response.

Date action(s) scheduled to be complete: 1-27-84

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
11	Design basis FRS curves have been issued as a controlled drawing document; accordingly, BEC Engineering Department procedure EDP 4.46 will be used to control these curves. However, the issued FRS curves do not refer to the EHS response spectra, which will also be used to verify adequacy of all prior and future seismic designs and qualifications. In order to ensure adequate consideration of EHS response spectra for future seismic qualification and/or modification of systems and components, BEC should also issue the EHS response spectra as a controlled document for STP assessment. Response: The EHS response spectra have been issued as Bechtel Civil/Structural Sketches No. 5 through 254 referenced in the STP Design Criteria No. 4A010SQ1004. The sketches are controlled documents, which in accordance with Engineering Department Procedures, are appropriate for within-project use restricted to the Civil/Structural Discipline, Piping Stress and Support Group and the Equipment Qualification Group. The only off-project release of the EHS spectra that is anticipated at this time is a limited submittal to Westinghouse (W). This will not be a submittal of design-basis documents to W. The submittal will be only for the purpose of identifying to W the EHS-augmented spectral response that prevails in the low frequency range corresponding to SSI of the RCB, and enable W to confirm that there is no significant effect on the NSSS.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
11	(Continued) The following actions have been implemented within the project in order to ensure adequate consideration of the floor response spectra augmented by the EHS SSI analysis: (1) All the equipment, components* and structural elements previously qualified and/or designed based on the design-basis response spectra must be subject to verification in accordance with Design Criteria No 4A010SQ1004. (2) All future seismic analysis and design by Bechtel of components* and structural elements shall be based on the design-basis spectra. If the components and structural elements have natural frequencies within range that is affected by the EHS-augmented spectra, the seismic analysis shall be based on the envelope of the EHS spectra and the design-basis spectra. (3) The project specifications for new procurement of seismic category I equipment will include the following provisions on seismic qualifications: "The equipment shall be designed to avoid natural frequencies lower than 10 cps. This requirement is confined to the frequencies of modes whose motion in the installed configuration of the equipment corresponds to a horizontal direction of motion. Any equipment that does not satisfy

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

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item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
11	(Continued) or which cannot be easily modified to satisfy the minimum frequency limit of 10 cps shall be specifically identified by the Vendor. If the equipment exhibits natural frequencies lower than 5 cps, the equipment shall be identified and its proposed analysis/qualification plan shall be submitted by the Vendor for the prior review and acceptance by the Purchaser." (4) All of the new seismic category I equipment and components qualified by vendors will be subject to verification in accordance with Design Criteria No. 4A010SQ1004. * The only exception on the applicability of the design-basis response spectra is for the case of piping components in the Mechanical Electrical Auxiliary Building (MEAB). The seismic analysis and design of piping in the MEAB has been and will continue to be based on the design-basis spectra that had been revised and issued by B&R to reflect changes in the structural configuration. These configuration-revised spectra (B&R TRD, Rev. E), as well as the original design-basis spectra (B&R TRD, Rev. D), were both calculated by two-step FEM and are considered to be adequate and conservative. The corresponding configuration-revised spectra have been issued as Civil/Structural Sketches No. 255 through 260 and No. 265 through 301, restricted for within-project use by PSSG.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date: 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

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item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
12	It was observed that the procedure for verifying seismic qualification with respect to the FRS augmented by EHS SSI analysis (Attachment 1 to response to NRC Question 220.08) did not specify the approach for assessing the Nuclear Steam Supply System (NSSS). Since in the containment structure the design basis FRS curves do not fully envelop the EHS response spectra, it is essential that STP develop a NSSS/Balance of Plant seismic design interface procedure to assess NSSS adequacy. Response: Both the STP design-basis spectra and the EHS will be submitted to Westinghouse (W) for review and confirmation of the NSSS design. The effects of the EHS spectra on the NSSS have been discussed informally with W, and the assessment is that the augmented spectral response peaks in the low frequency range are inconsequential. Formal closure of this subject will follow upon completion of the current evaluation of the updated NSSS model coupled to the RCB structural model.

Date action(s) scheduled to be complete: 10-7-83

Manager, STP Engineering — Date 8/26/83

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
13	Section 5.0 of the SWEC report (Appendix) contains the specific conclusions and recommendations resulting from SWEC's review. BEC should review this report and the associated recommendations and should provide a response regarding these recommendations. 1. The observations discussed in Section 4.1 of this report regarding the enveloping of the design spectra be addressed in the plant licensing for clarification. 2. HL&P verify the vertical Bechtel EHS spectra by comparison to the SWEC vertical spectra at El. 86'-0". 3. HL&P continue to use the Brown & Root spectra for equipment qualification, since they represent a conservative design basis. 4. HL&P determine if the effect of variation in soil properties (±33 percent) as required by the NRC Standard Review Plan was considered in the EHS analysis. No evidence that this was considered was found in the information provided. Response: Responses to recommendations from Section 5.2 of the (SWEC) report are as follows:

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
13	(Continued) (1) Fig. 3.7-13 in Section 3.7.1.2 of the FSAR is consistent with the RG 1.60 spectra except that the "Control Point" at 3.7 cps should be plotted at 3.5 cps per the Regulatory Guide requirement. This error is insignificant and is attributed to a drafting error. The other concerns stated in Section 4.1 of the report, pertaining to frequency points and calculated spectra, were addressed in the foregoing item 2. (2) The vertical EHS spectra (4% damping, OBE, Elev. 86'-0") by Bechtel has been incorporated into Fig. 17 of the report, refer to the attached copy of figure 17. The Bechtel curve is considered to be in agreement with the SWEC curve. (3) The B&R original floor response spectra have been preserved as the STP design-basis spectra, issued as controlled drawings listed in Bechtel drawing No. 4N169S-39150. For a special case on the applicability of design-basis spectra refer to item 11 where the seismic analysis/design of piping in the MEAB is addressed.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date

Action Item Reply Form

Review/assessment subject title: Soil-Structure Interaction Analysis and Seismic Design

Review/assessment no: 83-1

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
13	(Continued) (4) The EHS analysis performed by Bechtel (and by B&R) are considered to be confirmatory analyses, not design-basis analyses, and accordingly the average soil properties used are adequate. There is precedent for this approach, and it has been specifically mentioned for the STP as part of the supplementary material presented in the response to NRC Question 220.08. The effect of variation in soil properties was indirectly accounted for by widening the spectral response band by ± 15% consistent with RG 1.122 position C2, which addresses variations in soil and other properties. References: A. "Soil - Structure Interaction Analysis Re-evaluation for South Texas Project", Bechtel Report No. S-001. B. Bechtel to HL&P letter ST-YB-HL-2452, dated December 20, 1982.

Date action(s) scheduled to be complete: N/A

Manager, STP Engineering — Date 8/26/83

Vertical Resonant Frequency
Floor Response Study
at Damping
of 8% of Critical
Bldg. Right
Bldg. Left
Frequency (CPS)

HL&P 1008A (12-82)

Houston Lighting & Power Company

OFFICE MEMORANDUM

October 12, 1983

To S. M. Dew

ST-HL-29419
File No.: D27

From R. A. Frazar

Subject Independent Technical Assessment 83-1

We have evaluated the STP response to the action items identified from the subject assessment of SSI and seismic design. The attached memo details our evaluation.

Please provide additional response to action items 2 and 12 by November 15, 1983. All other items are either closed or closed pending Engineering Assurance verification of action.

RAF:jog
Attachment

cc: G. W. Oprea, Jr.
J. H. Goldberg
D. G. Barker
M. K. Chakravorty
STP RMS

HL&P 1008A (12-82)

Houston Lighting & Power Company

OFFICE MEMORANDUM

October 6, 1983

To R. A. Frazar

ST-HL-29383
File No.: D27

From M. K. Chakravorty Manoj K Chakravorty

Subject Action Item Responses,
Independent Technical Assessment 83-1,
Soil-Structure Interaction and Seismic Design

STP responses to action items generated by Independent Technical Assessment 83-1, covering soil-structure interaction and seismic design, have been reviewed. Attachment 1 is a summary of our evaluation of the responses, which are classified under four categories:

C The item is closed, and STP's response is acceptable.

C/R The item is closed with some recommendation to STP Engineering for consideration.

C/V The proposed actions are considered adequate; however, further Engineering Assurance verification may be performed when the actions have been implemented.

O The item is open, awaiting further response from STP for formal closure.

In accordance with the above, responses to action items 1, 3, 7, 9, 11, and 13 can be considered closed. Of the remaining seven responses, items 4, 5, 6, 8, and 10 have been categorized C/V. Item 12 is considered open (O), and item 2 is classified closed with some recommendations provided to STP for consideration (C/R).

On item 2, we recommend that STP Engineering and Licensing discuss the condition that STP time histories do not meet Reg. Guide 1.60 spectra below 0.4 Hz and jointly evaluate whether any further Licensing clarification is required.

In response to item 12, STP indicated that a formal closure will follow when the ongoing evaluation of the NSSS/BOP seismic interface is completed, expected by October 7, 1983. Thus, this item is still considered open.

MKC:jog
Attachment

cc: STP RMS

Attachment 1

Independent Technical Assessment 83-1
Soil-Structure Interaction and Seismic Design

Item	STP action	EA evaluation
1	Action item 1 (AI-1) required that FSAR 3.7 and STP seismic design criteria documents be revised to reflect current status. In response, STP has indicated that FSAR Section 3.7 has been revised per HL&P SARCNs 250 and 262 and that the criteria for verification of seismic qualification of equipment and components have been defined in design criterion 4A010SQ1004. By November 18, 1983, seismic design criterion 5A360SQ1001 will be updated to reflect current status. Actions proposed and already taken are adequate to resolve this issue; no additional review by EA is necessary to close out the item. It should, however, be noted that the updated FSAR and design criteria will be automatically reviewed as a part of our technical assessment on equipment qualification.	Response is adequate; no further EA review is necessary. C^1
2	AI-2 identified two discrepancies (considered minor in their impact on plant design) in the adequacy of STP time histories enveloping the Reg. Guide 1.60 spectra and required STP to clarify the licensing position related to these. In reply, STP determined that these discrepancies would have no significant effect on plant design. Additionally, in the applicable section of the FSAR, STP will provide a clarification regarding the mismatch of vertical spectra at the six cited frequencies. However, the response did not specify whether licensing clarification will address the failure of response spectra generated from STP synthetic time histories to envelop the Reg. Guide 1.60 spectra in frequencies less than 0.4 cps. We recommend that STP bring this to the attention of HL&P Licensing and with Licensing jointly assess our position on Reg. Guide 1.60 regarding the need for further clarification.	STP's response is acceptable regarding impact of identified discrepancies on plant design. However, the response regarding licensing clarification should be further assessed. EA should be informed of the final resolution. C/R^2

Item	STP action	EA evaluation
3	AI-3 required clarification regarding statistical independence of STP time histories and use of Reg. Guide 1.122. In response, STP stated that STP seismic analysis did not algebraically combine the responses due to 3-simultaneous excitation and that the seismic analysis complies with position C1 of Reg. Guide 1.122. A change in the pertinent section of the FSAR has already been initiated to reflect this clarification. The actions initiated are considered adequate, and no further EA review is necessary to close this issue.	Response and actions taken by STP are adequate. No additional EA review is necessary. C
4	To address the effect of significant structural configuration changes on floor response spectra, STP will utilize EHS and/or single-step FEM SSI analysis scheduled to be complete by September 28, 1984. The project response is considered adequate; no further EA review is necessary at this time. However, we recommend that a seismic process review be conducted during the fourth quarter of 1984 to verify that proposed actions are implemented.	No immediate EA verification is required. A seismic design process review during the fourth quarter of 1984 is suggested. C/V^3
5	AI-5 required STP to review the finite element superstructure model (developed by EDS) to determine any possible impact on its results or conclusions resulting from any subsequent changes in the structural configuration. STP reviewed this item and concluded the single-step FEM analysis is not sensitive to changes in structural configuration. However, the latest structural configuration will be incorporated in the EHS and the single-step FEM analysis scheduled to be complete by September 28, 1984. The STP reply is considered adequate; no further EA review is required at this time. However, we recommend a seismic design process review during the fourth quarter of 1984 to verify the implementation of the proposed actions.	No immediate EA verification is required. A seismic design process review during the fourth quarter of 1984 is suggested. C/V

Item	STP action	EA evaluation
6	AI-6 identified some discrepancies between the maximum relative displacements specified in the response to NRC question 220.09 (ST-HL-AE-919) and those computed by WCC and required that STP resolve this concern. The project response gave a reason for the discrepancy and recognized that displacements obtained from a single-step FEM analysis should be reviewed against the design basis displacements, particularly because of the acknowledged limitations inherent in the two-step FEM analysis. It was also noted that adverse effects are not anticipated since the differential building settlement displacements are substantially higher and govern the seismic design. STP will compare displacements obtained from a one-step FEM SSI analysis with those used for design purposes. The STP response is considered adequate; no further evaluation is necessary at this time.	No immediate EA verification is required. A seismic design process review during the fourth quarter of 1984 is suggested. C/V
7	STP has reviewed the bearing stress expected to develop under the foundation mat of the MEAB (calculation no. 3M051SC067-15C) and found it adequate. No further EA review is necessary to close this item.	Response is adequate; no further EA review is necessary. C
8	AI-8 required that seismic design of the load-carrying members (of Category 1 structures) be revised to reflect the latest seismic load and structure configuration. STP acknowledged that the changes in structural configuration may affect the distribution of seismic loads among major load-carrying walls and base mat. STP has scheduled the evaluation for completion by August 31, 1984. Based on an initial assessment, Bechtel has determined that the current design of the load-carrying walls has adequate margin and that reassessment does not deserve immediate attention. Thus, the completion schedule for this item will not affect the project schedule.	No immediate EA verification is required. A seismic design process review during the fourth quarter of 1984 is suggested.
9	STP response to this action item regarding compliance with Reg. Guide 1.122 is considered adequate, and no further EA verification is required.	Response is adequate; no further EA review is necessary. C

Item	STP action	EA evaluation
10	AI-10 required Bechtel to develop an action plan to address the effect of floor flexibility on vertical floor response spectra. In response, Bechtel indicated that a parametric study will be performed to establish a lower-bound floor frequency (above which the effect is negligible). The natural frequencies of the floors will then be examined against the study results to determine the effects on vertical spectra. This effort is expected to be completed by January 27, 1984. The response is considered adequate. EA, however, will verify this during the review of equipment qualification.	No immediate EA verification is required. A verification of the implementation of the proposed actions will be automatically carried out during the review of seismic qualification of Class 1 equipment. C/V
11	STP response to AI-11 (related to control of EHS response spectra curves) is considered adequate; no further EA review is required to close this issue. Various aspects of the actions (which are already implemented) will be automatically reviewed during the EA equipment qualification review.	No immediate EA review is required. C
12	AI-12 required STP to develop a NSSS-BOP seismic interface plan to address EHS SSI analysis spectra for NSSS assessment. Bechtel indicated that the effect of EHS spectra on NSSS has been informally discussed with Westinghouse, and their assessment is that it will not significantly affect the NSSS seismic qualificaiton. At present, Bechtel and Westinghouse are evaluating the updated seismic NSSS model coupled to the RCB structural model. The study is to be completed by October 7, 1983, and formal closure of this item, which we are awaiting from STP, is expected to follow the study's completion.	Formal closure of this item will follow upon EA's receipt of a formal response from STP. We recommend an EA review of the NSSS-BOP seismic interface. O^4
13	Project response to AI-13 (regarding SWEC recommendations) is considered adequate.	No further EA action is required. C

Notes:

[1]C indicates item is closed.
[2]C/R indicates item is closed with some recommendation to STP.
[3]C/V indicates proposed actions are considered adequate, but further EA verification may be performed when actions have been implemented.
[4]O indicates open item, awaiting further STP response, or the response is not acceptable.

Houston Lighting & Power Company

OFFICE MEMORANDUM

June 23, 1983

To S. M. Dew

ST-HL-28288
File No.: D27

From R. A. Frazar

Subject Report of Design Process Review 83-2,
RHR/Safety Injection System

Attached for your information and action are:
(1) the subject report, including Stone & Webster Engineering Corporation (SWEC) report,
(2) Action Item Forms resulting from the design process review,
(3) Action Item Reply Form, and
(4) design process review checklists and component checklists.

Each action item requires a response from Project Engineering in order for us to close out the item.

Please provide your response to all items by August 15, 1983, using the accompanying Action Item Reply Form. If a need to discuss the report or action items arises, please contact S. R. Basu at 486-3795.

Your prompt attention is appreciated.

RAF:jog
Attachments

cc: J. H. Goldberg (with Attachment 1)
D. G. Barker (with Attachment 1)
J. E. Geiger (with Attachment 1)
STP RMS (with Attachments 1, 2, 3, and 4)

Document Number
83-2

Review/assessment subject: RHR/safety injection system, South Texas Project Electric Generating Station

Date(s) of review/assessment: May 31, 1983, to June 10, 1983

Prepared by: _____ Date: 6/23/83

Approved by: _____ Date: 6/23/83
Manager,
Engineering Assurance Department

Approved by: J. H. Goldberg Date: 7-16-83
Vice President,
Nuclear Engineering & Construction

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Appendix: SWEC report

REVIEW REPORT
DESIGN PROCESS REVIEW 83-2
RHR/SAFETY INJECTION SYSTEM
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

1.0 The purpose of this design process review was to evaluate adequacy of design process controls by examining design development of the safety injection portion of the RHR/safety injection system. The review was concentrated on confirmation of adequate control in the following areas of the design process:

- design inputs,
- design interfaces,
- design process, including tracking process for commitment control,
- design outputs, and
- design changes.

The review concentrated on evaluating design process control of the part of the system in the architect-engineer's scope. That portion of the design done by the NSSS vendor, Westinghouse Nuclear Energy Services (WNES), was not reviewed, but input and other system requirements and criteria provided by WNES and implemented by the architect-engineer in further development of the total system were evaluated.

Interfaces between the architect-engineer and other external organizations, e.g., equipment vendor and constructor, were also considered during the review process.

The mechanical, electrical, and instrumentation and control (I&C) portions of the system were reviewed, as well as the methodology and criteria followed to develop pipe stress and pipe support for the system. Safety injection system requirements on support systems like electrical, I&C, etc., were reviewed but not in depth. The adequacy of support systems to meet requirements such as separation, etc., was not reviewed; neither were provisions for postulating and evaluating effects of pipe break, jet impingement, etc.

Specifications for selected components like valve, pump, instrument tubing, level switch, flow transmitter, and circuit breaker, together with pipe stress analysis, etc., were reviewed to verify that:

- design documents contain proper design inputs consistent with established criteria and commitments;

- design calculations and analysis have been systematic and performed in such a way that objectives of calculations, design assumptions, design inputs, and pertinent references were clearly specified;

- procurement documents clearly specify applicable codes, regulatory commitments, and the extent of applicability;

- issue and use of design inputs and outputs have been controlled by procedures; and

- flow of design information between internal and external organizations has been controlled and adequate.

Documents reviewed are listed in Section 3.0, and the system status observed during the review is described in Section 4.0. Section 5.0 is a summary of findings and recommendations in each area of design process review. The details of findings are given in Section 7.0.

Checklists completed during the design process review of various documents and documentation leading to findings or recommendations are filed separately with the Records Management System.

The report prepared by Stone & Webster Engineering Corporation (SWEC) is attached as an appendix.

2.0 Participants

The following persons participated in the design process review:

- S. R. Basu, Consulting Engineer, HL&P Engineering Assurance Department, team leader, electrical discipline
- M. K. Chakravorty, Consulting Engineer, HL&P Engineering Assurance Department, structural, pipe stress/support
- S. A. Shuman, Assistant Project Engineer, SWEC, mechanical
- J. F. Harkins, Senior Control Engineer, SWEC, instrumentation and control
- P. W. Day, Engineering Assurance Engineer, SWEC, procedures

3.0 Documents reviewed

1 Spec. 1L529TS0104, Rev. 0, metal diaphragm valve specification

2 Calc. 2N129RC004, Rev. 0, stress calculation

3 WNES criteria PFD-FTE-285, WNES layout criteria

4 Dwg. 5N129F05013 through 016, Rev. 0, P&ID, RHR/SI system

5 Calc. 2N129MC5244, preliminary, safety injection pump NPSH

6 Pipe support calc. 2F159JC-5611

7 Criteria 5L019PS004, Rev. 2, criteria for piping design

8 Vendor manual 14926-0205(I)00036, operating manual RHR pump

9 Vendor manual 14926-0205(I)00025, operating manual LHSI pump

10 Vendor manual 14926-0205(I)00026, operating manual HHSI pump

11 Spec. 5Z689ZS1027, Rev. 0, general requirements for instrument construction, and spec. change notice no. 1, 3-15-83

12 Spec. 4Z439Z1007, Rev. 0, ASME III control valves

13 WNES TGX/THX-283 and 284, Rev. 2, system description

14 Spec. 4Z519Z51040, Rev. 0, instrument tubing installation, seismic Category 1

15 Work package EM402

16 FSAR, Section 6.3

17 RHR system design criteria 5R169MQ1021, Rev. 0

18 Safety injection system design criteria 5R129MQ1045, Rev. 0

19 Spec. 5A230ES1028, Rev. 0, electrical construction specification

20 Spec. 3E189ES018-D, 5 kv power cable (issued for construction but not for procurement)

21 Spec. 3E189ES020-D, 600 v power cable (issued for construction but not for procurement)

22 Spec. 3E179ES035-D, Rev. 0, Class IE motor control center

23 Spec. 3E189ES022-D, control cables (issued for construction but not for procurement)

24 Calc. EC 5004, Rev. 0, cable ampacity study

25 Spec. 4N129RS1005, Rev. 0, ASME III design specification for safety injection system piping

26 Dwg. 5F-15-9-P5151, composite piping drawing

27 Fabrication isometric drawings on SI 1101 sheets 1-5, SI 1201 sheets 1-3, SI 1301 sheets 1-3, CS 1101 sheet 1, CS 1201 sheet 1, and CS 1301 sheet 1

28 Floor response spectra 4N169S-3900-39155, Rev. 1

29 Doc. 2C011SC040B

30 Dwg. 8373D92, Westinghouse valve drawing

31 Spec. 2R019NS014, specification for field erected tank

32 Spec. for fabrication of ASME III piping 2½ inches and larger, 4L020PS0100, Rev. 2

33 Westinghouse (NSSS) documents:
- SI system P&IDs 1207E17, sheets 1-4
- HHSI/LHSI pump E spec. 952455, Rev. 1
- Drawing 300-VN49752, Rev. 12
- Block diagram 8758076
- Functional control diagram 8758022

34 Valve data sheet specification 4Z019Z44712, Rev. 0 (draft)

35 P&ID 5R209F05017, Rev. 0 (4-25-83), component cooling water

36 Drawing register (history report for BEC drawings)

37 CEBUS log dated 4-22-83

38 Specification change notices: SCN 1 (3-29-83) for specification 42519ZS10, Rev. 0, and SCN 1 (3-15-83) for specification 5Z689ZA1027, Rev. 0

39 Work package report EM 402, 10-29-82

40 Logic diagrams 42182, Rev. 0 (preliminary), Z42029 and Z42005

41 FSAR change notices 33 (8-9-72) and 67 (9-24-82)

42 Spec. 5Z689ZS1028, Rev. 0, general requirements for instrumentation construction

43 Specification change notice (SCN) No. 1 and affected specification 5Z689ZS1027, Rev. 0

44 Design criteria document 5A969EQ1009, Rev. 0 (draft), general discipline electrical design criteria

45 Instrument piping drawing MEAB fluor and wall sleeve tabulation 6M159Z0100, Rev. 2, 3-11-83

46 Safety relief valve PSV 6873, System R28 B*14926-8035-00011-ALG, Lonergan no. A2924, Rev. B

47 Spec. for Classes 7, 8, and 9 control valves 9Z439ZS0211, Rev. 1, 2-19-83, and 7Z439ZS0211, Rev. 0, 9-22-82

48 Spec. data sheet for CCW disch. from RHR Hx Cont VW 4Z019Z44712, sheet 7, Rev. 0 (preliminary)

49 Instrument tube and installation design criteria 5Z019ZQ1012, Rev. 0, 9-8-82 (replaces B&R TRD 5Z019ZQ003, Rev. H)

50 Fisher Controls print no. F43237, sheet 2 of 2, Rev. 2, for control valve (butterfly)

51 Spec. data sheet 7Z439Z5211, sheet 57 (review copy), hotwell level control data sheet NICD-LV-7005

52 Spec. for instrumentation electronic transmitters 7Z019ZS0500, Rev. 0, 9-10-82, B&R 7Z019ZS500-D

53 Spec. for instrumentation electronic transmitters (nuclear service) 4Z479ZS1033, Rev. 0, 2-15-83

54 Spec. for instrumentation electronic transmitters (Class 1CIII) 9Z019XS1038, Rev. 0, 1-7-83

55 Data sheets for spec. 9Z019XS1038, Rev. 0, preliminary

56 Manufacturer's drawing - sys. R28 ESS Clg Wtr-PSV 6873 Lonergan 1½ X Q X 2½ 14296-8035-00011 ALG (4035-00010 ALG) Lonergan no. A2924

57 Instrument index engineering report 5Z019Z48000, Rev. 3, 5-4-83, page 1622

58 Action Item/Critical Item Report, May 25, 1983 (15 pages)

59 Engineering Procedures Manuals (EDPs), Vol. IIIA and IIIB, distribution list (controlled EDP manual holders) (5 pages)

60 Design Criteria Manual distribution list (control manual holders) (2 pages)

61 Design control checklist, PSSG (1 page), Rev. 1, May 27, 1983

62 Project master distribution schedule, Rev. 3, March 30, 1983
- (Section for documents except design drawings) and Bechtel IOM 09851, March 30, 1983
- (Section for Bechtel design drawings), Rev. 3, April 30, 1983, and Bechtel IOM 11063, May 2, 1983

63 South Texas Project manuals indexes
- Volume I - South Texas Project general project requirements (GPRs), April 12, 1983
- Volume II - South Texas Project control procedures, October 9, 1982
- Volumes III A&B - South Texas Project Engineering Department Procedures (EDP), May 19, 1983

64 EDP 4.4, List of Codes and Standards Referenced on South Texas Project, May 13, 1983 (IOM 11509), to all EGSs from A. J. Munguia

65 Bechtel corrective action request (CAR) 83-4-16-3.1, April 19, 1983

66 Computer program catalog dated January 1983

67 IOM 12229, R. E. Seaman to PEs and others, June 6, 1983 (distribution of delinquency reports for FCRs, SDDRs, DCNs, SCNs, supplier documents, and Bechtel design documents) and attachments:
- Delinquency report - DCNs
- Delinquency report - supplier document review
- Delinquency report - SDDRs
- Delinquency report - specification change notices (SCNs)
- Delinquency report - Bechtel drawings, delinquent amendments

68 Design document register, full history, May 24, 1983
- Bechtel drawings, pages 1-679
- Large-bore ISOs, pages 680-975
- Pipe support drawings, pages 976-1336
- Small-bore ISOs, pages 1337-1675
- Specifications, pages 1676-1741

69 STP QE action item request 10-0076 (draft)

70 CEBUS report, mechanical engineering group calculations, May 20, 1983

71 NSSS coordination logs
- Action item register (NSSS only)
- W PIP indices (by shop order)
- NSSS correspondence log (manual, by NSSS coordinator)

72 Bechtel procedures:
- Volume I, GPRs
  - 1.3, Rev. 2, NSSS Interface Document and Interface Between Entities
  - 2.1, Rev. 2, Project Procedures Manual
  - 2.4, Rev. 0, Design Calculations (Numbering)
- Volume III, EDPs
  - 1.7, Rev. 1, Engineering Department Procedures
  - 1.10, Rev. 4, Project Engineering Department Procedures, Preparation and Control
  - 4.1, Rev. 1, Design Criteria (also draft Rev. 2)
  - 4.[illegible], Rev. 3, Design Standard and References for Project Libraries
  - 4.23, Rev. 0, SAR Change Control
  - 4.24, Rev. 0, ER Change Control
  - 4.26, Rev. 0, Interdisciplinary Design Review
  - 4.27, Rev. 0, Design Verification
  - 4.33, Rev. 0, On-Project Design Review
  - 4.34, Rev. 4, Off-project Design Review
  - 4.36, Rev. 1, Standard Computer Programs
  - 4.37, Rev. 1, Design Calculations
  - 4.40, Rev. 0, Release of Calculations to Client
  - 4.46, Rev. 3, Project Drawings
  - 4.47, Rev. 1, Drawing Change Notices

- 4.49, Rev. 2, Project Specifications
- 4.50, Rev. 2, ASME Component Design Specifications
- 4.58, Rev. 2, Specifying and Reviewing Supplier Engineering and Quality Verification Documentation
- 4.61, Rev. 0, Nonconformance Reports (NCRs)
- 4.62, Rev. 1, Field Change Requests (FCRs)
- 4.63, Rev. 1, Supplier Deviation Disposition Requests (SDDRs)

73 Samples checked
- For index checking
  - BEC piping composite drawing 5C-15-9-P-5003, Rev. 1, December 3, 1982
  - BEC piping composite drawing 5F-15-9-P-5151, Rev. 0, October 5, 1982
  - P&ID, safety injection system, 5N129F05013, Rev. 0, February 24, 1983
  - Vendor drawing (W), HHSI pump O/L package 1680
  - Vendor drawing (W), RHR oval pump and motor O/L package 1750
  - Dresser pump and motor outline drawing 300-V9764, sheet 1 of 2, Rev. 4
  - Spec. (Technical Services contract) 14926-T002, Exhibit D, Rev. 2, May 12, 1983, "Review of Existing Field Erected Tanks"
  - Calc. 2N129RC004, Rev. 1, May 6, 1983

74 STP open items list by engineer, May 18, 1983 (tracking letters from HL&P to BEC requiring responses)

75 Engineering action items by group, responsible engineer, and letter number: transmittal June 6, 1983

76 PEP 3.01, Rev. 2, January 17, 1983, HL&P Project Engineering Procedure, "Performance of Owners Reviews"

4.0 System status

The system status was reflected in the work package issued in November 1982. Bechtel review of this work package consisted of comparing the Brown & Root design against Nuclear Regulatory Commission requirements, WNES criteria, and Bechtel design standards.

In February 1983 Bechtel issued P&ID, Rev. 0, for the RHR/safety injection system based on the criteria of work package review with "holds" at certain portions of the system. At present, P&IDs are undergoing significant revision to incorporate cold shutdown and TMI-related items. In addition, all action items identified in the work package, except water hammer, cold shutdown, and containment emergency sump performance problems, will also be incorporated in the next revision. The design is scheduled to be frozen in September 1983.

The water hammer problem is being resolved by WNES on a generic basis. Resolution for containment emergency sump performance is scheduled to be completed shortly.

Bechtel indicated that most major equipment for the system has been installed. The fabrication drawings for the piping system were reissued by Bechtel for construction.

The refueling water storage tank (RWST), which is already procured, is presently being reviewed to ensure that the design and fabrication comply with ASME III Code requirements. Bechtel indicated that tank capacity is adequate to ensure proper performance of the safety injection system; however, for refueling purposes it is short by approximately 75,000 gallons. Resolution of this problem is being studied.

5.0 Summary of findings and recommendations

The design process appears to be adequate in mechanical, instrumentation and control, and pipe stress analysis portions of the RHR/safety injection system. The general procedural approach to systems also appears to be in order. A determination could not be made about adequacy of the overall design process of the electrical portion of this system, due to a lack of issued documentation. The supporting auxiliary electrical distribution system is also being revised.

The procedure followed to resolve comments on documents received from WNES is observed to be adequate.

Findings and recommendations for improvement in areas of the design process are summarized as follows:

5.1 Design input

Stress input preparation: the safety injection system pump suction line stress analysis references WNES criteria for piping design, process conditions, and piping requirements. These documents provide some of the information required for stress analysis but not all possible significant operating modes, possible major transients to which the system may be subjected, and the BOP-generated information that must be considered for stress analysis.

It is our observation that the input process for stress analysis needs improvement. The responsible system engineer should provide the stress analyst with all possible significant system operating modes so the stress analyst can determine which of the operating modes, out of all possible system conditions, are to be considered for analysis.

5.2 Design interface

5.2.1 WNES interface with Bechtel

The NSSS interface was reviewed, including STP procedure GPR 1.3 defining the interface between WNES, Bechtel, and HL&P, which was signed by all three parties. It was verified that upon receipt of a drawing from the NSSS vendor, WNES,

Bechtel statuses the drawing, and comments are sent to WNES via a letter, which is given an action item number by the NSSS coordinator and is tracked on a computerized index.

Drawings received from WNES by Brown & Root are being statused by Bechtel as a backfit.

Procedure GPR 1.3 requires that "selected" design documents generated by Bechtel be sent to WNES for review and confirmation that interface requirements have been fulfilled. These selected documents that need verification by WNES have not yet been identified. Bechtel stated that STP is presently establishing ground rules to identify which A-E documents require WNES verification. Criteria to be followed in reviewing interface documents also need to be established, including identification of areas of a document to be reviewed after it is selected.

It is noted that P&ID, Rev. 0, for the RHR/safety injection system has been issued and that Rev. 1 is in the process of being issued shortly. Bechtel P&ID, Rev. 0, has not been sent to WNES to verify if Bechtel has met WNES interface requirements. Since the P&ID is a basic document that provides input for further progress in design work of other disciplines, it is of concern that without WNES formal review of this document there is a potential that the intent of WNES design criteria will not be met. The A-E should, however, determine at what stage of the design P&IDs need to be sent for interface review.

5.2.2 Interdisciplinary interface on nozzle loads

The pipe stress calculation on the safety injection system pump suction analysis produced nozzle loads for the RWST for which vendor allowables were not available. This calculation was issued for use on May 6, 1983, but as of June 7, nozzle loads had not been sent to the mechanical group for discussion with the vendor for acceptability.

The discipline supervisor issued an internal memorandum to the stress engineers informing them that when no vendor allowables are available they should send nozzle loads to the mechanical group for confirmation with the vendor. However, this memo did not give any instructions to be followed when nozzle loads exceed vendor allowables.

Procedures should be developed to control this activity and produce desired results.

5.2.3 Vendor drawing review

Vendor drawings are reviewed by the groups responsible for checking interface and technical information. Four series of vendor drawings, one series each for high head safety injection pump, low head safety injection pump, RHR heat exchanger, and RHR pumps, were reviewed to verify if interdisciplinary review was performed. Of the four series of vendor prints, two were not sent to the civil and structural group for review, although the prints contained information on anchor bolt sizes and mounting bolt loading required to confirm adequacy of anchorage and embedment plate.

Bechtel should reassess their interdisciplinary review process for vendor drawings and develop any instructions necessary to ensure that proper interdisciplinary review is performed by affected groups.

5.3 Design process

5.3.1 System calculations to meet WNES criteria

Safety injection and RHR system calculations required to confirm piping arrangement acceptability to WNES layout, and pressure drop criteria have not yet been performed. No evidence was observed that these calculations will be performed.

Bechtel should identify and complete these calculations to demonstrate that WNES's layout criteria have been met.

5.3.2 Detail requirements in calculation procedure

Calculation 5E010EC5004 for cable ampacity did not identify its scope or purpose or give a summary description of how to use the various tables generated by this calculation. It was also noted that the calculation did not address derating of cable wrapped by fire-retardant material for separation purposes. No evidence was found that a separate calculation will be prepared for providing cable ampacity when the cable is wrapped by fire-retardant material.

The STP procedure for calculations, EDP 4.37, Rev. 2, does not require a calculation specifically to identify its purpose, scope, or conclusion. This is observed as a weakness in the procedure that has affected the electrical calculation identified above. Procedure EDP 4.37 also is not specific regarding identification of input data that are preliminary and require confirmation at a later date.

A method was established to identify calculations containing inputs that are not final by marking only the cover sheet as

"preliminary"; however, specific inputs that cause a calculation to be marked "preliminary" are not required to be identified.

Procedure EDP 4.37 should be specific regarding the minimum information a calculation should contain and a means to identify whether some specific input to a calculation is preliminary.

5.3.3 Verification requirements for interdisciplinary review

Engineering Department procedures for preparation and review of various design documents currently allow document review notices or equivalent review documents to be discarded, although they are defined as the only documents containing the interfacing groups' approval.

It was noted, however, that the P&ID and control logic diagram reviewed were signed off by the key interfacing discipline supervisors as well as the originating group supervisor. It is suggested that STP procedures be upgraded to reflect this practice or that the signed DRNs be retained.

5.3.4 Design verification procedures

There is a concern that the procedure governing design verification does not clarify the terms "supervisor" and "immediate supervisor" as contained in a Bechtel memorandum on this subject. Additionally, conditions related to using supervisory personnel as reviewers should be consistent in all procedures.

5.4 Design output

No concerns were identified during this review.

5.5 Design changes

Adequacy of the design change system could not be determined because very few documents in this system have undergone design changes.

6.0 Methods used for design process review

The design process review was performed in accordance with Engineering Assurance Department procedure EAD-3, Design Process Reviews and Independent Technical Assessments, and involved reviewing and verifying design documents to determine the adequacy of the design process for the RHR/safety injection system.

To accomplish the objective of the review, activities were structured to address the following areas of the design process:
- design inputs
- design interfaces
- design process
- design outputs
- design changes.

For each of the above tasks, checklists were prepared to examine the adequacy of the design process for the overall system, including support systems. To reach a conclusion on the adequacy of some parts of the design process, the following methods were used:

6.1 Design inputs

6.1.1 Several codes and requirements identified in the design criteria were chosen, and their inclusion in selected specifications was investigated to determine consistency.

6.1.2 Selected design requirements specified in the design criteria, FSAR, and WNES PIP documents were investigated to verify that they were incorporated in the sub-tier design documents.

6.1.3 In the event a particular design was changed, the reason for the change was investigated, and methods for accomplishing the change were examined to verify that proper design process was followed.

6.2 Design interfaces

Design information sent by the NSSS vendor, WNES, was selected, and the administrative system requiring action or follow-up was reviewed to verify accounting and tracking of the design information. Tracking included interdisciplinary interface among different groups in the A-E organization.

The process followed for transmitting design information generated by the architect-engineer to outside organizations was also reviewed.

6.3 Design process

To verify the adequacy of design process, the following methods were used:

6.3.1 A calculation was selected and verified to meet the architect-engineer calculation procedure requirements, including the verification process and that the calculation specified its purpose, scope, assumptions, design input references, conclusion(s), etc.

6.3.2 A specification for a component was selected, and verification was made that the document scope was stated. If any regulatory requirements were involved, the full or partial applicability of those requirements were noted. If the input criteria document required partial application of a standard or regulatory requirement, it was verified that the specification identified the extent of applicability of such standard or requirement.

6.4 Design output and design changes

The adequacy of these systems could not be verified because very few physical drawings had been generated in the system, and very few changes had taken place at the time of this review.

Concerns and recommendations identified during the design process review were explained to representatives of the architect-engineer and the HL&P project engineering group during the exit meeting.

7.0 Details of findings

For reference and future corrective action, following are details of concerns or recommendations identified in summary Section 5.0 of this report.

7.1 Design input process

The design specification for safety injection system piping, 4N129RS1005, Rev. 0, references WNES system description SD-TGX/THX-284 and WNES piping design requirements PFD-FTE-285 for a description of operating modes.

The WNES system description functionally describes how the system operates but does not describe the operating conditions that result. WNES system piping requirements PFD-FTE-285 provide typical temperatures and pressures during each major mode of operation (e.g., injection and recirculation) but do not describe how the system can operate within that mode in a condition like single failure, for example. The information provided by WNES also needs to be adjusted for plant-specific conditions generated as a part of the BOP scope (e.g., temperature of water in the containment sump, generated by the architect-engineer while performing containment analysis related to temperature of the safety injection system fluid).

Pipe stress calculation 2N129RC004 performed for the safety injection system pump suction line analysis references criteria 5L019PS004 for piping design and an NUS temperature calculation ST-NS-BR-0725 for containment sump and WNES pump design requirements and system description. These provide some required information but not a description of each possible operating mode during each plant condition, e.g., normal, upset, emergency, and faulted conditions. Consideration of BOP-generated information, such as maximum and

minimum RWST water temperature, coincident with single failure for various operating modes does not appear complete. Input information on system transients like pump start, valve opening and closing, etc., was not provided or not used. System test conditions were also not considered. (Project procedure 5LC10RQ1002 states that transient information should be obtained from the mechanical group.)

In view of the above, it is not clear that all modes of operational conditions were considered in the pipe stress analysis. Pipe break/jet impingement provisions were also not evaluated.

7.2 Design interface

7.2.1 WNES interface with Bechtel

STP procedure GPR 1.3 regarding the interface between WNES, Bechtel, and HL&P was reviewed. This procedure was signed by all three parties to indicate agreement. It was verified that upon receipt of a drawing from the NSSS supplier, WNES, Bechtel statuses the drawing, and comments are sent to WNES via a letter, which is given an action item number by the Bechtel NSSS coordinator and is tracked on a computerized index. Drawings previously received by Brown & Root from WNES are also being statused by Bechtel as a backfit effort.

Procedure GPR 1.3 identifies the Bechtel document that requires review by HL&P and EBASCO. The procedure also requires that "selected" design documents generated by Bechtel be sent to WNES for review and confirmation that the WNES interface requirements have been fulfilled. However, the specific documents that need to be sent to WNES for verification have not yet been identified. Bechtel stated that STP is presently in the process of establishing which documents require WNES verification. It is our opinion that the criteria to be used in selecting and reviewing the interface documents need to be established, including identification of areas of a document to be reviewed after it is selected.

It is noted that P&ID, Rev. 0, for the RHR/safety injection system has been issued and that Rev. 1 is in the process of being issued shortly. Bechtel P&ID, Rev. 0, has not been sent to WNES to verify if Bechtel has met WNES interface requirements. Since the P&ID is a basic design document that provides input for further progress of other disciplines' design work, it is our concern that without WNES formal review of this document there is a potential for the intent of WNES design criteria not to be met. Bechtel should, however, determine at what stage of the design P&IDs need to be sent for interface review.

7.2.2 Interdisciplinary interface on nozzle loads

Pipe stress calculation 2N129RC004 performed for the safety injection system pump suction analysis resulted in nozzle loads for the RWST, for which vendor nozzle allowable loads were not available. As of June 7, 1983, nozzle loads had not been sent to the mechanical group to be transmitted to the vendor for acceptability; the calculation was issued for use on May 7, 1983.

The discipline supervisor issued an internal memorandum to the stress engineers instructing them to send nozzle loads to the mechanical group when vendor allowable nozzle loads were not available. This memorandum, however, did not discuss the action to be taken when vendor allowable nozzle loads were exceeded.

7.2.3 Vendor drawing review

The four vendor drawing series that were reviewed are:

- LHSI pump	14926-0205(I)00016 through 00019
- RHR heat exchanger	14926-0210(I)00010 through 00012
- HHSI pump	14926-0205(I)00012 through 00015
- RHR pump	14926-0205(I)00031 through 00032

The LHSI pump and HHSI pump drawings were not sent to the civil/structural group for review although the drawings contained anchor bolt sizes and mounting bolt loadings required both to confirm that the anchorage is adequate for equipment loads and to design embedment plates. Vendor drawings for RHR pumps and heat exchanger were sent to the civil/structural group for review. These four issues were the first formally statused review.

7.3 Design process

7.3.1 System calculations to meet WNES criteria

Safety injection and RHR system calculations have not yet been performed to confirm piping arrangement acceptability to WNES layout and pressure drop criteria provided in PIP document PFD-FTE-285. These calculations were not scheduled.

This condition was also applicable to certain other WNES systems, e.g., charging, volume control, and boron recycle systems. Brown & Root performed some calculations for a portion of the containment depressurization system, but these calculations had not yet been accepted by Bechtel.

7.3.2 Calculation procedure

The STP procedure for calculations, EDP 4.37, was reviewed. This procedure does not specifically require a calculation to identify its purpose, scope, or conclusions, nor does it require positive identification of assumptions and input data that are preliminary and must be confirmed at a later date. A method was established to identify calculations containing inputs that are not final by marking only the cover sheet as "preliminary"; however, specific inputs that cause a calculation to be marked "preliminary" are not required to be identified.

During the review it was observed that calculation 5E010EC5004 for cable ampacity did not identify its scope or purpose, nor did it provide a summary description as to the use of various tables generated by this calculation. It was also noted that the calculation did not address derating of cable wrapped by fire-retardant material for separation purposes. No evidence was found that a separate calculation will be prepared for providing cable ampacity when the cable is wrapped by fire-retardant material.

The inadequacies observed in calculation 5E010EC5004 are felt to be due to the above-mentioned weaknesses in the procedure, in view of which it is suggested that procedure EDP 4.37 should be specific regarding the minimum information a calculation should contain and a means to identify preliminary input requiring verification.

7.3.3 Verification requirements for interdisciplinary review

Document Review Notices (EDP 4.33) are generated by the Engineering Group Supervisors (originating group) to identify other affected disciplines that must review a design document prior to its issue. According to procedures, at the completion of interdiscipline review these forms are the only place where the concurrence signatures of interfacing Engineering Group supervisors are documented. The supervisors are not required by EDP 4.33 to sign the final document. The same applies to the use of coordination prints that are Project Drawings (EDP 4.46).

EDP 4.33 states that this documentation may be discarded after the final document has been signed by the Project Engineer and issued. The original DRN kept on file does not contain these concurrence signatures; only the list of disciplines is included.

Since DRNs and coordination prints document concurrence signatures that are not required on the final issued design document, the requirement to discard them should be

reconsidered. Alternatively, consideration should be given to changing the procedure to require interdiscipline concurrence signatures on the issued drawings.

It was noted during the review that logic diagram 5Z-01-9-Z-40420, Rev. 0, and P&ID 5N129F05014, Rev. 0, contained sign-offs by the responsible Engineering Group Supervisor and interfacing discipline EGSs, although EDP 4.46 (Para. 5.0) does not require these approvals. Consideration should be given to revising the EDP to reflect current practice for these types of drawings.

7.3.4 Design verification procedures

A review of EDP 4.36, Standard Computer Programs, EDP 4.46, Project Drawings, EDP 4.49, Project Specifications, EDP 4.27, Design Verification, and EDP 4.37, Design Calculations, was performed relative to requirements for design verification. It was noted that in EDP 4.36 limitations concerning the use of "supervisors" as reviewers were not always consistent. Differences are:

- EDP 4.36 (Para. 5.4) indicates that the originator's "immediate supervisor" should be excluded unless such immediate supervisor is the only qualified individual.

- The remaining EDPs indicate that the originator's "supervisor" must be excluded unless that person is the only individual competent to check the drawing and did not specify a singular design approach, rule out certain design considerations, or establish inputs.

It was also noted during the review that an internal memorandum (IOM 09800, dated March 29, 1983) was issued for clarification by the Project Engineering Manager that Group Leaders (immediate supervisors) are to be considered "supervisors" in the context of EDPs 4.46, 4.47, 4.49, etc. However, this information was not included in formally-issued Project Procedures.

8.0 Need for further audit

Adequacy of the design change system could not be determined at this time; the system will be reviewed at a later date to be scheduled with the South Texas Project.

DESIGN PROCESS REVIEW, TASK NO. 83-2

REPORT FOR THE
SWEC PORTIONS OF DESIGN PROCESS REVIEW OF
RHR/SI SYSTEM
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION
J.O.NO. 14475.02

PREPARED FOR

HOUSTON LIGHTING AND POWER COMPANY

BY

STONE & WEBSTER ENGINEERING CORPORATION

JUNE 1983

Project Engineer

Date 6/22/83

B14/3F

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1.0 INTRODUCTION

This report pertains to the Houston Lighting and Power (HL&P) Company's Design Process Review of the South Texas Project that was conducted at Bechtel Offices in Houston, Texas during May 31 - June 10, 1983. It includes only those review results for the Nuclear/Mechanical, Instrumentation and Controls, and Procedures portions of the review which were performed by Stone & Webster Engineering Corporation (SWEC) personnel under the direction of HL&P's Engineering Assurance Department as addressed by Purchase Order ST-140158, Supplement 3. The Electrical and Engineering Mechanics portions of the review were conducted by HL&P personnel.

2.0 PURPOSE AND SCOPE OF THE HL&P DESIGN PROCESS REVIEW

This review was performed to assess the adequacy of the design process as applied to the Safety Injection portion of Residual Heat Removal (RHR)/ Safety Injection (SI) System. The following aspects of the design process were evaluated:

- design inputs
- design interfaces
- design process, including tracking process for commitment control and procedures
- design outputs
- design changes

The review's primary focus was the design process pertaining to the architect engineer, Bechtel Energy Corporation (BEC), portion of the system. Interfaces between BEC and other organizations (NSSS, owner, constructor, and equipment suppliers) were also considered. The review did not include an assessment of the NSSS vendor's design process. However, the receipt of inputs, system requirements, and criteria from the NSSS vendor and implementation by the architect engineer in further development of the total system was considered.

3.0 SAFETY INJECTION SYSTEM STATUS

The system status was reflected in a work package report issued in November 1982. The work package reflects the results of Bechtel's review of the Brown & Root (B&R) design against NRC requirements, and Bechtel criteria and Design Standards.

Bechtel issued P&ID, Rev. 0 for the RHR/Safety Injection system in February 1983 based on the above criteria containing "holds" at certain portions of the system. At present, P&ID's are undergoing a significant revision to incorporate certain cold shutdown and TMI related items. In addition, all action items identified in the work package, except water hammer, cold shutdown, and containment emergency sump performance problems, will also be incorporated in the next revision. The project intends to freeze the design in September 1983.

The water hammer problem is being resolved by Westinghouse on a generic basis. The resolution for the containment emergency sump performance and cold shutdown is scheduled to be complete shortly.

Bechtel indicated that most major equipment for the system has been installed. The fabrication drawing for the piping system have been re-issued by Bechtel for construction.

The capacity of the RWST is being reviewed and Bechtel identified that the capacity of the tank for refueling purposes is short by approximately 75,000 gallons. A study is being made to resolve the problem.

4.0 REVIEW METHOD

The first stage of the review was a pre-review meeting conducted on May 20, 1983 between the review team and Bechtel Power Corporation personnel assigned to the Southwest Texas Project. During this meeting the purpose and scope of the review was presented by the HL&P review team leader.

SWEC personnel identified in Appendix 1 performed the reviewing activities in their assigned area of responsibility under the direction of the HL&P team leader during the period of May 31, 1983 to June 9, 1983. The personnel contacted during these activities are identified in Appendix 2.

The various aspects of the design process described in Section 2.0 were evaluated using review checklists developed by review team members under the direction of the HL&P review team leader prior to Appendix 2. To the extent possible, the checklists were completed based on reviews of the current issue of design documents pertaining to the Safety Injection System portion of the RHR/SI system and discussion with responsible Southwest Texas Project Personnel. In those cases, where design documents for this system were not suitable for review, representative samples of formally issued documents for other systems were utilized. The design documents reviewed by SWEC personnel during the review are identified on Appendix 3.

The review checklists for the nuclear/mechanical, instrumentation and controls, and procedures portion of the audit as completed by SWEC personnel are included in Appendices 4 and 5.

At the end of each day of review, review team members discussed and noted areas of concern. These were discussed with STP representatives the following day, prior to the start of the day's review activities.

At the conclusion of the review, a post-review conference was held to present the review results. Observations requiring corrective action, as determined by individual team members and mutually agreed upon by the team leader, were presented. The attendees at the post-review conference conducted on June 10, 1983 are identified in Appendix 6.

5.0 SUMMARY OF RESULTS

5.1 General

The results of the review indicate that the mechanical, I&C, and procedural aspects of the work performed to date by Bechtel, on the South Texas Project, is in general proceeding in a controlled manner. Certain concerns were identified by the review team and are described in this report. It should be noted that the work that was reviewed represents a small sample of the total plant design and that the system design is not complete, has not gone through major design changes, and construction activities over the past year have been limited.

The detailed review results are presented in attachments to this report. The SWEC concerns are in the procedural and mechanical areas. There are no concerns in the I&C area. It is suggested that HL&P review these concerns with Bechtel to determine if these concerns have generic implications and to establish corrective and preventive actions as necessary.

5.2 Design Inputs

The control of design input documents such as codes, standards, and calculations was generally acceptable, except as noted below:

- All applicable pipe stress inputs and a complete description of each significant system operating mode were not available or used in pipe stress calculation 2N129RC004 dated May 6, 1983. In addition, the source documents (referenced in the system design specification), from which this input should be obtained, were not complete for stress analysis input purposes. HL&P should review with Bechtel the need to formalize and identify all significant system operating modes and inputs for pipe stress analysis.

- Safety Injection and RHR system calculations that are required to confirm piping arrangement acceptability to NSSS layout and pressure drop criteria have not been issued to date and were not scheduled to be issued. HL&P should review with Bechtel the need to perform the calculations to confirm acceptability of the piping arrangement.

5.3 Design Interface

Design Interfaces between internal and external organizations was controlled in an acceptable manner, except as noted below:

The general requirement included in Project Procedures that "selected" Bechtel design documents be sent to Westinghouse (NSSS) for review have not been translated into implementation details. No list of documents to be sent has been developed. Appropriate documents, including system P&IDs, have not yet been sent.

- Nozzle loads calculated by pipe stress were not sent to the Mechanical Group for vendor interface although Vendor allowables to confirm the acceptability of the calculated loads were not available on project. Formal procedures have not been issued to address this or other cases where vendor interface is required. HL&P should review with Bechtel whether procedures need to be issued to address this concern.

- The interdiscipline review distribution for vendor drawings entered into the Bechtel interdiscipline review process for the first time did not always list all affected groups. HL&P should review with Bechtel the need to issue instructions to ensure reviews by all affected groups.

5.4 Design Process

Controls established to assure approval and control of design documents have been established and are being implemented. Procedures reviewed were generally adequate, except as noted below:

- Engineering Department procedures relating to design verification establish requirements to limit the use of an originating group supervisor as the reviewer to implement applicable regulatory requirements. However, the limitations are not the same in all procedures and the terms "immediate supervisor" and "supervisor" are both used without appropriate clarification of the intent. HL&P should review with Bechtel a need to make its procedures consistent and more clear.

- Engineering Department procedures for preparation and review of various design documents currently allow document review notices or equivalent review documents to be discarded, although they are defined as the only documents containing the interfacing groups' approvals. HL&P should review with Bechtel the regulatory commitments for STP with regard to retention of documents and establish the need to retain the documents mentioned above.

It is suggested that Engineering Department procedures for the preparation of calculations be revised to include requirements for defining in the calculation, the objective, the conclusion, and the assumptions that must be verified at a later date.

5.5 Design Output

No concerns were identified during the audit.

5.6 Design Changes

Only a few RHR/SI system design documents have gone through formal revision process. Thus, the adequacy of the overall design change control process could not be determined during the audit. Most of the system design documents issued to date are initial issues by Bechtel and have not gone through a formal revision process to include extensive changes.

REVIEW TEAM MEMBERS

The members of the team that performed the review and their respective areas of responsibility are as follows:

1.	Mr. S.R. Basu, Consulting Engineer, HL&P Engineering Assurance Department	Team Leader & Electrical
2.	Dr. M.K. Chakravorty, Consulting Engineer, HL&P Engineering Assurance Department	Structural/Engineering Mechanics
3.	Mr. P.W. Day, Engineering Assurance Engineer, SWEC	Procedures
4.	Mr. J.F. Harkins, Sr. Control Engineer, SWEC	Instrumentation & Controls
5.	Mr. S. A. Shuman, Assistant Project Engineer, SWEC	Nuclear/Mechanical

SOUTH TEXAS PROJECT PERSONNEL CONTACTED

F. Lopez - Assistant Project Engineer - BEC

S. Cozzens - Project Quality Engineer - BEC

D. Carathers - Nuclear System Engineer - HL&P

PROCEDURES

R. Seaman - Supervisor, Records Management - BEC

G. Bulkin - Project Quality Engineer - BEC

W. Melton - NSSS Coordinator - BEC

M. Robinson - Systems Engineer - HL&P

INSTRUMENTATION AND CONTROLS

R.H. Pence - Engineering Group Supervisor - BEC

M. Gross - Deputy Engineering Group Supervisor - BEC

R. Taylor - Engineering Group Leader - BEC

M. Gugenheim - Engineer - BEC

Y. Williams - Responsible Engineer, Logics - BEC

R. Fatheree - Responsible Engineer, Control Valves - BEC

T. Wardlow - Responsible Engineer, Instrument Installation and Design - BEC

NUCLEAR/MECHANICAL

W. Melton - NSSS Coordinator - BEC

B. Morton - Mechanical EGS - BEC

A. Guidry - Responsible Engineer - BEC

DOCUMENTS REVIEWED

I. MECHANICAL

IA. Bechtel Documents

1. NPSH Calculation 2N129MC5244
2. Licensing Commitment Tracking System Report
3. Draft Procedure PED-19, Rev. 0 - Significant Interface Review Program
4. Work Package Final Report EM402 - 10/29/82
5. P&ID's 5N129F05013 through F05016 (All Rev. 0)
6. FSAR - Section 6.3
7. Pipe Stress Calculation 2N129RC004 (5/6/83)
8. Specification 1L529TS0104, Rev. 0 - ASME III, Bellows Seal or Packless Metal Diaphram Valves . . and Under
9. Addendum No. 1 to Bl Valve Specification 1L529TS0104, Rev. 0
10. RHR System Design Criteria 5R169MQ1021, Rev. 0
11. SI System Design Specification 4N129RS1005, Rev. 0
12. P&ID's F-5013-J and F-5014-J
13. Drawing Change Notice (DCN) No. 1 to P&ID's 5N129F050013 and 5N129F0014
14. Preliminary Calculation 2N129MC5244 - Safety Injection Pump
15. SIS System Design Criteria 5R129MQ1045, Rev. 0

IB. Westinghouse (NSSS) Documents

1. SI System P&ID's 1207E17, Sheets 1-4
2. HHSI/LHSI Pump E Specification 952455, Rev. 1
3. Drawing 300-VN49752, Rev. 12
4. PIP Document (PFD) - FTE-285

II. INSTRUMENTATION AND CONTROLS

IIA. Bechtel Documents

1. Valve Data Sheet Specification 4Z019Z44712, Rev. 0 (Draft)

2. P&ID 5R209F05017, Rev. 0 (4/25/83) Component Cooling Water

3. Drawing Register (History Report for BPC Drawings)

4. CEBUS Log Dated 4/22/83

5. Specification Change Notices - SCN 1 (3/29/83) for Specification 42519ZS10, Rev. 0, and SCN 1 (3/15/83) for Specification 5Z689ZA1027, Rev. 0

6. Work Package Report EM 402 - 10/29/82

7. Logic Diagrams 42182, Rev. 0 (Preliminary), Z42029 and Z42005

8. FSAR Change Notices 33 (8/9/72) and 67 (9/24/82)

9. Specification 526892S1028, Rev. 0 - General Requirements for Instrumentation Construction

10. Specification 4243921007, Rev. 0 - ASME III, Control Valves

11. Design Criteria Documents 5R169MQ1021, Rev. 0 - RHR System and 959129MQ1045, Rev. 0 - SI System

12. Specification Change Notice (SCN) No. 1 and Affected Specification 526892S1027, Rev. 0

13. Design Criteria Document, 5A969EQ1009, Rev. 0 (Draft) - General Discipline Electrical Design Criteria

14. Instrument Piping Drawing MEAB Fluor & Wall Sleeve Tabulation 6M159Z0100, Rev. 2, 3/11/83

15. Safety/Relief Valve PSV 6873, System R28 B*14926-8035-00011-ALG, Lonergan No. A2924, Rev. B

16. Spec. for ASME Section III Control Valves 4Z439ZS1007, Rev. 0, 4/28/83

17. Spec. for Classes 7, 8, and 9 Control Valves 9Z439ZS0211, Rev. 1, 2/19/83, and 7Z439ZS0211, Rev. 0, 9/22/82

18. Spec. Data Sheet for CCW Disch. From RHR Hx Cont VW 4Z019Z44712, Sh. 7, Rev. 0 (Preliminary).

19. Spec. for General Requirements for Instrumentation Construction 5Z689ZS1027, Rev. 0, 1/27/83, and Spec. Change Notice No. 1, 3/15/83

20. Instrument Tube & Installation Design Criteria 5Z019ZQ 1012, Rev. 0, 9/8/82 (replaces B&R TRD 5Z019ZQ003, Rev. H)

21. Fisher Controls Print No. F43237, Sh. 2 of 2, Rev. 2 for Control Valve (Butterfly)

22. Spec. Data Sheet 7Z439Z5211, Sh. 57 (Review Copy) Hotwell Level Control Data Sheet NICD-LV-7005

23. Spec. for Instrumentation Electronic Transmitters 7Z019ZS0500, Rev. 0, 9/10/82, B&R 7Z019ZS500-D

24. Spec. for Instrumentation Electronic Transmitters (Nuclear Service) 4Z479ZS1033, Rev. 0, 2/15/83

25. Spec. for Instrumentation-Electronic Transmitters (Class 1CIII) 9Z019XS1038, Rev. 0, 1/7/83

26. Data Sheets for Spec. 9Z019XS1038, Rev. 0, Preliminary

27. Manufacturer's Drawing-Sys. R28 ESS Clg Wtr-PSV 6873 Lonergan 1 1/2 X Q X 2 1/2 14296-8035-00011 ALG (4035-00010 ALG) Lonergan No. A2924

28. Instrument Index Engineering Report 5Z019Z48000, Rev. 3, 5/4/83, Page 1622

IIB. Westinghouse (NSSS) Documents

1. W System Descriptions TGX/THX-284, Rev. 2 - SI System and TGX/THX-293, Rev. 2 - RHR System

2. W Block Diagram 8758076

3. W Functional Control Diagram 8758022

III. PROCEDURES

IIIA. Bechtel Logs/Distribution Lists

1. Action Item/Critical Item Report - May 25, 1983 (15 pages)

2. Engineering Procedures Manuals (EDPs) - Vol. IIIA and IIIB - Distribution List (Controlled EDP Manual Holders) (5 pages)

3. Design Criteria Manual Distribution List (Control Manual Holders) (2 pages)

4. Design Control Check List - PSSG (1 page) Rev. 1 - May 27, 1983

5. Project Master Distribution Schedule - Re. 3 - March 30, 1983

   a. (Section for Documents Except Design Drawings) and Bechtel IOM No. 09851, March 30, 1983)

b. (Section for Bechtel Design Drawings) - Rev. 3 - April 30, 1983 and Bechtel IOM No. 11063, May 2, 1093

6. STP Project Manuals Indexes

a. Volume I - STP General Project Requirements (GPRs) - April 12, 1983

b. Volume II - STP Project Control Procedures - October 9, 1982

c. Volumes IIIA&B - STP Engineering Department Procedures (EDP) - May 19, 1983 May 19, 1983

7. a. EDP 4.4 List of Codes and Standards Referenced on South Texas Project - Transmittal dated May 13, 1983 (IOM No. 11509) to all EGSs from A. J. Munguia

b. Bechtel Corrective Action Request (CAR) No. 83-4-16-3.1 - April 19, 1983

8. Computer Program Catalog dated January 1983

9. IOM No. 12229 - R. E. Seaman to PE's and others - June 6, 1983 (Distribution of Delinquency Reports for FCR's SDDR's, DCNs, SCNs, Supplier Documents, and Bechtel Design Documents) and Attachments:

a. Delinquency Report - DCNs
b. Delinquency Report - Supplier Document Review
c. Delinquency Report - SDDRs
d. Delinquency Report - Specification CHange Notices (SCNs)
e. Delinquency Report - Bechtel Drawings, Delinquent Amendments

10. Design Document Register - Full History - May 24, 1983

a. Bechtel Drawings - pages 1-679
b. Large Bore ISOs - pages 680-975
c. Pipe Support Drawings - pages 976-1336
d. Small Bore ISOs - pages 1337-1675
e. Specifications - pages 1676-1741

11. STP QE Action Item Request No. 10-0076 (Draft)

12. CEBUS Report - Mechanical Engineering Group Calculations - May 20, 1983

13. NSSS Coordinnation Logs

a. Action Item Register (NSSS only)
b. Westinghouse PIP Indices (By Shop Order)
c. NSSS Correspondence Log (Manual; by NSSS Coordinator)

IIIB. Bechtel Procedures

Volume I - GPRs

1.3, Rev. 2, NSSS Interface Document and Interface between Entities

2.1, Rev. 2, Project Procedures Manual

2.4, Rev. 0, Design Calculations (Numbering)

Volume III - EDPs

1.7,	Rev. 1	Engineering Department Procedures
1.10,	Rev. 4	Project Engineering Departmtne Procedures, Preparation and Control
4.1,	Rev. 1	Design Criteria; (Also Draft Rev. 2)
4.4,	Rev. 3	Design Standard and References for Project Libraries
4.23,	Rev. 0	SAR Change Control
4.24,	Rev. 0	ER Change Control
4.26,	Rev. 0	Interdisciplinary Design Review
4.27,	Rev. 0	Design Verification
4.33,	Rev. 0	On Project Design Review
4.34,	Rev. 4	Off Project Design Review
4.36,	Rev. 1	Standard Computer Programs
4.37,	Rev. 1	Design Calculations
4.40,	Rev. 0	Release of Calculations to Client
4.46,	Rev. 3	Project Drawings
4.47,	Rev. 1	Drawing Change Notices
4.49,	Rev. 2	Project Specifications
4.50,	Rev. 2	ASME Component Design Specifications
4.58,	Rev. 2	Specifying and Reviewing Supplier Engineering and Quality Verification Documentation
4.61,	Rev. 0	Nonconformance Reports (NCRs)
4.62,	Rev. 1	Field Change Requests (FCRs)
4.63,	Rev. 1	Supplier Deviation Disposition Requests (SDDRs)

IIIC. Samples Selected

For Index Checking:

a. BPC Piping Composite Drawing 5C-15-9-P-5003, Rev. 1 dated December 3, 1982

b. BPC Piping Composite Drawing 5F-15-9-P-5151, Rev. 0 dated October 5, 1982

c. P&ID - Safety Injection System - 5N129F05013, Rev. 0 Dated February 24, 1983

d. Vendor Drawing (W) High Head SI Pump O/L Package 1680

e. Vendor Drawing (W) RHR Oval Pump and Motor O/L Pagkage 1750

f. Dresser Pump and Motor Outline Drawing No. 300-V9764, Sheet 1 of 2, Rev. 4

g. Specification (Technical Services Contract) No. 14926-T002, Exhibit D, Rev. 2, May 12, 1983, "Review of Existing Field Erected Tanks"

h. Calculation No. 2N129RC004, Rev. 1 - May 6, 1983

D. HL&P Documents

1. STP Open Items List by Engineer - May 18, 1983 (Tracking Letters from HL&P to BPC requring responses)

2. Engineering Action Items by Group, Responsible Engineer, and Letter No. - Transmittal dated June 6, 1983

3. PEP 3.01, Rev. 2 - January 17, 1983 HL&P Project Engineering Procedure "Performance of Owners Reviews"

Attachment 7.1
Design Process Review Checklist*
Part 1 - Design Input

S A Schuman 6/6/83
J F Harkins 6/22/83
P W Day 6/22/83

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1A	Are codes, standards, regulatory commitments, and requirements identified? Is their scope of applicability defined in design criteria and lower-level documents?		MECH.
		A	ASME III Bellows Seal or Packless Metal Diaphragm Valves Specification 1L529TS0104, Rev. 0, were reviewed and found to generally identify the appropriate codes & standards. Design criteria documents also exist for the mechanical portion of these systems.
			I&C
		A	Spec. for gen. requirements instrumentation construction 5Z689ZS1028, Rev. 0, 1/27/83, Spec. for ASME III control valves 4Z439Z1007, Rev. 0, 4/28/83, Section 4 of both specs. identify applicable codes and standards.
			NOTE: A set of preliminary wall penetration diagrams (coordination copy of Rev. 0) was reviewed. Review comments on coordination prints are being incorporated on logics prior to issuing Rev. 0. These logics reflect the system as shown on Rev. 0 of the P&ID.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*

Part 1 - Design Input

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1B	Do design inputs consider all requirements of system criteria?		MECH.
		C	All applicable inputs and a complete description of each significant system operating mode were not available or used in pipe stress calculation 2N129RC004. In addition, the sources from which the input should be obtained, referenced in the design specification for the safety injection systems, 4N129RS1005, Rev. 0, do not contain all required inputs. System calculations to confirm WNES layout criteria contained in the PIP document (PFI-FTE-285) have not yet been scheduled or performed (see Continuation Sheet Summary).
			I&C
		A	W system descriptions for SI TGX/THX-284, Rev. 2, 9/81 and system description for RHR TGX/THX-293, Rev. 2, 9/81 were reviewed. Bechtel Design Criteria documents, BEC-5R169MQ1021, Rev. 0, 1/12/83 RHR 959129 MQ 1045, Rev. 0, 1/12/83 have been utilized to develop the logic.
1C	Do design inputs consider feedback from pertinent industry engineering and constructions experience in design documents?		MECH.
		A	Nuclear industry information systems, the Bechtel problem report system, and NRC IE Bulletins, circulars, and Information Notices are used.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be incl in this list.

Attachment 7.1
Design Process Review Checklist*
Part 1 - Design Input

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1C	(Cont'd)		I&C Not observed. PROCEDURES
		A	EDP 4.74, Rev. 2 - Experience Feedback Data establishes a system to assure experience on other plants is considered. Also, GPR 1.3, Rev. 2 establishes requirements for EBASCO review of Bechtel drawings after issue. MECH.
1D	Are changes to approved design inputs documented and approved prior to their use?	A	Rev. 0 to P&IDs 5N129F05013 and 5N129F05014 were reviewed against superceded P&IDs F-5013-J and F-5014-J. Also, DCN 1 to the Rev. 0 P&IDs were reviewed. I&C
		A	Specification Change Notice SCN 1 dated 3/15/83 to Spec. No. 5Z689ZS1027, Rev. 0 1/27/83 includes approval signatures of same people signed the original issue of the spec., plus the signature of the Project Quality Assurance Engineer. PROCEDURES
		A	Refer to response to Item 6E.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

CONTINUATION OF ITEM 1B OF
ATTACHMENT 7.1

Stress Input Preparation

The design specification for the safety injection system piping, 4N129RS1005, Rev. 0 references the WNES system description, SD-TGX/THX-284, and WNES SIS piping design requirements, PFD-FTE-285 (both part of the PIP) for a description of operating modes.

Neither of the above provides a complete description sufficient for purposes of stress analysis. The WNES system description functionally describes how the system operates, but does not describe the operating conditions that result. PFD-FTE-285 provides typical temperatures and pressures during each major mode of operation (e.g., injection, recirculation, etc), but does not describe how the system can operate within that mode, such as during a single failure, etc. The information provided must also be adjusted for plant specific conditions generated as a part of the BOP scope (e.g., the temperature of water in the containment sump generated during A/E containment analysis relates to the temperature of the safety injection system fluid).

The Safety Injection System pump suction line analysis, pipe stress calculation 2N129RC004, was reviewed. The calculation references 5L019PS004, Criteria for Piping Design, ST-NS-BR-0725, an NUS temperature calculation for the containment sump, and the WNES piping design requirements and system description. These provide some of the required information, but not a description of each possible operating mode during each plant condition (normal, upset, emergency, and faulted). Consideration of BOP generated information, such as maximum and minimum RWST water temperatures, coincided with single failure for various operating modes does not appear to be complete. Input information regarding system transients (pump start, valve opening and closing, etc) were not provided or were not used. (Project Procedure 5L010RQ1002 states that transient information should be obtained from the Mechanical Group.) System test conditions were not considered. Pipe break/jet impingement effects have not yet been evaluated, in general, by the Project.

It is, therefore, not clear that all modes of operation were considered in the analysis.

System Calculations to WNES Criteria

Safety injection and residual heat removal system calculations to confirm that piping arrangement meets the WNES layout and pressure drop criteria provided in the PIP document (PFD-FTE-285) have not yet been performed. In addition, they are not yet scheduled in the CEBUS (level 3) schedule dated May 20, 1983. This condition also applies to certain other WNES systems, such as charging and volume control and boron recycle. Brown and Root performed calculations for portion of the containment depressurization system, but these have not yet been reviewed and found acceptable by Bechtel.

Attachment 7.1
Design Process Review Checklist*
Part 2 - Design Interfaces

P W Day 6/22/83

CA Shuman 6/22/83

JF Harris 6/22/83

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2A	Is flow of design information between internal and external organizations controlled and timely? - Bechtel/Westinghouse - Bechtel/[illegible] - Bechtel/disciplines (internal) - Bechtel/[illegible] - Vendor [illegible]/document control	C	MECH. Safety Injection System Pump Suction Analysis, pipe stress calc. 2N129RC004, resulted in nozzle loads (for the RWST) for which vendor allowables were not available. The calculated loads had not yet been sent to the Mechanical group for transmittal to the vendor at the time of the audit, approximately one month after completion of the calculation. Vendor drawings for the high and low head safety injection pumps were not provided to the civil/structural group for review, although they contain information essential to design the equipment anchorage. (See Continuation Sheet Summary.) I&C Bechtel/Westinghouse I Logic reference W block diagram 8758D76 and utilize W functional control diagrams 8758022 which have not been statused by BEC yet (see Bechtel/Disciplines (internal) next page).

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2A	(Cont'd)		I&C Bechtel Disciplines (Internal)
		I	Electrical separation shown on both logics and P&ID could not be checked since "General Discipline Electrical Design Criteria" "Electrical Systems" 5A969EQ1009, Rev. 0 which includes separation and identification of Cl. IE equip. and ckts. (Para. 3.1.2.8) has not been issued (see Continuation Sheet Summary).
			I&C Bechtel/Ebasco Not reviewed. PROCEDURES No sampling was performed to allow a judgement on practice. However, it was noted that Logging Systems, distribution lists, and delinquency reports have been established to control the flow of design information in a timely manner. Refer to list of documents reviewed for identification of the various lists/reports. (Refer to Items 6D, 6F, and 6G.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2B	Are verbal and other informal means of communication that provide significant design information, including letters and memos, confirmed and promptly made a part of design inputs by controlled documents.		MECH.
		I	Verbal agreement was reached by Bechtel and WNES to delete HCV-921, 922, and 923, and the corresponding piping without a confirmatory letter being planned. It is planned to discuss this item at the next WNES interface meeting and confirm the agreement via the notes of that meeting. This item was being tracked on the NSSS coordinator's Action Item Register.
			I&C
			Not observed.
			PROCEDURES
		I	STP Project Procedure GPR 1.3, Rev. 2, Part A does establish requirements for including telephone/meeting agreements in formal correspondence. Only one example of this was noted during the audit as discussed above.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
2C	Is system interaction considered in system design and analysis?	A	A high point in RHR heat exchanger could have resulted in potential for water hammer in the safety injection system. A jockey pump subsystem is being considered in the SIS System to keep the heat exchanger water solid. This system modification will reduce the possibility of water hammer occurrence.
			I&C
		NA	The design of a control system for a process considers process interaction in order to select appropriate controls.
			MECH.
2D	Is design change information coordinated effectively with all affected disciplines?	A	The review process for P&IDs and DCNs appears adequate. Deletion of the containment pump suction isolation valve encapsulation via DCN 1 to P&ID 5N129F05013, Rev. 0, was transmitted from mechanical to PSSG and incorporated in pipe stress calculation 2N129RC004.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2D	(Cont'd)		I&C
		A	Design change information is coordinated with affected disciplines as illustrated by a set of logic coordination prints issued for the review and comments of the electrical, mechanical, and nuclear groups.
			A "HOLD" on P&ID of failure mode for control valve was resolved on a document review notice (DRN), therefore the hold was not shown on the applicable valve data sheet Spec. 4Z019Z44712, Sh. 7, Rev. 0 (in review) P&ID 5R209F05017, Rev. 0 4/25/83. Service: CCW disch. from RHR Hx.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

CONTINUATION OF ITEM 2A
FOR ATTACHMENT 7.1

Item 2A - Mechanical Observation

Vendor drawings should be reviewed by engineering groups that are responsible for checking the interface and technical information and for using information in the drawings to complete the BOP design.

The internal review given to the following vendor drawings was evaluated:

- LHSI Pump - 14926-025(1)00016-AWN through 00019-AWN
- RHR Hx - 14926-0210(1)00010-AWN through 00012-AWN
- HHSI Pump - 14926-0205(1)00012-AWN through 00015-AWN
- RHR Pump - 14926-0205(1)00031-AWN through 00032-AWN

LHSI pump and HHSI pump drawings were not provided to civil/structural (C/S) for review although they contain anchor bolt sizes and mounting bolt loadings required to both confirm the anchorage being adequate for the actual equipment loads and for evaluating embedment plates. RHR pump and Hx drawings were correctly sent to C/S. It was noted that the above drawings were the first formal review statusing by Bechtel.

CONTINUATION OF ITEM 2A FOR
ATTACHMENT 7.1

Audit Item 2A - I&C

Safety Injection System P&ID (5N129F013, Rev. 1, Preliminary) was reviewed to determine if separation group was properly shown for the RWST level transmitters, associated instrumentation, and controls.

Observation

The RWST level transmitters are used to develop actuation logic for automatic switchover to recirculation for the Safety Injection System.

The channel signals and train actuation logic separation appears to be consistent with preliminary separation design criteria (Ref. 4).

Correspondence (Ref. 1, 2, and 3) illustrates BEC's concerns and W's response to those concerns about the appropriateness of a 1/1 switchover logic (used on STP) vs. 2/4 logic used on other plants.

These concerns are summarized as follows: Although the separation may be adequate and licensable, the absence of increased reliability of 2/4 or 2/3 vs. 1/1 initiation of automatic switchover to recirculation could result in severe damage to plant components by early or late initiation of transfer.

Reference

1. ST-YB-WB-0147, 12/1/82, Action Item No. 185
2. ST-WN-YB-263, 2/3/83
3. ST-YB-WN-0281, 6/2/83, Action Item No. 258
4. SA969EQ1009, Rev. 0 (Prelim.) General Discipline Electrical Design Criteria

S O Sherman 6/22/83

Attachment 7.1
Design Process Review Checklist*
Part 3 - Design Process

QW Day 6/22/83

J F Harkins 6/22/83

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3A	Does overall design review process include system design reviews, verification of calculations and computer runs, and validation of computer codes?	I	MECH. System design review, computer runs, and computer codes were not reviewed. Vendor installation and operating manuals are not normally reviewed by engineering. The following Vendor operating manuals were entered "For Information Only": RHR Pump - ID-14926-0205(1)00036-AWV LHSI Pump - ID-14926-0205(1)00025-AWV HHSI Pump - ID-14926-0205(1)00026-AWV The project policy is to not review and approve operating manuals. Although the information contained is not normally needed to complete the engineering phase, the information is very valuable during installation, startup, and plant operation. If review of the manuals is delayed until that phase, and purchase orders with the corresponding Vendors have been closed, it would be very difficult and perhaps costly to obtain necessary, missing information.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 3 - Design Process

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3A	(Cont'd)		I&C
		NA	Not observed.
			PROCEDURES
		A	Procedures establish appropriate requirements - refer item Nos. 6E, 6J, and 6K. Bechtel Procedures EDP 4.27, Rev. 0 (Design Verification) and EDP 4.26, Rev. 0 (Interdiscipline Design Review) were specifically for the review of Bechtel design on a system basis.
			MECH.
3B	Do design documents include scope and applicability as well as identity of originator and checker?	A	Preliminary calculation 2N129MC5244, Safety Injection Pump, and Specification 1L529TS0104 were reviewed.
			I&C
		A	Logics include scope and applicability by general note which indicates that they represent functional requirements only. There are signature blocks for DFT, CKR, GL, EGS, and PEM for Rev. 0 and subsequent revisions.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 3 - Design Process

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
3C	Do calculations and analyses clearly specify information such as applicability, assumptions, design inputs, references, methods, and results?	A	Calculation 2N129MC5244 was reviewed and although not fully clear in all respects, it did appear to reach the correct conclusion. Calculation format attributes were adequate. No other calculations were available for review.
			I&C
		NA	I&C calculations are typically done by manufacturer to size his equipment based on data sheets for that equipment.
			PROCEDURES
		C	Refer to Item No. 6J.
			MECH.
3D	Are design problems identified and decisions made to resolve problems in a timely and effective manner?	A	Problems identified in the work packages have been resolved or are being evaluated. Certain of those problems remain and are scheduled for completion later in 1983 or 1984.
			I&C
		A	See 2D.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

S A Sherman 6/21/83

Attachment 7.1
Design Process Review Checklist*
Part 4 - Design Output

J F Hanlon 6/22/83

R W Day 6/22/83

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
4A	Are use limitations for each type of design document clearly defined to assure proper use in development of design and in construction?	A	System P&IDs and valve Specification 1L529TS0104 were reviewed.
			I&C
		A	See 3B; holds are utilized on logics (see Z42011, 42012, 24 & 25) to limit use of logic.
			MECH.
4B	Do appropriate design output documents undergo constructability review?	I	Normally, design output drawings undergo a constructability review by EBASCO only after issue. The project attempts to issue drawings 6 months prior to installation to allow time for this review, however, at the present time, there is only a 2 month lead time. This may not be enough time to allow problems found to be resolved without impacting the schedule. Construction Specialist involvement in preparation, perhaps during checking, particularly as long as there is a short lead time, may prevent construction delays.
			I&C
		NA	Not observed.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1

Design Process Review Checklist*

Part 4 - Design Output

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
4C	Are design output documents issued and kept current using a controlled process?	A	System P&IDs, specifications, and corresponding DCNs and SCNs were reviewed. Project procedures (e.g., EDP-4.47) require revisions within specified periods of time.
			I&C
		A	- Verified that issued logics are tracked on the design document register and in CEBUS log (4/22/83 issue). - See 2D for discussion of hold on control valve. - Spec change notices have been issued for the following specs.: Instrument Tubing Installation, Seismic Cat. 1 42519ZS10, Rev. 0, 3/10/83, SCN No. 1, 3/29/83 Gen. Requirements, Instrument Construction 5Z689ZA1027, Rev. 0, 1/27/83, SCN No. 1, 3/15/83.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 4 - Design Output

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4C	(Cont'd)		PROCEDURES The BEC EDP for Drawings and Specification (EDPs 4.46 and 4.49) establish review and approvals prior to issue. They also establish Change Notice Systems (DCNs and SCNs) to allow changes to be made quickly. These documents are tracked for incorporation within specified time limits.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

S A Shumway 6/22/83

J F Harkins 6/22/83

Attachment 7.1
Design Process Review Checklist*
Part 5 - Design Changes

G W Day 6/22/83

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
5A	Are reasons for change identified and evaluated? If necessary, are actions taken to avoid future problems?	A	Reasons for change to drawings are identified on revision reports.
			I&C
		A	A revision report is issued for each revision of document. The Revision 0 report will indicate changes from superseded B&R drawing.
			MECH.
5B	Are changes subject to reviews, approvals, and control measures commensurate with those of original design?	A	DCN 1 to system P&IDs and Addendum 1 to valve Specification 1L529TS0104 were reviewed. Revisions to drawings get consistent reviews and approvals.
			I&C
		A	Review and approval signoff blocks are used for all revisions to document (see 1D for discussion of SCN).
			PROCEDURES
		A	Refer to Item No. 6F.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be inc[illegible] in this list.

Attachment 7.1
Design Process Review Checklist*

Part 5 - Design Changes

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
5C	Is a system used to determine whether or not a change being made impacts other parts of the system and other areas of the plant?	I	A system to ensure this is not known. Project drawings are routed to interfacing disciplines at the discretion of the originating EGS.
			I&C
		A	Review noted in 2D.
			MECH.
5D	Are changes, including those initiated by regulation, construction, vendor, or design, properly approved by design organizations (including HL&P, when required)?	A	Changes to applicable P&IDs were properly approved.
			I&C
		A	- Work Package Report EM402 10/29/82 findings Paragraph 1.1A&B, RHR pump suction isolation valve remote shutdown capability and closure alarm are shown on logic diagrams 42182, Rev. 0 (Preliminary). - SAR Change Notices 33, 8/9/82, and 67, 9/24/82 have been incorporated on logic Z42029 and Z42005.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 5 - Design Changes

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
5E	Are appropriate design changes promptly evaluated by each affected discipline for effect on calculations, analyses, or selection of equipment and material?	A	Only a limited review was possible. In one case, deletion of isolation valve encapsulation in safety injection pump suction via DCN 1 to drawing 5N129F05013 (issued 3/21/83) was included in pipe stress calculation 2N129RC004 (issued 5/6/83).
			I&C
		A	- See 2D for discussion of cont. vlv. hold.
			- See 2D for discussion of logic coordination prints.
			- A comment print for a safety/relief valve 14928-8035-00011-ALG was reviewed by mechanical and RF flanges were changed to flat face.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

PW Day 6/22/83

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	DEVELOPMENT AND ISSUE OF PROCEDURES		
6A	Have personnel been assigned to coordinate the preparation, maintenance, and control of STP procedures related to engineering and design?	A	Responsible group is Project Quality Engineering headed by S. Cozzens. A member of the group, G. Bulkin provided a schedule for needed revisions; produced folders for several procedures containing information relating to necessary changes; produced several copies of procedures in review; and provide his log of Interim Change Notices which is used to track their incorporation. (See Continuation Sheet Summary for procedural system background information.)
6B	Are these procedures required to be issued for review and/or approval by affected organizations and personnel responsible for administration of the STP engineering and design effort prior to issue?	A	GRP 2.1, Rev. 2, Para. 2.0, 4.0, 5.0, 7.1, and Exhibit A GPRs require review/approval by Project Mgr., cognizant Dept., each affected Dept., and HL&P (selected GPRs). Revisions are approved the same as the original. EDP 1.10, Rev. 4, STP-Para. 5.0 EDPs are reviewed and approved by the Project Eng. Mgr., Project QA (if safety-related subject), and Houston Area Office Engineering Manager. Revisions are approved in the same manner.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identificati... shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6B	DEVELOPMENT AND ISSUE OF PROCEDURES (Cont'd)		EDP 1.10, Rev. 4, STP-Para. 5.0 (Cont'd) Interim Change Notices (ICNs) which are used to make changes quickly or for a trial period, are approved the same as revisions except the Houston Office Eng. Mgr. approval is not required. NOTE: Procedures requiring HL&P review are shown on Exhibit A of GPR 2.1. None of those in Vol. IIIA or IIIB require HL&P approval. Selected ones in Vol. I do; a review of GPR 1.3 and GPR 1.5 shows HL&P approved is being obtained, when required.
6C	Has a system for tracking necessary future changes to issued procedures been established to assure significant changes are included in a timely manner?	A	Changes reflected on Interim Change Notices are tracked for inclusion in a revised procedure before the expiration date by George Bulkin via an ICN log.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6C	DEVELOPMENT AND ISSUE OF PROCEDURES (Cont'd)		Other sources of change are kept in a set of folders - one for each procedure. An inspection of a couple of folders shows that they contain material such as internal correspondence, audit observations (HL&P, Bechtel), and others describing the need/request for changes.
6D	Have distribution methods been established that identifies manual holders, provides for distribution of revisions to procedures and indices, and discontinuing the use of superseded revisions?	A	GPR 2.4, Rev. 1 - 11/12/82 establishes requirements for maintenance of a Project Master Distribution list. Distribution of procedures and revisions is made using a cover letter and an updated index. The cover letter instructs personnel to remove outdated procedures from their EDP manuals. A list of controlled manual holders used by Project Document Control was provided - all appropriate information was included.
	BECHTEL DESIGN DOCUMENTS		
6E	Do procedures relating to Bechtel design documents (design criteria, P&IDs, drawings, etc) establish requirements for preparation and internal review/approval by affected disciplines?	C	EDP 4.1 - Design Criteria, EDP 4.49 - Specs. EDP 4.46 - Project Drawings and EDP 4.47 Drawing Change Notices were reviewed. Responsibilities for preparation and review are included. Procedures given a minimum of information on review considerations.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6E	BECHTEL DESIGN DOCUMENTS (CONT'D)		Need for review by other groups is determined by the originating group supervisor on a revision-by-revision basis. Documents containing interfacing group supervisor concurrence signatures are not retained (see Continuation Sheet Summary, attached). Requirements for limiting the use of supervisors for design verification reviews is not always consistent. (See Continuation Sheet Summary, attached.)
6F	Do procedures establish requirements for review of Bechtel documents by external organizations, when required (NSSS, HL&P) including the following:		
	° Identification of the Bechtel documents that require external review and the reviewing organization.	C	° GPR 1.3 establish interface between major organization and is signed by them to indicate agreement. GPR 1.3, Section B and Section C, identify the Bechtel document that requires review by HL&P and EBASCO, respectively. GPR 1.3, Section A, Para. 5.4 requires that "selected" Bechtel documents be reviewed by the NSSS supplier. However, no specific list of documents has been issued (see Continuation Sheet Summary, attached).

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document tification shall be in[illegible] in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6F	BECHTEL DESIGN DOCUMENTS (CONT'D)		
	° Methods for tracking the status of documents sent for external review and accountability for comments received through the process of resolution and incorporation into affected documents, when required.	A	° Indices and logs identified in the list of documents reviewed provide appropriate accountability.
	Do procedures establish requirements for review of changes to Bechtel documents in the same manner as the original issue?	A	See list of documents reviewed. EDPs reviewed contained requirements for reviewing changes in the same manner as the original issue, except Change Notice forms, which did not get all approvals. However, approval process used was considered appropriate.
	BECHTEL DESIGN DOCUMENTS (CONT'D)		
6G	Do procedures include requirements for control of approved documents (e.g., numbering, indices, files, status markings, distribution) that assure current approved documents are used by affected organizations and superseded documents are discarded or marked to prevent misuse?	A	- EDP 4.46 - Drawings and EDP 4.37 - Calculations, do contain requirements for use of status markings (see Item 6J) concerning calculation markings. - EDP 4.46, Section 6.4, requires the use of the drawing index to verify current Rev. information prior to use of uncontrolled copies.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6G	BECHTEL DESIGN DOCUMENTS (CONT'D)		- EDP 4.46 and 4.37 generally address numbering. GPR 2.4 addresses calc. numbering in detail. - Project Filing System is described in GPR 2.3. - A master distribution matrix for design documents is developed according to GPR 2.4. It was noted that only calculation logs are distributed, not calculations. EDP 4.37 - "Calculations" does not require distribution of calcs. - Design Criteria are distributed in controlled copies of manuals. A list of manual holders is maintained and updated indices are sent with each update.
6H	Do procedures assign responsibility for the review of Bechtel design documents for conformance to FSAR requirements and establish a system for documenting needed FSAR changes in a timely manner?	A	A review of EDP 4.1 - Design Criteria, EDP 4.46 - Drawings, EDP 4.49 - Specs., EDP 4.47 - DCNs, and 4.23 - SAR Change was performed. Generally, procedures mention that originators/reviewers must consider FSAR requirements, but they do not include specific statement the SAR Change Notices shall be written. Also, EDP 4.23 is not referenced. The lack of this information in each EDP was not considered significant.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6H	BECHTEL DESIGN DOCUMENTS (CONT'D)		NOTE: S. Shuman indicated that his review of Mechanical Group practice regarding issuing design changes on P&IDs and specs. was to first issue an FSAR Change Notice.
6J	Do procedures establish requirements for the documentation of calculations including: ° Objective ° Method of Analysis/Formulae ° Computer Code (When Used) ° Inputs ° Assumption with an indication of those requiring reverification ° Results/conclusions	C	EDP 4.37, Rev. 1 STP - 10/5/82. The procedure is not definitive in regard to the contents of calculations. Methods, inputs/assumptions, and computer codes were generally covered. However, there was no mention of objective, conclusions, or positive identification of assumptions requiring confirmation at a later date. These three items are specifically discussed in ANSI N45.2.11, Section 4.2, and should be specifically addressed by this EDP. NOTE: According to S. Basu, some electrical calculations were deficient in this regard. Refer Electrical Audit Checklist. (See Continuation Summary Sheet, attached.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	BECHTEL DESIGN DOCUMENTS (CONT'D)		
6K	Do procedures establish requirements for the documentation and verification of computer codes used in design before use or as part of the review of calculations?	A	- EDP 4.37, Rev. 1 STP - Calcs, Para. 3.9, 3.10, 3.11, 3.12, and 3.13 (Programmable Calculators) - EDP 4.36, Rev. 1, "Standard Computer Programs" - A listing of Bechtel Standard Programs showing the program identification, including release number and the status of program documentation/cerification was reviewed. Program No. ME101, Version J2, which was used to perform Calc. No. 2R129RC004 dated 5/11/83 was found in this list - the program release was verified. NOTE: Stan Cozzens indicated that Bechtel was currently discussing the use of programmable calculator, minicomputers. Additionally, detail will be added to EDP 4.37 "Project Calculations"to assure sufficient program documentation is retained in calculations and appropriate reviews are performed.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	PROCEDURES DEFINING INTERFACES WITH EXTERNAL ORGANIZATIONS		NSSS (For NSSS consideration, see Item 6P.) EQUIPMENT SUPPLIERS
6M	Have procedures been issued in relation to the receipt and processing of STP design documents generated by external organizations (see 6P, Equipment Suppliers).	A	EDP 4.58 - Specifying and Reviewing Supplier...Documentation" described the system used to "status" vendor documents (including NSSS) through Bechtel review.
6N	Has a system been established to account for each document received from external organizations (NSSS, equipment suppliers) and its status in regard to processing by Bechtel? Has responsibility for coordinating the system been assigned?	A	The following were reviewed with the NSSS Coordinator (Wade Melton): ° Action Item Register (NSSS only) ° W PIP Indices ° Informal Correspondence Log The following were reviewed with the Supervisor, Records Mgt. (Rosemary Seaman): ° Supplier Document Review Status Log ° Supplier Document Review Delinquency Report

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	PROCEDURES DEFINING INTERFACES WITH EXTERNAL ORGANIZATIONS (CONT'D)		EQUIPMENT SUPPLIERS (CONT'D)
6P	Do procedures identify the types of NSSS documents that require Bechtel engineering review and the organizations most responsible for performing the review?	A	Satisfactory based on review of the following: ° GPR 3.1, Section 5.0 ° PIP Documents (NSSS Coordinator's copies contain current W indices by Shop Order and PIP documents.) ° Supplier Document Review Tracking Log and Delinquency Reports ° EDP 4.58 - Specifying and Review... Supplier Documents
6Q	Are time limits established to provide for timely processing of documents?	A	Time limits are set and delinquency reports are issued, based on review of the Delinquency Reports listed in the "List of Documents Reviewed."
6R	Do procedures establish controls (logs, files, distribution) that assure current, Bechtel approved documents are used in developing interfacing designs?	A	Logs are developed and distributed. Distribution lists maintained for the various documents received from Vendors including the NSSS. The index of Vendor documents was reviewed - it is published by Records Mgt. and distributed to appropriate personnel. Delinquency reports are issued also. Refer 6Q.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6R	PROCEDURES DEFINING INTERFACES WITH EXTERNAL ORGANIZATIONS (CONT'D)		EQUIPMENT SUPPLIERS (CONT'D) Vendor document files are maintained by Records Mgt. who provides copies to Engineers for review and use.
	HL&P PROJECT REVIEW OF BECHTEL DESIGN DOCUMENTS		
6S	Have procedures been established to describe the responsibility and method of receiving and processing Bechtel design documents requiring HL&P review/approval?	A	HL&P Procedure PEP-3.01, Rev. 2, "Performance of Owner's Review"
6T	Do the procedures identify the types of Bechtel documents that require HL&P review and the disciplines required to perform the review?	A	GPR 1.3, Rev. 2, 3/15/83, Section B identifies the Bechtel documents requiring HL&P review/approval before issue (P&IDs and one lines) and those requiring HL&P review after issue by Bechtel.
6U	Have responsibility and methods been established for tracking the status of HL&P comments through satisfactory resolution by Bechtel?	A	HL&P maintains status logs for Bechtel documents sent for HL&P review/approval that track in-house action through completion. HL&P also maintains an open items list showing letters sent to Bechtel (e.g., HL&P Comments) that require action by Bechtel. (Refer to List of Documents Reviewed.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be incl in this list,

Attachment 7.1
Design Process Review Checklist*
Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	DESIGN CHANGE CONTROL PROCEDURES		
6V	Have procedures been established to control design changes caused by:	A	
	a. Regulatory Requirements		a. EDP 4.4 - Codes & Standards
	b. Design Development		b. EDPs 4.49 (SCNs) 4.47 (DCNs)
	c. Construction Requirements		c. EDPs 4.62 (FCRs) 4.61 (N&Ds)
	d. Vendor Requirements		d. EDP 4.63 (SDDRs)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be in[illegible] ! in this list.

CONTINUATION OF ITEM 6A FOR
ATTACHMENT 7.1

STP Manuals - General Background

Normal Bechtel approach for procedures is to require a Project to use generic Bechtel Engineering Department Procedure (EDPs) and develop a Project Manual that contains project unique requirements. The Project Manual procedures would supplement the EDPs.

On Southwest Texas Project, however, due to unique requirements the situation of Bechtel picking up Engineering and design where Brown & Root left off, normal Bechtel approach was not used. Rather a separate set of manuals containing procedures for STP were created. Procedures were developed from the generic Bechtel EDPs, but revised to reflect unique STP requirements. Currently, the procedures are being updated to add emphasis/special attention to changes to E&D documents (i.e., Bechtel Rev. 1 and later issues). The set of STP manuals includes the following:

- Volume I - General Project Requirements (GPR)
- Volume II - Project Control Procedures
- Volume III A & B - Engineering Procedures
- Volume IV - Project Procurement Procedures
- Volume V - Project QA Procedures
- Volume VI - Project Records Management Procedures
- Volume VII - Construction Manufacturer Procedures

The Bechtel Procedures affecting engineering and design are primarily in Volume IIIA and IIIB which are maintained by Stan Cozzens/George Bulkin (Project QE) for the Project Engineering Manager. Stan/George review procedures from other Bechtel Departments for interface (e.g., Records Management). Volume I of Bechtel STP procedures affect Engineering (e.g., organization, NSSS interface agreements, calculation numbering). Volume II contains cost and scheduling related information.

The procedures issued to describe requirements for development and control of the procedures of interest during the audit (i.e., Volume I and III) are as follows:

- GPR 2.1, Rev. 2 - 3/15/83 - Project Procedures Manual Scope, Implementation, and Control - Volume I
- EDP 1.10, Rev. 4 STP - Project Engineering Department Procedures Preparation and Control - Volume IIIA & IIIB

CONTINUATION OF ITEM 6A FOR
ATTACHMENT 7.1 (CONT'D)

Applicable Regulatory Requirements

Bechtel has submitted a description of their quality assurance program which invokes the use of the Bechtel Topical Report. This report endorses Regulatory Guide 1.64, Rev. 2 - June 1976 (ANSI N45.2.11-1974) with some exceptions and interpretations. These are described in Appendices to the report. The requirements in these documents represent a fundamental baseline for development of procedures for control of nuclear safety related designs.

CONTINUATION OF ITEM 6E FOR
ATTACHMENT 7.1

Design Verification Procedures

A review of EDP 4.36 - Standard Computer Programs, EDP 4.46 - Project Drawings, EDP 4.49 - Project Specifications, EDP 4.27 - Design Verification, and EDP 4.37 - Design Calculations was performed relative to requirements for design verification. It was noted that the limitations in EDP 4.36 concerning limiting the use of "supervisors" as reviewers were not always consistent. The differences are as follows:

1. EDP 4.36 (Para. 5.4) indicates that the originator's "immediate supervisor" should be excluded unless he is the only qualified individual.

2. The remaining EDPs indicate that the originator's "supervisor" must be excluded unless he is the only individual competent to check the drawing, and did not specify a singular design approach, rule out certain design considerations, or establish inputs...

It was also noted during the review that an internal memorandum (IOM 09800 dated March 29, 1983) was issued to reflect clarification by the Project Engineering Manager that Group Leaders (immediate supervisors) are to be considered as "supervisors as used in the context of EDP 4.49, 4.46, 4.47, etc." However, this information was not included in formally issued Project Procedures.

Retention of DCNs and Coordination Prints

Document Review Notices (EDP 4.33) are generated by the Engineering Group Supervisors (originating group) to identify other affected disciplines that must review a design document prior to issue. These forms, at the completion of the interdiscipline review process, are according to procedures, the only place where the concurrence signatures of interfacing Engineering Group Supervisors is documented. They are not required by EDP 4.33 to sign the finalized document. The same applies to the use of coordination prints that are Project Drawing (EDP 4.46).

EDP 4.33 states that this documentation may be discarded after the final document has been signed by the Project Engineer and issued. The original DRN kept on file does not contain these concurrence signatures; only the list of disciplines is included.

Since these documents (DRNs and Coordination Prints) document concurrence signatures which are not required to be included on the final issued design document, the requirement to discard them should be reconsidered. Alternatively, consideration should be given to changing procedure to require interdiscipline concurrence signatures on the issued drawings.

CONTINUATION OF ITEM 6F OF
ATTACHMENT 7.1

Design Interfaces - BECH/WNES

The NSSS interface, including the Procedure No. GPR 1.3, was reviewed. It has been verified that upon receipt of a W drawing, Bechtel statuses the drawings and comments are sent to W via a letter. The letter is given an action item number by the NSSS Coordinator and is tracked on computerized index. The drawings received from W during B&R time are being statused by BPC as a backfit effort.

The Procedure No. FPR 1.3 requires that "selected" design documents generated by Bechtel be sent to W for review and confirmation.

It was noted during the review that interface requirements have been met. It was also noted that the specific BPC documents that need to be sent to W have not yet been defined. Bechtel has stated that STP is presently in the process of establishing the ground rules for identifying the A/E documents requiring W verification.

It is noted that P&ID, Rev. 0 for RHR/SI system has been issued and RWI is in the process of being issued imminently. The Bechtel P&ID, Rev. 0 was not sent to W to verify if W interface requirements have been met by Bechtel. Since P&ID is a basic document which provides input for further progress of other disciplines design work, it is our concern that without W formal review of this document, there is a potential for not meeting the intent of W design criteria.

CONTINUATION OF ITEM 6J OF
ATTACHMENT 7.1

Calculation Procedures

A review of Bechtel EDP 4.37, Rev. 2 STP revealed that no specific requirements are included for the inclusion of a statement of the calculation "objective" and "conclusions" reached after an evaluation of the calculation results. These areas were weaknesses in the electrical calculations reviewed by S. Basu (HL&P) during the review. The EDP also was not specific regarding the identification of inputs/assumptions requiring confirmation at a later date. These areas are addressed by Section 4.2 of ANSI N45.2.11 which addresses the contents of procedures on design analysis.

It was noted that a method of identfying calculations containing inputs that are not final has been established. Such calculations are marked "Preliminary." However, the specific inputs that caused the use of this marking is not required to be identified. Further, clarification of this marking is also needed and is underway in a draft of EDP 4.37, Rev. 3 STP due to the fact that two separate uses of the marking currently exist.

Attachment 7.2
Component Checklist†

PW Day 6/22/83

JF Harkins 6/22/83

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
	Control valves		
1.	Clearly-specified valve functional requirements (flow capacities, valve flow characteristics, leak tightness, valve accessories)	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.
2.	Properly-specified environmental and design conditions	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.
3.	Correct ASME code and quality class specified for valve	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
4.	Valve actuator/operator requirements correctly incorporated into the design	A	See Attachment 7.1, Item 2D, for observation of control valve failure mode (Ref. 5 and Ref. 9).
5.	Specific material compatible with piping in which it is installed and fluid it contains	A	Piping Spec., P&ID, and Valve Data Sheets were compared to determine adequacy.
6.	Valve and actuator weight furnished by manufacturer	A	Ref. 15 and Ref. 8 show weights.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
7.	Installation requirements considered in installation specification or layout drawing	NA	Not observed.
	Instrument tubing		
8.	Consistent listing of the following items in design specifications, engineering criteria document, and installation specifications: a) Tube and fitting material specified	A	Ref. 7 and Ref. 6 both refer to 4Z519ZS1019 and drawing 9Z10030 for materials.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
8.	b) Design temperature and pressure specified	NA	Not observed.
	c) Temperature and pressure specified same as process line to which tubing is connected	A	Ref. 6 refers to piping line list for applicable press. and temp.
9.	Consistent listing of the following in W requirements, A-E design criteria, and installation specification a) Minimum slope specified	A	Paragraph 5.22, Ref. 7, and Paragraph 6.4.1.12, Ref. 6.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
9.	b) Separation criteria specified	A	Criteria specified in Ref. 7, Paragraph 5.2.3 and Ref. 6, Paragraph 6.6.6 separation divisions are separated in instrumentation index Ref. 16.
	c) Routing criteria specified to minimize possibility of damage to lines from missiles, falling objects, etc.	A	Paragraph 6.3, Ref. 6.
10.	Consistent listing of the following in W design specification, A-E design criteria, and installation specification		
	a) High point vents and low point drains specified	A	Paragraphs 6.4.2.4, 6.4.2.5, and 6.2.7 of Ref. 6.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
10.	b) Bend radius specified	A	Paragraph 6.6.4.8, Ref. 6 and Paragraph 5.2.4, Ref. 7.
	c) Connections specified for test and calibration	A	Typical installation detail shows test and calibration connections.
	d) Quality class and code category specified	A	Ref. 16.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
10.	e) Hydrostatic test specified	A	Paragraph 7.2, Ref. 6.
	f) Safety lines identified	A	Identification of safety lines is through the associated instrument mark number.
	Level, flow, pressure switches, and flow transmitters		
11.	a) Accuracy requirements met	A	A review of the following Ref. 11, 12, 13, and 14 did not lead to evidence of concerns or not acceptable observations.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
11.	b) Drift requirements met	A	See 11A.
	c) Repeatability requirements met	A	See 11A.
	d) Range requirements met	NA	Not observed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
11.	e) Voltage level acceptable	A	See 11A.
	f) Device input compatible with component	A	See 11A.
12.	Instrument weight furnished by manufacturer	NA	Not observed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

DOCUMENTS REVIEWED (REFERENCES) FOR I&C
PORTION OF ATTACHMENT 7.2

1. Instrument Piping Drawing MEAB Fluor & Wall Sleeve Tabulation 6M159Z0100, Rev. 2, 3/11/83.

*2. Safety/Relief Valve PSV 6873, System R28 B*14926-8035-00011-ALG, Lonergan No. A2924, Rev. B.

3. Spec for ASME Section III Control Valves 4Z439ZS1007, Rev. 0, 4/28/83.

4. Spec. for Classes 7, 8, and 9 Control Valves 9Z439ZS0211, Rev. ., 2/19/83, and 7Z439ZS0211, Rev. 0, 9/22/82.

5. Spec. Data Sheet for CCW Disch. From RHR Hx Cont VW 4Z019Z44712, Sh. 7, Rev. 0 (Preliminary).

6. Spec. for General Requirements for Instrumentation Construction 5Z689ZS1027, Rev. 0, 1/27/83, and Spec. Change Notice No. 1, 3/15/83.

7. Instrument Tube & Installation Design Criteria 5Z019ZQ 1012, Rev. 0, 9/8/82 (replaces B&R TRD 5Z019ZQ003, Rev. H).

*8. Fisher Controls Print No. F43237, Sh. 2 of 2, Rev. 2 for Control Valve (Butterfly).

*9. P&ID 5R209F05017, Rev. 0 (4/25/83) Component Cooling Water.

*10. Spec. Data Sheet 7Z439Z5211, Sh. 57 (Review Copy) Hotwell Level Control Data Sheet NICD-LV-7005.

11. Spec. for Instrumentation Electronic Transmitters 7Z019ZS0500, Rev. 0, 9/10/82, B&R 7Z019ZS500-D.

12. Spec. for Instrumentation Electronic Transmitters (Nuclear Service) 4Z479ZS1033, Rev. 0, 2/15/83.

13. Spec. for Instrumentation-Electronic Transmitters (Class 1CIII) 9Z019XS1038, Rev. 0, 1/7/83.

14. Data Sheets for Ref. 13, Rev. 0, Preliminary.

*15. Manufacturer's Drawing-Sys. R28 ESS Clg Wtr-PSV 6873 Lonergan 1 1/2 X Q X 2 1/2 14926-8035-00011 ALG (4035-00010 ALG) Lonergan No. A2924, Rev. B.

16. Instrument Index Engineering Report 5Z019Z48000, Rev. 3, 5/4/83, Page 1622.

*These documents were reviewed in lieu of specific RHR/SI documentation which was not available for review due to its preliminary status.

PW Day 6/22/83

Attachment 7.2
Component Checklist†

SA Sherman 6/24/83

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
1.	Is the system layout consistent with NSSS vendor layout criteria? Have system friction losses been calculated using NSSS L/D criteria?	C	The system layout has not yet been evaluated against WNES layout criteria provided in the WNES PIP documents (PFD-FTE-285 for this system) or other WNES systems. (See Attachment 7.1, Item 1B.)
2.	Are inputs that require confirmation identified?	A	Inputs which require confirmation were indicated in calculation 2N129MC5244.
3.	Are environmental conditions specified for equipment consistent with A-E building analysis?	I	The environmental conditions specified, and the ability of the existing equipment to be qualified to those environmental conditions is presently being evaluated by Bechtel.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
4.	Is stress input, including system operating conditions, load combinations, and applicable transients, provided to the pipe stress analysts?	C	Stress input, including the various significant system operating conditions and applicable transients, are not adequately being provided to the stress analysts at this time. (See Attachment 7.1, Item 1B.)
5.	Are revisions to specifications and drawings reviewed against the SAR?	A	EDP-4.46 states that drawing changes should be reviewed by the initiating group for conformance to licensing commitments, but does not say what should be done if they do not conform. A separate procedure exists describing how SAR change notices should be written. Based on the limited review possible, it appears that SAR change notices are being written, when appropriate.
6.	Are SAR change notices written when appropriate?	A	See Item 5, above.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
7.	Is there a system for ensuring that action required as a result of IE bulletins and other licensing commitments is completed?	A	Licensing commitments in the FSAR, ER, and other documents such as letters are listed and tracked on the Licensing Commitments Tracking System.
8.	Have required cold shutdown features for the systems been identified and implemented? Is WNES interface information scheduled and provided in a timely manner?	A	Required cold shutdown features have been identified. Implementation is scheduled to be completed by September 1983.
9.	Is there a formal review process of A-E flow diagrams by WNES?	I	A formal review process exists and review by Bechtel has been performed of WNES P&IDs for the Safety Injection System (1207E17, Sheets 1 through 4). A corresponding review of the Bechtel prepared system P&IDs has not yet been performed by WNES as Rev. 0 of the drawings have not been transmitted to WNES. Bechtel stated informally that they planned to send Rev. 1 of the P&IDs to WNES for review. A "Significant Interface Review Program" with WNES and HL&P is being prepared (draft procedure PED-19, Rev. 0) describing the various project documents to be reviewed by WNES, to be implemented after agreement by Bechtel, HL&P, and WNES.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
10.	Is there a system for monitoring completion of items identified in work packages? Has a schedule for completion been established?	A	Work Package Final Report, Action Items, tracks resolution of these items, including scheduled resolution dates.
11.	Implementation of interlocks and controls for automatic transfer to recirculation; conformance to code and FSAR		(To be completed by Controls/Electrical.)
	Pumps		
12.	Pump matched to system to ensure sufficient net positive suction head at design and runout flow and to ensure proper flow	I	Available NPSH for the high and low head safety injection pumps were calculated and checked against required NPSH in calculation 2N129MC5244 (Attachment 7.1, Item 3C). NPSH for RHR pump has not yet been calculated.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
13.	Will pump minimum flow piping design satisfy manufacturer's flow and interface requirements?	I	The acceptability of the miniflow design has not yet been documented for the high and low head safety injection pumps.
14.	Adequacy of active cooling system for pump bearings, if required; method for supervising bearing oil pressure	NA	
15.	Source of seal water for pump seals in accordance with manufacturer's specification	NA	

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
16.	Code classification transmitted across organizational interfaces	A	P&IDs 5N129F05013 through -F05016 WNES HHSI and LHSI pump E Spec. 952455, Rev. 1, Bechtel valve Spec. 1L529TS0104, Rev. 0, and FSAR Section 6.3 were reviewed.
17.	Pump material selected to be compatible with process fluid within operational ranges for pressure and temperature	A	WNES E-Specification 952455, Rev. 1, was reviewed.
18.	Pump nozzle/attached piping interface consistent	A	WNES Drawing 300-VN49752, Rev. 12, was reviewed against Bechtel P&ID 5N129F05013 through -F05016, Rev. 0.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
19.	Radiation behavior considered in material selection	A	WNES E-Specification 952455, Rev. 1, reviewed.
20.	Loading sequence in diesel generator in agreement with Westinghouse PIP requirements		(To be confirmed in Electrical review.)
21.	Motor and pump capable of withstanding torque created by fast bus transfer		(To be confirmed in Electrical review.)

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
22.	Pump nozzle reaction forces compared with vendor allowables and reconciled with vendor if they have been exceeded	I	Stress Calculation 2N129RC004 generated nozzle reaction forces at the pump suction. Bechtel is awaiting completion of the discharge piping stress analysis before compiling loads and forwarding to WNES, if necessary.
23.	Have WNES installation requirements been considered in A-E installation specification or layout drawing?	I	None available for review.
24.	IE Bulletin 79-15 addressed for HHSI and LHSI pumps	I	Scheduled for evaluation in the "Work Package Final Report: Action Items" report by 3/1/84.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
	Valves	A	Opening and closing times, pressure rating, seat leak tests, etc, specified in ASME III Bellows Seal or Packless Metal Diaphragm Valves 2 in. and under, Specification 1L529TS0104, Rev. 0.
25.	Clearly-specified valve functional requirements (flow capacities, opening and closing time, flow resistances, leak tightness)		
26.	Properly-specified environmental and design conditions	I	Bechtel is in the process of reviewing environmental conditions included in specs. to calculated environments for adequacy.
27.	Are valve stems designed with backseats or flared ends to eliminate possibility of valve stem ejection?	A	Specification 1L529TS0104 was reviewed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
28.	Correct ASME code and quality class specified for valve	A	ASME III Class 2 specified in 1L529TS0104, Rev. 0.
29.	Operator size consistent with specified pressure, temperature, and flow conditions under which it must operate	A	12529TS0104, Rev. 0, specifies design and testing requirements to ensure that the valve can open and close under the conditions specified.
30.	Material composition requirements specified	A	1L529TS0104, Rev. 0 (Section 4.0) reviewed.

*A - acceptable C - concern D - not acceptable NA - not applicable ! - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

Attachment 7.2
Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments**
31.	Specific material compatible with piping in which it is installed and fluid it contains	A	1L529TS0104, Rev. 0 was reviewed (SA351 GR CF8M-SA102 GRF 316)
32.	ALARA considerations included in selection of materials (review of stellite valve seats and seals, etc.)	A	1L529TS0104, Rev. 0 (Section 4.2.2).
33.	Appropriate corrosion allowance incorporated into valve design	NA	

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

** Check against appropriate criteria of attachment 7.1.

ATTENDEES AT POST-REVIEW CONFERENCE HELD JUNE 10, 1983

LIST OF ATTENDEES	REPRESENTING
R.A. Frazar	HL&P - Engineering Assurance
S.M. Dew	HL&P - Manager Engineering
D.L. Carathers	HL&P - Nuclear Systems
M.K. Chakravorty	HL&P - Engineering Assurance
S.R. Basu	HL&P - Engineering Assurance
M.A. Robinson	HL&P - Systems Engineer
E. Rumbaugh	BEC - Project Management
J. Hurley	BEC - Project Engineer
F. Lopez	BEC - Assistant Project Engineer
K.R. Dotterer	BEC - Project Quality Assurance Engineer
A.O. Guidry	BEC - Mechanical Engineer
S.T. Cozzens	BEC - Project Quality Engineer
A. Banerjee	SWEC - Project Engineer
J.F. Harkins	SWEC - Senior Control Engineer
P.W. Day	SWEC - Engineering Assurance Engineer
S.A. Shuman	SWEC - Assistant Project Engineer

Action Item Cover Sheet

Review/assessment subject title: RHR/Safety Injection System, STP

Document no.: 83-2 Review/assessment no.: 83-2

1. Action items prepared by

[signature] 6/22/83
Engineering Assurance Department engineer — Date

N/A
Engineering Assurance Department engineer — Date

2. Action items reviewed by

[signature] 6/23/83
Manager, Engineering Assurance Department — Date

3. Actions pertaining to review/assessment 83-2 have been implemented.

Manager, STP Engineering — Date

4. Implementation of actions has been verified.

Engineering Assurance Department engineer — Date

Engineering Assurance Department engineer — Date

5. All concerns pertaining to review/assessment no. 83-2 have been resolved.

Manager, Engineering Assurance Department — Date

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
1	Stress input preparation The safety injection system pump suction line stress analysis (calc. 2N129RC004) references WNES criteria for piping design, process conditions, and piping requirements. These documents provide some of the information required for stress analysis but not all possible significant operating modes, possible major transients to which the system may be subjected, and the BOP-generated information that must be considered for stress analysis. The responsible system engineer should provide the stress analyst with all possible significant system operating modes so the stress analyst can determine which of the system operating modes to consider for stress analysis. Procedures should be reviewed for specificity to control this activity and produce desired results.
2	WNES interface with Bechtel Procedure GPR 1.3 requires that "selected" design documents generated by Bechtel be sent to WNES for review and confirmation that interface requirements have been fulfilled. These selected documents that need verification by WNES have not yet been identified. The project should expedite development of this list of documents to be reviewed and also establish criteria to be followed in reviewing interface documents, including identification of areas of a document to be reviewed after it is selected.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
3	Interdisciplinary interface on nozzle loads Nozzle loads calculated by pipe stress (calc. 2N129RC004) were not sent to the mechanical group for vendor interface although vendor allowables to confirm the acceptability of the calculated loads were not available. Formal procedures have not been issued to address this or other cases where vendor interface is required. Procedures should be developed to control this activity and produce desired results.
4	Vendor drawing review Vendor drawings are reviewed by the groups responsible for checking interface and technical information. Four series of vendor drawings, one series each for high head safety injection pump, low head safety injection pump, RHR heat exchanger, and RHR pumps, were examined to verify if interdisciplinary review was performed. Of the four series of vendor prints, two were not sent to the civil and structural group for review, although the prints contained information on anchor bolt sizes and mounting bolt loading required to confirm adequacy of anchorage and embedment plate. Bechtel should reassess their interdisciplinary review process for vendor drawings and develop any instructions necessary to ensure that proper interdisciplinary review is performed by affected groups.
5	System calculations to meet WNES criteria Safety injection and RHR system calculations required to confirm piping arrangement, acceptability to WNES layout, and pressure drop criteria have not yet been performed. No evidence was observed that these calculations will be performed. Bechtel should identify and complete these calculations to demonstrate that WNES layout criteria have been met.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
6	Calculation procedure The STP procedure for calculations, EDP 4.37, Rev. 2, does not require a calculation specifically to identify its purpose, scope, or conclusion. This is observed as a weakness in the procedure that has affected electrical calculation 5E010EC5004 for cable ampacity. Procedure EDP 4.37 also is not specific regarding identification of input data that are preliminary and require confirmation at a later date. It is suggested that Engineering Department procedures for preparing calculations be revised to include requirements in the calculation for defining the objective, conclusion, and assumptions that must be verified at a later date.
7	Document review procedure Engineering Department procedures for preparation and review of various design documents currently allow document review notices or equivalent review documents to be discarded, although they are defined as the only documents containing the interfacing groups' approvals. The requirement to discard the DRN should be reconsidered. Alternatively, consideration should be given to changing the procedure to require interdisciplinary concurrence signatures on issued documents.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
8	Procedures on design verification Engineering Department procedures relating to design verification limit the use of an originating group supervisor as reviewer to implement applicable regulatory requirements. However, the limitations are not the same in all procedures, and the terms "immediate supervisor" and "supervisor" are both used without appropriate clarification of intent. Conditions related to using supervisory personnel as reviewers should be consistent in all procedures.

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.

Date action(s) scheduled to be complete: _____

_____ _____

Manager, STP Engineering Date

Design Process Review Checklist*

Part 1 - Design Input

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1A	Are codes, standards, regulatory commitments, and requirements identified? Is their scope of applicability defined in design criteria and lower-level documents?	I	Electrical system design criteria have not yet been issued. Break exclusion criteria at containment penetrations were not specified in criteria document. Reviewed calc. 2N129RC004 for piping stress. This calculation appropriately addressed break exclusion requirements at containment penetrations. Reviewed spec. 4L020PS0100 and 4N129RS1005, Rev. 0. Reviewed spec 9A230ES1008 for installation of electrical cable and raceway, spec. 5A230ES1038 for electrical construction, spec. 3E189ES022-D for control cables, 3E189ES018-D for 5-kv power cable, and 3E189ES020-D for 600-volt power cables.
		A	Appropriate standards have been used in specification and calculations reviewed.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1B	Do design inputs consider all requirements of system criteria?	I	Electrical system criteria have not yet been issued, and hence it was not possible to determine if documents met design criteria. To ensure that worst system operating mode is considered in pipe stress analysis, there is a need for mechanical/nuclear group to transmit all system operating modes to PSSG group.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1C	Do design inputs consider feedback from pertinent industry engineering and construction experience in design documents?	A	The project has three feedback systems: - feedback from bulletins, etc., issued by NRC (Reviewed Bechtel procedure PED 012, Rev. 0, on review of NRC bulletins, circulars, etc., and the tracking documents associated with resolution of NRC notice 82-55 on Westinghouse solid state protection relays.) - problem alert system from discipline chief engineers (Reviewed resolution of problems identified by PIR report LA-83-06, February 9, 1983, on use of RELAP-5 program for pipe support design, LA-83-09, March 23, 1983, on problems associated with DG supplied by Cooper Energy Services, and LA-83-03, January 12, 1983, on Barton models 763 and 764 pressure transmitters.) - problem identification report issued to project by Bechtel corporate committee

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1D	Are changes to approved design inputs documented and approved prior to their use?	I	Could not verify due to lack of design progress in the electrical area.
		A	The pipe stress calculation 2N129RC004, Rev. 1, incorporated changes made through approved DCN 1, which caused revision to P&ID 5N129F05013, 14, and 15, Rev. 0.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2A	Is flow of design information between internal and external organizations controlled and timely? - Bechtel/Westinghouse - Bechtel/HL&P - Bechtel disciplines (internal) - Bechtel/Ebasco - vendor drawing/document control	A	Reviewed the CEBUS on elem. dwg. 9E-S105-001 on HHSI system. The elem. is scheduled for internal review September 1, 1983. The logic is scheduled to be issued July 15, 1983. The seismic input to stress analysis was provided through approved calc. documents (4N169S-39000-39155 and 2C011SC040). Pipe support calculation (2F159JC-5611) considered the latest revision of pipe stress calc. (2N129RC004, Rev. 1).
2B	Are verbal and other infomal means of communication that provide significant design	NA	Documents reviewed for pipe stress analysis and electrical design did not contain data to allow determination of this item.
2C	Is system interaction considered in system design and analysis?	A	From the standpoint of stress analysis, the piping model included the effect of other branch lines (e.g., stress analysis reviewed included 12" CS-1101, 1201, and 1301 in the analysis). Also, piping stress analysis criteria (5L010RQ1002) provided guidance for inclusion or exclusion of branch pipes.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2D	Is design change information coordinated effectively with all affected disciplines?	A	When pipe stress calculation 2N129RC004, Rev. 1, was issued, the corresponding pipe support calculation 2F159JC5611 was also revised to reflect the latest stress analysis.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 3 - Design Process

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3A	Does overall design review process include system design reviews, verification of calculations, methods, and computer runs, and validation of computer codes?	A	Calc. 5E010EC5004, Rev. 0, was reviewed and found to have been verified per procedure. Review of SI pump suction line stress analysis consisted of using a checklist that required verification of input. The computer program used was found to be approved (ME 101, version J2, June 13, 1982). Design in the electrical area has not progressed sufficiently to allow a determination to be made.
3B	Do design documents include scope and applicability as well as identity of originator and checker?	I	Calc. 5E010EC5004, Rev. 0, for cable ampacity was issued for use but did not identify scope or give a summary of how to use the various tables generated by the calc. However, the number of calculations issued was limited, and a definite determination could not be made in the electrical area.
		A	Stress calc. 2N129RC004 included scope, applicability, and identity of originator and checker. Drawing 9P5151 was also initialed by the originator and checker.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 3 - Design Process

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3C	Do calculations and analyses clearly specify information such as applicability, assumptions, design inputs, references, methods, and results?	A	SI pump suction line stress analysis 2N129RC004 specified applicability, assumptions, design inputs, references, methods, and results.
3D	Are design problems identified and decisions made to resolve problems in a timely and effective manner?	I	Stress analysis for SI pump suction analysis calculated nozzle loads developed at CS, LHSI, and HHSI pump nozzles. Bechtel indicated that when the combined suction and discharge nozzle loads are available they will be sent to WNES for verification. Nozzle allowable for 24" nozzle of RWST is not available. Calculated loads at this nozzle were not provided to the engineer responsible for the procurement of RWST for verification. Some design of the electrical system could not meet system voltage regulation requirements; however, resolution of the problem is in a preliminary stage of development.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 4 - Design Output

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4A	Are use limitations for each type of design document clearly defined to assure proper use in development of design and in construction?	I	Prel. calc. EC5008 for Class IE 125-v DC battery and battery chargers contained data that covers 30% load on the inverter marked "based on Engineering judgment." However, the calc. is not stamped "preliminary" to indicate that some data is preliminary. If the calc. is not marked "preliminary" but preliminary data are so marked, this could cause problems in the future.
		A	Spec. 4L020PS0100, for fabrication of ASME III piping 2½" and larger and composite piping, and drawing indicated that they were issued for construction. The composite piping drawing also indicated "holds" in the penetration areas.
4B	Do appropriate design output documents undergo constructability review?	I	General rule is that constructability review is performed in the field after the drawings are issued. The general rule is to issue drawings six months before construction. No electrical or piping drawing for this system has undergone constructability review.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 4 - Design Output

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4C	Are design output documents issued and kept current using a controlled process?	A	Output documents reviewed in pipe stress and pipe support areas were issued in accordance with Bechtel engineering procedures.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 5 - Design Changes

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
5A	Are reasons for change identified and evaluated? If necessary, are actions taken to avoid future problems?	A	Preliminary calculation on voltage drop study 5E019EC5000 identified reasons why some of existing LC transformers need replacement. Specification change notice indicating changes required in spec. 4L020PS0100, Rev. 2, was issued.
5B	Are changes subject to reviews, approvals, and control measures commensurate with those of original design?	A	For pipe stress calculation 2N129RC004, Rev. 1, the same type of review and approval cycle was observed as before issue of Rev. 0 of the calc.
5C	Is a system used to determine whether or not a change being made impacts other parts of the system and other areas of the plant?	A	Bechtel indicated that when a document is changed it undergoes an interdisciplinary review through design review notice (DRN). The responsible group supervisor is responsible for notifying affected organizations when a design document is revised. Pipe support calc. 2F159JC-5611 was revised when stress calculation 2N129RC004 was reissued as Rev. 1.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 5 - Design Changes

Discipline: electrical and pipe stress

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
5D	Are changes, including those initiated by regulation, construction, vendor, or design, properly approved by design organizations (including HL&P, when required)?	I	A study has been initiated whereby in calc. 5E019EC-5001 and EC-5000 various system changes have been suggested. The study has been sent to HL&P, and the exact solution has not been determined yet.
		A	Pipe stress calc. 2N129RC004, Rev. 1, incorporated changes made through approved DCN 1, which caused revision to P&ID 5N129F05013, 14, and 15, Rev. 0.
5E	Are appropriate design changes promptly evaluated by each affected discipline for effect on calculations, analyses, or selection of equipment and material?	A	Same comment as above.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

*All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1A	Are codes, standards, regulatory commitments, and requirements identified? Is their scope of applicability defined in design criteria and lower-level documents?	A	MECH. ASME III Bellows Seal or Packless Metal Diaphragm Valves Specification 1L529TS0104, Rev. 0, were reviewed and found to generally identify the appropriate codes & standards. Design criteria documents also exist for the mechanical portion of these systems.
		A	I&C Spec. for gen. requirements instrumentation construction 5Z689ZS1028, Rev. 0, 1/27/83, Spec. for ASME III control valves 4Z439Z1007, Rev. 0, 4/28/83, Section 4 of both specs. identify applicable codes and standards. NOTE: A set of preliminary wall diagrams (coordination copy of Rev. 0) was reviewed. Review comments on coordination prints are being incorporated on logics prior to issuing Rev. 0. These logics reflect the system as shown on Rev. 0 of the P&ID.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1B	Do design inputs consider all requirements of system criteria?	C	MECH. All applicable inputs and a complete description of each significant system operating mode were not available or used in pipe stress calculation 2N129RC004. In addition, the sources from which the input should be obtained, referenced in the design specification for the safety injection systems, 4N129RS1005, Rev. 0, do not contain all required inputs. System calculations to confirm WNES layout criteria contained in the PIP document (PFI)--FTE-285) have not yet been scheduled or performed (see Continuation Sheet Summary).
		A	I&C W sys. descriptions TGX/THX-284, Rev. 2, 9/81 SI and TGX/THX-293, Rev. 2, 9/81 RHR. BEC- 5R169MQ1021, Rev. 0, 1/12/83 RHR 959129 MQ 1045, Rev. 0, 1/12/83 have been utilized to develop the logic.
1C	Do design inputs consider feedback from pertinent industry engineering and constructions experience in design documents?	A	MECH. Nuclear industry information systems, the Bechtel problem report system, and NRC IE Bulletins, circulars, and Information Notices are used.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 1 - Design Input

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
1C	(Cont'd)		I&C Not observed. PROCEDURES
		A	EDP 4.74, Rev. 2 - Experience Feedback Data establishes a system to assure experience on other plants is considered. Also, GPR 1.3, Rev. 2 establishes requirements for EBASCO review of Bechtel drawings after issue. MECH.
1D	Are changes to approved design inputs documented and approved prior to their use?	A	Rev. 0 to P&IDs 5N129F05013 and 5N129F05014 were reviewed against superceded P&IDs F-5013-J and F-5014-J. Also, DCN 1 to the Rev. 0 P&IDs were reviewed. I&C
		A	Specification Change Notice SCN 1 dated 3/15/83 to Spec. No. 5Z689ZS1027, Rev. 0 1/27/83 includes approval signatures of same people signed the original issue of the spec., plus the signature of the Project Quality Assurance Engineer. PROCEDURES
		A	Refer to response to Item 6E.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

CONTINUATION OF ITEM 1B

Stress Input Preparation

The design specification for the safety injection system piping, 4N129RS1005, Rev. 0 references the WNES system description, SD-TGX/THX-284, and WNES SIS piping design requirements, PFD-FTE-285 (both part of the PIP) for a description of operating modes.

Neither of the above provides a complete description sufficient for purposes of stress analysis. The WNES system description functionally describes how the system operates, but does not describe the operating conditions that result. PFD-FTE-285 provides typical temperatures and pressures during each major mode of operation (e.g., injection, recirculation, etc), but does not describe how the system can operate within that mode, such as during a single failures, etc. The information provided must also be adjusted for plant specific conditions generated as a part of the BOP scope (e.g., the temperature of water in the containment sump generated during A/E containment analysis relates to the temperature of the safety injection system fluid).

The Safety Injection System pump suction line analysis, pipe stress calculation 2N129RC004, was reviewed. The calculation references 5L019PS004, Criteria for Piping Design, ST-NS-BR-0725, an NUS temperature calculation for the containment sump, and the WNES piping design requirements and system description. These provide some of the required information, but not a description of each possible operating mode during each plant condition (normal, upset, emergency, and faulted). Consideration of BOP generated information, such as maximum and minimum RWST water temperatures, coincided with single failure for various operating modes does not appear to be complete. Input information regarding system transients (pump start, valve opening and closing, etc) were not provided or were not used. (Project Procedure 5L010RQ1002 states that transient information should be obtained from the Mechanical Group.) System test conditions were not considered. Pipe break/jet impingement effects have not yet been evaluated, in general, by the Project.

It is, therefore, not clear that all modes of operation were considered in the analysis.

System Calculations to WNES Criteria

Safety injection and residual heat removal system calculations to confirm that piping arrangement meets the WNES layout and pressure drop criteria provided in the PIP document (PFD-FTE-285) have not yet been performed. In addition, they are not yet scheduled in the CEBUS (level 3) schedule dated May 20, 1983. This condition also applies to certain other WNES systems, such as charging and volume control and boron recycle. Brown and Root performed calculations for portion of the containment depressurization syste., but these have not yet been reviewed and found acceptable by echtel.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2A	Is flow of design information between internal and external organizations controlled and timely? - Bechtel/Westinghouse - Bechtel/HL&P - Bechtel/disciplines (internal) - Bechtel/Ebasco - Vendor drawing/document control	C	MECH. Safety Injection System Pump Suction Analysis, pipe stress calc. 2N129RC004, resulted in nozzle loads (for the RWST) for which vendor allowables were not available. The calculated loads had not yet been sent to the Mechanical group for transmittal to the vendor at the time of the audit, approximately one month after completion of the calculation. Vendor drawings for the high and low head safety injection pumps were not provided to the civil/structural group for review, although they contain information essential to design the equipment anchorage. (See Continuation Sheet Summary.) I&C Bechtel/Westinghouse Logic reference W block diagram 8758D76 and utilize W functional control diagrams 8758022 which have not been statused by BEC yet (see Bechtel/Disciplines below).
		I	

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2A	(Cont'd)	I	I&C Bechtel Disciplines (Internal) Electrical separation shown on both logics and P&ID could not be checked since "General Discipline Electrical Design Criteria" "Electrical Systems" 5A969EQ1009, Rev. 0 which includes separation and identification of Cl. IE equip. and ckts. (Para. 3.1.2.8) has not been issued (see Continuation next page). I&C Bechtel/Ebasco Not reviewed. PROCEDURES No sampling was performed to allow a judgement on practice. However, it was noted that Logging Systems, distribution lists, and delinquency reports have been established to control the flow of design information in a timely manner. Refer to list of documents reviewed for identification of the various lists/reports. (Refer to Items 6D, 6F, and 6G.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2B	Are verbal and other informal means of communication that provide significant design information, including letters and memos, confirmed and promptly made a part of design inputs by controlled documents.	I	MECH. Verbal agreement was reached by Bechtel and WNES to delete HCV-921, 922, and 923, and the corresponding piping without a confirmatory letter being planned. It is planned to discuss this item at the next WNES interface meeting and confirm the agreement via the notes of that meeting. This item was being tracked on the NSSS coordinator's Action Item Register. I&C Not observed. PROCEDURES
		I	STP Project Procedure GPR 1.3, Rev. 2, Part A does establish requirements for including telephone/meeting agreements in formal correspondence. Only one example of this was noted during the audit as discussed above.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2C	Is system interaction considered in system design and analysis?		MECH.
		A	A high point in RHR heat exchanger could have resulted in potential for water hammer in the safety injection system. To prevent this possibility, a jockey pump subsystem is being considered in the SIS System to keep the heat exchanger water solid.
			I&C
		NA	The design of a control system for a process considers process interaction in order to select appropriate controls.
2D	Is design change information coordinated effectively with all affected disciplines?		MECH.
		A	The review process for P&IDs and DCNs appears adequate.
			Deletion of the containment pump suction isolation valve encapsulation via DCN 1 to P&ID 5N129F05013, Rev. 0, was transmitted from mechanical to PSSG and incorporated in pipe stress calculation 2N129RC004.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 2 - Design Interfaces

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
2D	(Cont'd)	A	I&C Design change information is coordinated with affected disciplines as illustrated by a set of logic coordination prints issued for the review and comments of the electrical, mechanical, and nuclear groups. A "HOLD" on P&ID of failure mode for control valve was resolved on a document review notice (DRN), therefore the hold was not shown on the applicable valve data sheet Spec. 4Z019Z44712, Sh. 7, Rev. 0 (in review) P&ID 5R209F05017, Rev. 0 4/25/83. Service: CCW disch. from RHR Hx.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Audit Item 2A

Safety Injection System P&ID (5N129F013, Rev. 1, Preliminary) was reviewed to determine if separation group was properly shown for the RWST level transmitters, associated instrumentation, and controls.

Observation

The RWST level transmitters are used to develop actuation logic for automatic switchover to recirculation for the Safety Injection System.

The channel signals and train actuation logic separation appears to be consistent with preliminary separation design criteria (Ref. 4).

Correspondence (Ref. 1, 2, and 3) illustrates BEC's concerns and W's response to those concerns about the appropriateness of a 1/1 switchover logic (used on STP) vs. 2/4 logic used on other plants.

These concerns are summarized as follows: Although the separation may be adequate and licensable, the absence of increased reliability of 2/4 or 2/3 vs. 1/1 initiation of automatic switchover to recirculation could result in severe damage to plant components by early or late initiation of transfer.

Reference

1. ST-YB-WB-0147, 12/1/82, Action Item No. 185
2. ST-WN-YB-263, 2/3/83
3. ST-YB-WN-0281, 6/2/83, Action Item No. 258
4. SA969EQ1009, Rev. 0 (Prelim.) General Discipline Electrical Design Criteria

Design Process Review Checklist*

Part 3 - Design Process

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3A	Does overall design review process include system design reviews, verification of calculations and computer runs, and validation of computer codes?	I	MECH. System design review, computer runs, and computer codes were not reviewed. Vendor installation and operating manuals are not normally reviewed by engineering. The following Vendor operating manuals were entered "For Information Only": RHR Pump - ID-14926-0205(1)00036-AWV LHSI Pump - ID-14926-0205(1)00025-AWV HHSI Pump - ID-14926-0205(1)00026-AWV The project policy is to not review and approve operating manuals. Although the information contained is not normally needed to complete the engineering phase, the information is very valuable during installation, startup, and plant operation. If review of the manuals is delayed until that phase, and purchase orders with the corresponding Vendors have been closed, it would be very difficult and perhaps costly to obtain necessary, missing information.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 3 - Design Process

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
3A	(Cont'd)		I&C
		NA	Not observed.
			PROCEDURES
		A	Procedures establish appropriate requirements - refer item Nos. 6E, 6J, and 6K. Bechtel Procedures EDP 4.27, Rev. 0 (Design Verification) and EDP 4.26, Rev. 0 (Interdiscipline Design Review) were specifically for the review of Bechtel design on a system basis.
			MECH.
3B	Do design documents include scope and applicability as well as identity of originator and checker?	A	Preliminary calculation 2N129MC5244, Safety Injection Pump, and Specification 1L529TS0104 were reviewed.
			I&C
		A	Logics include scope and applicability by general note which indicates that they represent functional requirements only. There are signature blocks for DFT, CKR, GL, EGS, and PEM for Rev. 0 and subsequent revisions.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 3 - Design Process

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
3C	Do calculations and analyses clearly specify information such as applicability, assumptions, design inputs, references, methods, and results?	A	Calculation 2N129MC5244 was reviewed and although not fully clear in all respects, it did appear to reach the correct conclusion. Calculation format attributes were adequate. No other calculations were available for review.
			I&C
		NA	I&C calculations are typically done by manufacturer to size his equipment based on data sheets for that equipment.
			PROCEDURES
		C	Refer to Item No. 6J.
			MECH.
3D	Are design problems identified and decisions made to resolve problems in a timely and effective manner?	A	Problems identified in the work packages have been resolved or are being evaluated. Certain of those problems remain and are scheduled for completion later in 1983 or 1984.
			I&C
		A	See 2D.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 4 - Design Output

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4A	Are use limitations for each type of design document clearly defined to assure proper use in development of design and in construction?	A	MECH. System P&IDs and valve Specification 1L529TS0104 were reviewed.
		A	I&C See 3B; holds are utilized on logics (see Z42011, 42012, 24 & 25) to limit use of logic.
4B	Do appropriate design output documents undergo constructability review?	I	MECH. Normally, design output drawings undergo a constructability review by EBASCO only after issue. The project attempts to issue drawings 6 months prior to installation to allow time for this review, however, at the present time, there is only a 2 month lead time. This may not be enough time to allow problems found to be resolved without impacting the schedule. Construction Specialist involvement in preparation, perhaps during checking, particularly as long as there is a short lead time, may prevent construction delays.
		NA	I&C Not observed.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 4 - Design Output

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4C	Are design output documents issued and kept current using a controlled process?	A	MECH. System P&IDs, specifications, and corresponding DCNs and SCNs were reviewed. Project procedures (e.g., EDP-4.47) require revisions within specified periods of time. I&C
		A	- Verified that issued logics are tracked on the design document register and in CEBUS log (4/22/83 issue). - See 2D for discussion of hold on control valve. - Spec change notices have been issued for the following specs.: Instrument Tubing Installation, Seismic Cat. 1 42519ZS10, Rev. 0, 3/10/83, SCN No. 1, 3/29/83 Gen. Requirements, Instrument Construction 5Z689ZA1027, Rev. 0, 1/27/83, SCN No. 1, 3/15/83.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 4 - Design Output

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
4C	(Cont'd)		PROCEDURES The BEC EDP for Drawings and Specification (EDPs 4.46 and 4.49) establish review and approvals prior to issue. They also establish Change Notice Systems (DCNs and SCNs) to allow changes to be made quickly. These documents are tracked for incorporation within specified time limits.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 5 - Design Changes

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
			MECH.
5A	Are reasons for change identified and evaluated? If necessary, are actions taken to avoid future problems?	A	Reasons for change to drawings are identified on revision reports.
			I&C
		A	A revision report is issued for each revision of document. The Revision 0 report will indicate changes from superseded B&R drawing.
5B	DELETED		
			MECH.
5C	Are changes subject to reviews, approvals, and control measures commensurate with those of original design?	A	DCN 1 to system P&IDs and Addendum 1 to valve Specification 1L529TS0104 were reviewed. Revisions to drawings get consistent reviews and approvals.
			I&C
		A	Review and approval signoff blocks are used for all revisions to document (see 1D for discussion of SCN).
			PROCEDURES
		A	Refer to Item No. 6F.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 5 - Design Changes

Discipline: Mechanical/Instrumentation & Controls/Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
5D	Is a system used to determine whether or not a change being made impacts other parts of the system and other areas of the plant?		MECH.
		I	A system to ensure this is not known. Project drawings are routed to interfacing disciplines at the discretion of the originating EGS.
			I&C
			Review noted in 2D.
5E	Are changes, including those initiated by regulation, construction, vendor, or design, properly approved by design organizations (including HL&P, when required)?		MECH.
		A	Changes to applicable P&IDs were properly approved.
			I&C
		A	- Work Package Report EM402 10/29/82 findings Paragraph 1.1A&B, RHR pump suction isolation valve remote shutdown capability and closure alarm are shown on logic diagrams 42182, Rev. 0 (Preliminary). - SAR Change Notices 33, 8/9/82, and 67, 9/24/82 have been incorporated on logic Z42029 and Z42005.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6E	BECHTEL DESIGN DOCUMENTS (CONT'D)		Need for review by other groups is determined by the originating group supervisor on a revision-by-revision basis. Documents containing interfacing group supervisor concurrence signatures are not retained (see Continuation Sheet Summary, attached).
6F	Do procedures establish requirements for review of Bechtel documents by external organizations, when required (NSSS, HL&P) including the following:		Requirements for limiting the use of supervisors for design verification reviews is not always consistent. (See Continuation Sheet Summary, attached.)
	° Identification of the Bechtel documents that require external review and the reviewing organization.	C	° GPR 1.3 establish interface between major organization and is signed by them to indicate agreement. GPR 1.3, Section B and Section C, identify the Bechtel document that requires review by HL&P and EBASCO, respectively. GPR 1.3, Section A, Para. 5.4 requires that "selected" Bechtel documents be reviewed by the NSSS supplier. However, no specific list of documents has been issued (see Continuation Sheet Summary, attached).

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results: Adequacy**	Review Results: Observations/Comments
6F	BECHTEL DESIGN DOCUMENTS (CONT'D)		
	° Methods for tracking the status of documents sent for external review and accountability for comments received through the process of resolution and incorporation into affected documents, when required.	A	° Indices and logs identified in the list of documents reviewed provide appropriate accountability.
	Do procedures establish requirements for review of changes to Bechtel documents in the same manner as the original issue?	A	See list of documents reviewed. EDPs reviewed contained requirements for reviewing changes in the same manner as the original issue, except Change Notice forms, which did not get all approvals. However, approval process used was considered appropriate.
	BECHTEL DESIGN DOCUMENTS (CONT'D)		
6G	Do procedures include requirements for control of approved documents (e.g., numbering, indices, files, status markings, distribution) that assure current approved documents areused by affected organizations and superseded documents are discarded or marked to prevent misuse?	A	- EDP 4.46 - Drawings and EDP 4.37 - Calculations, do contain requirements for use of status markings (see Item 6J) concerning calculation markings. - EDP 4.46, Section 6.4, requires the use of the drawing index to verify current Rev. information prior to use of uncontrolled copies.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6G	BECHTEL DESIGN DOCUMENTS (CONT'D)		- EDP 4.46 and 4.37 generally address numbering. GPR 2.4 addresses calc. numbering in detail. - Project Filing System is described in GPR 2.3. - A master distribution matrix for design documents is developed according to GPR 2.4. It was noted that only calculation logs are distributed, not calculations. EDP 4.37 - "Calculations" does not require distribution of calcs. - Design Criteria are distributed in controlled copies of manuals. A list of manual holders is maintained and updated indices are sent with each update.
6H	Do procedures assign responsibility for the review of Bechtel design documents for conformance to FSAR requirements and establish a system for documenting needed FSAR changes in a timely manner?	A	A review of EDP 4.1 - Design Criteria, EDP 4.46 - Drawings, EDP 4.49 - Specs., EDP 4.47 - DCNs, and 4.23 - SAR Change was performed. Generally, procedures mention that originators/reviewers must consider FSAR requirements, but they do not include specific statement the SAR Change Notices shall be written. Also, EDP 4.23 is not referenced. The lack of this information in each EDP was not considered significant.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
6H	BECHTEL DESIGN DOCUMENTS (CONT'D)		NOTE: S. Shuman indicated that his review of Mechanical Group practice regarding issuing design changes on P&IDs and specs. was to first issue an FSAR Change Notice.
6J	Do procedures establish requirements for the documentation of calculations including: ° Objective ° Method of Analysis/Formulae ° Computer Code (When Used) ° Inputs ° Assumption with an indication of those requiring reverification ° Results/conclusions	C	EDP 4.37, Rev. 1 STP - 10/5/82. The procedure is not definitive in regard to the contents of calculations. Methods, inputs/assumptions, and computer codes were generally covered. However, there was no mention of objective, conclusions, or positive identification of assumptions requiring confirmation at a later date. These three items are specifically discussed in ANSI N45.2.11, Section 4.2, and should be specifically addressed by this EDP. NOTE: According to S. Basu, some electrical calculations were deficient in this regard. Refer Electrical Audit Checklist. (See Continuation Summary Sheet, attached.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results	
		Adequacy**	Observations/Comments
	PROCEDURES DEFINING INTERFACES WITH EXTERNAL ORGANIZATIONS (CONT'D)		EQUIPMENT SUPPLIERS (CONT'D)
6P	Do procedures identify the types of NSSS documents that require Bechtel engineering review and the organizations most responsible for performing the review?	A	Satisfactory based on review of the following: • GPR 3.1, Section 5.0 • PIP Documents (NSSS Coordinator's copies contain current W indices by Shop Order and PIP documents.) • Supplier Document Review Tracking Log and Delinquency Reports • EDP 4.58 - Specifying and Review... Supplier Documents
6Q	Are time limits established to provide for timely processing of documents?	A	Time limits are set and delinquency reports are issued, based on review of the Delinquency Reports listed in the "List of Documents Reviewed."
6R	Do procedures establish controls (logs, files, distribution) that assure current, Bechtel approved documents are used in developing interfacing designs?	A	Logs are developed and distributed. Distribution lists maintained for the various documents received from Vendors including the NSSS. The index of Vendor documents was reviewed - it is published by Records Mgt. and distributed to appropriate personnel. Delinquency reports are issued also. Refer 6Q.

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Process Review Checklist*

Part 6 - Procedures

Discipline: Procedures

Item No.	Review Items	Review Results: Adequacy**	Review Results: Observations/Comments
6R	PROCEDURES DEFINING INTERFACES WITH EXTERNAL ORGANIZATIONS (CONT'D)		EQUIPMENT SUPPLIERS (CONT'D) Vendor document files are maintained by Records Mgt. who provides copies to Engineers for review and use.
	HL&P PROJECT REVIEW OF BECHTEL DESIGN DOCUMENTS		
6S	Have procedures been established to describe the responsibility and method of receiving and processing Bechtel design documents requiring HL&P review/approval?	A	HL&P Procedure PEP-3.01, Rev. 2, "Performance of Owner's Review"
6T	Do the procedures identify the types of Bechtel documents that require HL&P review and the disciplines required to perform the review?	A	GPR 1.3, Rev. 2, 3/15/83, Section B identifies the Bechtel documents requiring HL&P review/approval before issue (P&IDs and one lines) and those requiring HL&P review after issue by Bechtel.
6U	Have responsibility and methods been established for tracking the status of HL&P comments through satisfactory resolution by Bechtel?	A	HL&P maintains status logs for Bechtel documents sent for HL&P review/approval that track in-house action through completion. HL&P also maintains an open items list showing letters sent to Bechtel (e.g., HL&P Comments) that require action by Bechtel. (Refer to List of Documents Reviewed.)

**A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

* All document identification shall be included in this list.

Design Interfaces - BECH/WNES

The NSSS interface, including the Procedure No. GPR 1.3, was reviewed. It has been verified that upon receipt of a W drawing, Bechtel statuses the drawings and comments are sent to W via a letter. The letter is given an action item number by the NSSS Coordinator and is tracked on computerized index. The drawings received from W during B&R time are being statused by BPC as a backfit effort.

The Procedure No. FPR 1.3 requires that "selected" design documents generated by Bechtel be sent to W for review and confirmation.

It was noted during the audit that interspace requirements have been met. It was noted during the audit that the specific BPC documents that need to be sent to W have not yet been defined. Bechtel has stated that STP is presently in the process of establishing the ground rules for identifying the A/E documents requiring W verification.

It is noted that P&ID, Rev. 0 for RHR/SI system has been issued and ~~RWI~~ Rev. 1 is in the process of being issued imminently. The Bechtel P&ID, Rev. 0 was not sent to W to verify if W interphase requirements have been met by Bechtel. Since P&ID is a basic document which provides input for further progress of other disciplines design work, it is our concern that without W formal review of this document, there is a potential for not meeting the intent of W design criteria.

Calculation Procedures

A review of Bechtel EDP 4.37, Rev. 2 STP revealed that no specific requirements are included for the inclusion of a statement of the calculation "objective" and "conclusions" reached after an evaluation of the calculation results. These areas were weaknesses in the electrical calculations reviewed by S. Basu (HL&P) during the audit. The EDP also was not specific regarding the identification of inputs/assumptions requiring confirmation at a later date. These areas are addressed by Section 4.2 of ANSI N45.2.11 which addresses the contents of procedures on design analysis.

It was noted that a method of identfying calculations containing inputs that are not final has been established. Such calculations are marked "Preliminary." However, the specific inputs that caused the use of this marking is not required to be identified. Further, clarification of this marking is also needed and is underway in a draft of EDP 4.37, Rev. 3 STP due to the fact that two separate uses of the marking currently exist.

Component Checklist†

Discipline: mechanical

Item No.	Review Results	Review Items	
		Adequacy*	Observations/Comments**
1.	Is the system layout consistent with NSSS vendor layout criteria? Have system friction losses been calculated using NSSS L/D criteria?	C	The system layout has not yet been evaluated against WNES layout criteria provided in the WNES PIP documents (PFD-FTE-285 for this system) or other WNES systems. (See Attachment 7.1, Item 1B.)
2.	Are inputs that require confirmation identified?	A	Inputs which require confirmation were indicated in calculation 2N129MC5244.
3.	Are environmental conditions specified for equipment consistent with A-E building analysis?	I	The environmental conditions specified, and the ability of the existing equipment to be qualified to those environmental conditions is presently being evaluated by Bechtel.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
4.	Is stress input, including system operating conditions, load combinations, and applicable transients, provided to the pipe stress analysts?	C	Stress input, including the various significant system operating conditions and applicable transients, are not adequately being provided to the stress analysts at this time. (See Attachment 7.1, Item 1B.)
5.	Are revisions to specifications and drawings reviewed against the SAR?	A	EDP-4.46 states that drawing changes should be reviewed by the initiating group for conformance to licensing commitments, but does not say what should be done if they do not conform. A separate procedure exists describing how SAR change notices should be written. Based on the limited review possible, it appears that SAR change notices are being written, when appropriate.
6.	Are SAR change notices written when appropriate?	A	See Item 5, above.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
7.	Is there a system for ensuring that action required as a result of IE bulletins and other licensing commitments is completed?	A	Licensing commitments in the FSAR, ER, and other documents such as letters are listed and tracked on the Licensing Commitments Tracking System.
8.	Have required cold shutdown features for the systems been identified and implemented? Is WNES interface information scheduled and provided in a timely manner?	A	Required cold shutdown features have been identified. Implementation is scheduled to be completed by September 1983.
9.	Is there a formal review process of A-E flow diagrams by WNES?	I	A formal review process exists and review by Bechtel has been performed of WNES P&IDs for the Safety Injection System (1207E17, Sheets 1 through 4). A corresponding review of the Bechtel prepared system P&IDs has not yet been performed by WNES as Rev. 0 of the drawings have not been transmitted to WNES. Bechtel stated informally that they planned to send Rev. 1 of the P&IDs to WNES for review. A "Significant Interface Review Program" with WNES and HL&P is being prepared (draft procedure PED-19, Rev. 0) describing the various project documents to be reviewed by WNES, to be implemented after agreement by Bechtel, HL&P, and WNES.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
10.	Is there a system for monitoring completion of items identified in work packages? Has a schedule for completion been established?	A	Work Package Final Report, Action Items, tracks resolution of these items, including scheduled resolution dates.
11.	Implementation of interlocks and controls for automatic transfer to recirculation; conformance to code and FSAR	I	Not available for review
	Pumps		
12.	Pump matched to system to ensure sufficient net positive suction head at design and runout flow and to ensure proper flow	I	Available NPSH for the high and low head safety injection pumps were calculated and checked against required NPSH in calculation 2N129MC5244 (Attachment 7.1, Item 3C). NPSH for RHR pump has not yet been calculated.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
13.	Will pump minimum flow piping design satisfy manufacturer's flow and interface requirements?	I	The acceptability of the miniflow design has not yet been documented for the high and low head safety injection pumps.
14.	Adequacy of active cooling system for pump bearings, if required; method for supervising bearing oil pressure	NA	
15.	Source of seal water for pump seals in accordance with manufacturer's specification	NA	

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
16.	Code classification transmitted across organizational interfaces	A	P&IDs 5N129F05013 through -F05016 WNES HHSI and LHSI pump E Spec. 952455, Rev. 1, Bechtel valve Spec. 1L529TS0104, Rev. 0, and FSAR Section 6.3 were reviewed.
17.	Pump material selected to be compatible with process fluid within operational ranges for pressure and temperature	A	WNES E-Specification 952455, Rev. 1, was reviewed.
18.	Pump nozzle/attached piping interface consistent	A	WNES Drawing 300-VN49752, Rev. 12, was reviewed against Bechtel P&ID 5N129F05013 through -F05016, Rev. 0.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
19.	Radiation behavior considered in material selection	A	WNES E-Specification 952455, Rev. 1, reviewed.
20.	Loading sequence in diesel generator in agreement with Westinghouse PIP requirements	I	Loading sequence is not yet final.
21.	Motor and pump capable of withstanding torque created by fast bus transfer	I	Design for fast bus transfer is not yet final.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
22.	Pump nozzle reaction forces compared with vendor allowables and reconciled with vendor if they have been exceeded	I	Stress Calculation 2N129RC004 generated nozzle reaction forces at the pump suction. Bechtel is awaiting completion of the discharge piping stress analysis before compiling loads and forwarding to WNES, if necessary.
23.	Have WNES installation requirements been considered in A-E installation specification or layout drawing?	I	None available for review.
24.	IE Bulletin 79-15 addressed for HHSI and LHSI pumps	I	Scheduled for evaluation in the "Work Package Final Report: Action Items" report by 3/1/84.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
	Valves	A	
25.	Clearly-specified valve functional requirements (flow capacities, opening and closing time, flow resistances, leak tightness)		Opening and closing times, pressure rating, seat leak tests, etc, specified in ASME III Bellows Seal or Packless Metal Diaphragm Valves 2 in. and under, Specification 1L529TS0104, Rev. 0.
26.	Properly-specified environmental and design conditions	I	Bechtel is in the process of reviewing environmental conditions included in specs. to calculated environments for adequacy.
27.	Are valve stems designed with backseats or flared ends to eliminate possibility of valve stem ejection?	A	Specification 1L529TS0104 was reviewed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
28.	Correct ASME code and quality class specified for valve	A	ASME III Class 2 specified in 1L529TS0104, Rev. 0.
29.	Operator size consistent with specified pressure, temperature, and flow conditions under which it must operate	A	12529TS0104, Rev. 0, specifies design and testing requirements to ensure that the valve can open and close under the conditions specified.
30.	Material composition requirements specified	A	1L529TS0104, Rev. 0 (Section 4.0) reviewed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: mechanical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments'
31.	Specific material compatible with piping in which it is installed and fluid it contains	A	1L529TS0104, Rev. 0 was reviewed (SA351 GR CF8M-SA102 GRF 316)
32.	ALARA considerations included in selection of materials (review of stellite valve seats and seals, etc.)	A	1L529TS0104, Rev. 0 (Section 4.2.2).
33.	Appropriate corrosion allowance incorporated into valve design	NA	

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
1.	Design specification adequately describes design basis of piping system being reviewed and properly identifies ASME boundaries and applicable ASME Code edition, addenda, and cases.	A	ASME III design specification on SI system (4N129RS1005, Rev. 0, 2-3-83) established the design basis by reference to various design criteria documents. ASME Code editions and addenda were specified. Code boundaries were established by referencing P&IDs.
2.	Isometric used for stress analysis matches piping drawing and latest flow diagram.	A	Stress analysis of SIS pump suction line (2N129RC004, Rev. 0) was based on fabrication isometrics (SI 1101 sh 1-5, SI 1201 sh 1-3, SI 1301 sh 1-3, CS 1101 sh 1, CS 1201 sh 1, and CS 1301 sh 1), which made reference to piping composite and P&ID. Latest DCN 1 on the P&ID 5N129-05013, 14 and 15, Rev. 0, was incorporated in the analysis.
3.	Isometric shows all supports and code classification of the line.	A	Analysis stress isometric indicated location of the supports. Code classifications shown in the P&ID were properly interpreted in the analysis.

*A - acceptable C - concern D - not acceptable NA - not applicable I - Indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
4.	Comparison of design parameters listed on isometric with those in design documents	NA	Fabrication isometrics do not list all the design and analysis requirements. Input parameters were listed in various design documents.
5.	The different operating modes as specified in design specification are addressed in the analysis. Thermal cycles are properly defined.	I	The design specification provided only the ASME definition of different plant operating conditions. For obtaining the actual system operating condition, the design specification referred to various documents. Whether all the significant operating modes were considered in the analysis could not be determined from the stress input used by the stress analysts. There is a need for the system engineer to compile all operating system conditions and transmit those to the pipe stress group to assure that no system operating mode is overlooked.
6.	Approved design guides and standards are used for the analysis.	A	Approved standards and criteria (e.g., piping stress analysis criteria, 5L010RQ1002, and criteria for piping design, 5L019PS004) were used in the stress analysis.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
7.	Adequacy of OBE/SSE floor response spectra curves used in the analysis	A	Floor response spectra curves were obtained from approved document 4N169S-J900039155, Rev. 1.
8.	Number of earthquake cycles is properly defined and considered in the analysis	NA	Number of earthquake cycle is defined in the piping stress analysis criteria (5LO10RQ1002). However, fatigue analysis is not required to be performed on the portion of the SI system reviewed.
9.	Damping values used for seismic analysis are consistent with Reg. Guide 1.61.	A	Damping values specified in the piping stress analysis criteria are in compliance with Regulatory Guide 1.61.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
10.	Seismic anchor movements are considered in the analysis.	A	Seismic anchor movement and building settlement were considered in the analysis as evidenced by the stress summary contained in page 24 of calc. 2N129RC004.
11.	Proper pipe support stiffness is used	A	Pipe support stiffness to be used for dynamic analysis is specified in 5L010RQ1002. Review of calculation (2N129RC004) indicated compliance with this requirement.
12.	Use of correct pipe material, size, corrosion allowance, and thermal expansion coefficients	A	Criteria for piping design (5L019PS004) listed the material specification including corrosion allowance. Stress calculation (2N129RC004) used the appropriate material and pipe spec.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
13.	Analysis meets W requirements, if applicable	I	Stress analysis determined the loads at W equipment nozzle, and the calculation noted that these loads will require verification from W for acceptability. Stress calculation referred to other W requirements, e.g., WNES system description.
14.	Anchor movements reflect vendor data and thermal movements.	A	Analysis calculated the anchor movement at the component nozzle.
15.	Use of properly-enveloped response spectra	A	Response spectra curves (4N169S-3900-39155) issued as controlled drawing contained spectral information for all Category 1 structures. Input response spectra for pipe stress analysis were enveloped.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
16.	Lumped mass dynamic model adequately reflects piping system considered and meets requirements of applicable design guide.	A	Lumped mass dynamic model as shown in the stress isometric is considered adequate. Masses were lumped between and at the support locations.
17.	Analysis meets requirements of Reg. Guides 1.92 and 1.122.	A	Pipe stress analysis criteria (5L010RQ1002) required compliance with Reg. Guide 1.92. Reg. Guide 1.122 is not applicable here, since pipe stress analysis did not generate any amplified response spectra.
18.	Branch connections are identified, and there are criteria for including/ excluding connected piping in the model.	A	Branch connections were identified in stress isometrics. Also piping stress analysis criteria (5L010RQ1002) provided criteria for inclusion/exclusion of branch pipe in the piping model.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
19.	Dynamic model and seismic analysis meet FSAR requirements.	A	Dynamic analysis performed for the SI pump suction lines utilized a response spectrum approach that is consistent with FSAR requirements.
20.	Consideration of differential building movement	A	Differential building movement was taken into account in the stress analysis, as evidenced in calc. 2N129RC004.
21.	Adequacy of valve modeling	A	Eccentricity between the CG of the valve and the pipe centerline was taken into account by including a member connecting the valve CG and the pipe centerline at the valve location. Valve properties used in the analysis generally comply with valve drawing reviewed (8373D92).

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
22.	Load combinations are in accordance with FSAR and design specification.	A	Loading combinations and allowable stresses for Class 2 and 3 piping as specified in design criteria are in compliance with FSAR.
23.	Allowable stresses are within acceptance criteria of FSAR and ASME Code.	A	See above.
24.	Valve accelerations are within allowable limit.	A	Piping stress analysis (2N129RC004) contained the valve responses. These were compared with the W allowable accelerations.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
25.	Compliance with break exclusion criteria at containment penetration	A	Although the piping stress design criteria and the design specification did not state design requirements that have to be satisfied in the break exclusion zone (containment penetration area), the pipe stress analysis complied with break exclusion criteria. The SI system analyzed was considered as a moderate energy system.
26.	Consideration of transient loads (valve closure/opening, relief valve thrust, etc.) on the analysis, if required	I	Transient loads due to valve closing/opening are required to be included in the analysis per design criteria (5L010RQ1002). The stress calculation reviewed (2N129RC004) indicated that these types of transient are not applicable to this portion of the piping. However, the stress calculation did not give the basis for this assumption.
27.	Nozzle loads are within specified limit.	I	Stress calculation indicated that the nozzle load developed at W equipment will be verified. Also, the nozzle allowable at RWST is not available for comparison.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: pipe stress

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
28.	Calculation documents are properly indexed and adequately substantiate the assumptions and analysis performed.	A	The calculation document reviewed described the purpose, method of analysis, assumptions, and stress summaries. The calculation was checked and approved.
29.	Computer programs used in the analysis are identified and have been issued for STP use.	A	The computer program used in the stress analysis (ME 101, version J2, 6-13-82) was found to be an approved computer program.
30.	Consideration of functional capability requirements, if applicable	NA	Stress analysis reviewed did not use any special stress acceptance criteria under faulted condition for functional capability. As per FSAR and criteria document, this was not committed to as a requirement. Stresses developed at the ends of active valves were checked against the allowable specified.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
	circuit breakers and motor controllers		
1	Does the circuit breaker continuous current rating exceed the load rating of the load? a) at 100% voltage at the load? b) at 90% voltage at the load?	A	The breaker sizing for RHR heat removal pump 2R161NPA101B and pressurizer heater 1R11NPZ01A was reviewed and found adequate.
2	a) Are overload protections provided at the 4.16 kv and 480 volt buses? b) Are overload protections provided for annunciation? alarm? c) Does this protection meet the requirements of PSB-1?	I	In the FSAR we have committed to provide secondary uv relays for annunciation and subsequent trip. The present B&R design does not incorporate this feature. Bechtel is in the process of revising the existing B&R design. Elem. diag. 9-E-PK01-01 is expected to identify the two sets of uv relays. One-line diagram 9-E-PKA-A-01 does indicate the two sets of uv relays; however, the one-line diagram has not yet been issued.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
3	Is locked rotor protection trip breaker fast enough to prevent trip of incoming line breaker?	I	The design has not progressed far enough to provide any documentation for verifying protection coordination.
4	Is locked rotor protection slow enough to permit motor to start?	I	See above.
5	Are short circuit protection trips fast enough to clear fault at the load end to prevent tripping of the incoming breaker?	I	See above.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
6	a) Is 4.16 kv bus provided with under-voltage protection? b) What kind of relaying is used for fast bus transfer?	I	The existing system is under modification.
7	Are the CT terminals at the 4.16 kv switch-gears the automatic shorting type?	A	Specification 8E159ES011-D, Section 3.2.4, indicates shorting type terminals.
8	Per W requirements, motors must start at 80% voltage; can DG provide this voltage at all conditions? Does the DG sequence timing meet W requirements?	I	The existing B&R-designed system does not meet the 80% voltage requirements under all conditions. Bechtel has provided HL&P with alternate proposals to change the system to meet voltage criteria. Prel. calcs. EC-5000 and -5001 identify the study results. Bechtel is in the process of verifying adequacy of voltage being provided by the diesel generator at the load end.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
9	Is secondary protection adequate to meet I^2Rt characteristics of containment penetration?	I	The mcc breaker is being provided with double breaker. The 460 v and 13.2 kv motors, etc., are under evaluation. Elec. calc. EC5025 is expected to provide this calc. Expected date of completion is August 24, 1983.
10	Design criteria require equipment to be qualified to IEEE 344-1975; are all Class IE equipment specifications upgraded to this requirement?	I	Per criteria for environmental qualification, the equipment that is qualified to IEEE 344-1971 and EICSB-10 will be reviewed against IEEE 344-1975.
11	Verify pick-up voltage rating of 480 volt starter. Can DG provide this voltage at worst case conditions?	I	The DG manufacturer has been contacted on the new load list and timing. W is being apprised of the proposed change.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
12	Check to determine if 480 volt circuit breakers supplying power to MOV are provided with thermal OL. If thermal OLs are provided, how do they meet regulatory requirements?	I	Reviewed drawing 9E-RH02-01, Rev. A. The thermal OLs are annunciated. The final elementary diagram for any Class IE valve has not yet been issued.
13	Check interchangeability of circuit breakers. If Class IE and non-Class IE are interchangeable, how is it assured that a non-Class IE circuit breaker is not interchanged with a Class IE circuit breaker?	A	5 kv IE breakers are Brown Boveri (ITE); the non-IE breakers are GE. The manufacturer of the 480-volt class IE breakers is also different from that of non-class IE breakers.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

+ All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
14	Are redundant circuit breaker components not exposed to common hazards like missile or fire?	I	The switchgear E1A is at elevation 10'-0"; switchgear E1B is at elevation 35'-0", and switchgear E1C is at 60'-0". The location of remote shutdown panel and transfer switches is not yet final.
15	Verify that in the event of fire in the cable spreading room alternate control can be provided from the hot shutdown panel independently for loads connected to the hot shutdown panel.	I	The location of the alternate shutdown panel as well as the method of isolation (i.e., location of isolation switch, etc.)are not yet final.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
16	Check the control of HH and LH valves, and verify dual control from control room and hot shutdown panel.	I	Elementary diagram in not final. There is no documentation to verify adequacy of the design.
17	Verify how anchor bolt for 5 kv switch-gear was coordinated between equipment qualification and installation specification.	I	The specification does not require bolts to be provided. Equipment qualification report EN-604 package (E159XR1323BGU) requested sizing and bolting details. The matter has not yet been resolved.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
18	Verify how dynamic seismic load as provided by manufacturer of unit substation was coordinated with installation of equipment foundation in unit substations.	I	In drawings 9178D24 and 25, W identified both sizes, which did not match with the mounting used in equipment qualification 4114-00015-C. Bechtel has also found that bolt sizing by W is inadequate. The matter is under investigation.
19	With impedance of load center at 8%, verify adequacy of voltage at the remote end of 480 volt system.	I	Bechtel calc. 5E019EC5000 indicates that the 480-v loads connected to the load centers may not meet 80% minimum voltage under all conditions. Bechtel is proposing to replace the LC transformers connected to Class IE buses with 4% impedance transformers. The design is not final.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
	electric cable		
20	Cable sizing/voltage drop calculations for the following: a) Load amperage correctly selected. b) Ambient temperature correctly selected. c) Voltage drop considered. (Motor is expected to start at 80%. Can system provide this value at the load end?) d) Cable sized to withstand short circuit current without damage.	I	The calculation is not final. Not enough documentation is available to draw any conclusion.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
20 cont'd	e) Cable sized to carry minimum of 125% full load current.	I	
	f) Has cable been specified so that it can withstand the worst radiation dose or submersion?	I	
21	Cable-pulling tension calculations showing: a) Actual length used for calculation is equal to or greater than length listed in EE 580.	I	There is not enough documentation to arrive at any conclusion.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: electrical

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
21 cont'd	b) Review procedure used for controlling maximum pull tension specified by vendor (e.g., maximum pull tension specified for 600 volt power cable).	I	
	c) Is vendor value for coefficient of friction equal to or less than value in calculation?	I	
	d) Is vendor value of cable weight/foot equal to or less than value in calculation?	I	

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
	Control valves		
1.	Clearly-specified valve functional requirements (flow capacities, valve flow characteristics, leak tightness, valve accessories)	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.
2.	Properly-specified environmental and design conditions	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.
3.	Correct ASME code and quality class specified for valve	A	References 3, 4, 5, and 10 were reviewed to determine adequacy.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
4.	Valve actuator/operator requirements correctly incorporated into the design	A	See Attachment 7.1, Item 2D, for observation of control valve failure mode (Ref. 5 and Ref. 9).
5.	Specific material compatible with piping in which it is installed and fluid it contains	A	Piping Spec., P&ID, and Valve Data Sheets were compared to determine adequacy.
6.	Valve and actuator weight furnished by manufacturer	A	Ref. 15 and Ref. 8 show weights.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
7.	Installation requirements considered in installation specification or layout drawing	NA	Not observed.
	Instrument tubing		
8.	Consistent listing of the following items in design specifications, engineering criteria document, and installation specifications: a) Tube and fitting material specified	A	Ref. 7 and Ref. 6 both refer to 4Z519ZS1019 and drawing 9Z10030 for materials.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
8.	b) Design temperature and pressure specified	NA	Not observed.
	c) Temperature and pressure specified same as process line to which tubing is connected	A	Ref. 6 refers to piping line list for applicable press. and temp.
9.	Consistent listing of the following in W requirements, A-E design criteria, and installation specification a) Minimum slope specified	A	Paragraph 5.22, Ref. 7, and Paragraph 6.4.1.12, Ref. 6.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
9.	b) Separation criteria specified	A	Criteria specified in Ref. 7, Paragraph 5.2.3 and Ref. 6, Paragraph 6.6.6 separation divisions are separated in instrumentation index Ref. 16.
	c) Routing criteria specified to minimize possibility of damage to lines from missiles, falling objects, etc.	A	Paragraph 6.3, Ref. 6.
10.	Consistent listing of the following in W design specification, A-E design criteria, and installation specification		
	a) High point vents and low point drains specified	A	Paragraphs 6.4.2.4, 6.4.2.5, and 6.2.7 of Ref. 6.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
10.	b) Bend radius specified	A	Paragraph 6.6.4.8, Ref. 6 and Paragraph 5.2.4, Ref. 7.
	c) Connections specified for test and calibration	A	Typical installation detail shows test and calibration connections.
	d) Quality class and code category specified	A	Ref. 16.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
10.	e) Hydrostatic test specified	A	Paragraph 7.2, Ref. 6.
	f) Safety lines identified	A	Identification of safety lines is through the associated instrument mark number shown on
	Level, flow, pressure switches, and flow transmitters		
11.	a) Accuracy requirements met	A	A review of the following Ref. 11, 12, 13, and 14 did not lead to evidence of concerns or not acceptable observations.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
11.	b) Drift requirements met	A	See 11A.
	c) Repeatability requirements met	A	See 11A.
	d) Range requirements met	NA	Not observed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

Component Checklist†

Discipline: instrumentation & controls

Item No.	Review Items	Review Results	
		Adequacy*	Observations/Comments
11.	e) Voltage level acceptable	A	See 11A.
	f) Device input compatible with component	A	See 11A.
12.	Instrument weight furnished by manufacturer	NA	Not observed.

*A - acceptable C - concern D - not acceptable NA - not applicable I - indeterminate

† All document identification shall be included in this list.

DOCUMENTS REVIEWED (REFERENCES) FOR I&C

1. Instrument Piping Drawing MEAB Fluor & Wall Sleeve Tabulation 6M159Z0100, Rev. 2, 3/11/83.

*2. Safety/Relief Valve PSV 6873, System R28 B*14926-8035-00011-ALG, Lonergan No. A2924, Rev. B.

3. Spec for ASME Section III Control Valves 4Z439ZS1007, Rev. 0, 4/28/83.

4. Spec. for Classes 7, 8, and 9 Control Valves 9Z439ZS0211, Rev. 1, 2/19/83, and 7Z439ZS0211, Rev. 0, 9/22/82.

5. Spec. Data Sheet for CCW Disch. From RHR Hx Cont VW 4Z019Z44712, Sh. 7, Rev. 0 (Preliminary).

6. Spec. for General Requirements for Instrumentation Construction 5Z689ZS1027, Rev. 0, 1/27/83, and Spec. Change Notice No. 1, 3/15/83.

7. Instrument Tube & Installation Design Criteria 5Z019ZQ 1012, Rev. 0, 9/8/82 (replaces B&R TRD 5Z019ZQ003, Rev. H).

*8. Fisher Controls Print No. F43237, Sh. 2 of 2, Rev. 2 for Control Valve (Butterfly).

*9. P&ID 5R209F05017, Rev. 0 (4/25/83) Component Cooling Water.

*10. Spec. Data Sheet 7Z439Z5211, Sh. 57 (Review Copy) Hotwell Level Control Data Sheet NICD-LV-7005.

11. Spec. for Instrumentation Electronic Transmitters 7Z019ZS0500, Rev. 0, 9/10/82, B&R 7Z019ZS500-D.

12. Spec. for Instrumentation Electronic Transmitters (Nuclear Service) 4Z479ZS1033, Rev. 0, 2/15/83.

13. Spec. for Instrumentation-Electronic Transmitters (Class 1CIII) 9Z019XS1038, Rev. 0, 1/7/83.

14. Data Sheets for Ref. 13, Rev. 0, Preliminary.

*15. Manufacturer's Drawing-Sys. R28 ESS Clg Wtr-PSV 6873 Lonergan 1 1/2 X Q X 2 1/2 14926-8035-00011 ALG (4035-00010 ALG) Lonergan No. A2924, Rev. B.

16. Instrument Index Engineering Report 5Z019Z48000, Rev. 3, 5/4/83, Page 1622.

*These documents were reviewed in lieu of specific RHR/SI documentation which was not available for review due to its preliminary status.

HL&P 1008A (2-83)

Houston Lighting & Power Company

OFFICE MEMORANDUM

To R. A. Frazar

August 25, 1983
ST-HL-HL-28976
PFN: D27

From S. M. Dew

Subject Engineering Design Assurance Report
of Independent Technical Assessment
83-2; RHR/SI System
SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

Reference: Office Memorandum ST-HL-28288

Enclosed are our responses to the subject report as requested in the referenced memorandum. The responses to the eight action items are shown on the Action Item Reply Forms.

Should you have any questions or require additional information please contact D. L. Carathers at 877-3104.

MAR/slb

cc: M. G. Zaalouk
R. R. Hernandez
J. N. Bailey
J. L. Barker
J. G. White
STP Engineering File
STP RMS (2)

B133

Action Item Cover Sheet

Review/assessment subject title: RHR/Safety Injection System, STP

Document no.: 83-2 Review/assessment no.: 83-2

1. Action items prepared by

[signature] — Engineering Assurance Department engineer — 6/22/83 Date

N/A — Engineering Assurance Department engineer — Date

2. Action items reviewed by

[signature] — Manager, Engineering Assurance Department — 6/23/83 Date

3. Actions pertaining to review/assessment 83-2 have been implemented.

Manager, STP Engineering — Date

4. Implementation of actions has been verified.

Engineering Assurance Department engineer — Date

Engineering Assurance Department engineer — Date

5. All concerns pertaining to review/assessment no. 83-2 have been resolved.

Manager, Engineering Assurance Department — Date

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
1	Stress input preparation The safety injection system pump suction line stress analysis (calc. 2N129RC004) references WNES criteria for piping design, process conditions, and piping requirements. These documents provide some of the information required for stress analysis but not all possible significant operating modes, possible major transients to which the system may be subjected, and the BOP-generated information that must be considered for stress analysis. The responsible system engineer should provide the stress analyst with all possible significant system operating modes so the stress analyst can determine which of the system operating modes to consider for stress analysis. Procedures should be reviewed for specificity to control this activity and produce desired results.
2	WNES interface with Bechtel Procedure GPR 1.3 requires that "selected" design documents generated by Bechtel be sent to WNES for review and confirmation that interface requirements have been fulfilled. These selected documents that need verification by WNES have not yet been identified. The project should expedite development of this list of documents to be reviewed and also establish criteria to be followed in reviewing interface documents, including identification of areas of a document to be reviewed after it is selected.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
3	Interdisciplinary interface on nozzle loads Nozzle loads calculated by pipe stress (calc. 2N129RC004) were not sent to the mechanical group for vendor interface although vendor allowables to confirm the acceptability of the calculated loads were not available. Formal procedures have not been issued to address this or other cases where vendor interface is required. Procedures should be developed to control this activity and produce desired results.
4	Vendor drawing review Vendor drawings are reviewed by the groups responsible for checking interface and technical information. Four series of vendor drawings, one series each for high head safety injection pump, low head safety injection pump, RHR heat exchanger, and RHR pumps, were examined to verify if interdisciplinary review was performed. Of the four series of vendor prints, two were not sent to the civil and structural group for review, although the prints contained information on anchor bolt sizes and mounting bolt loading required to confirm adequacy of anchorage and embedment plate. Bechtel should reassess their interdisciplinary review process for vendor drawings and develop any instructions necessary to ensure that proper interdisciplinary review is performed by affected groups.
5	System calculations to meet WNES criteria Safety injection and RHR system calculations required to confirm piping arrangement, acceptability to WNES layout, and pressure drop criteria have not yet been performed. No evidence was observed that these calculations will be performed. Bechtel should identify and complete these calculations to demonstrate that WNES layout criteria have been met.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
6	Calculation procedure The STP procedure for calculations, EDP 4.37, Rev. 2, does not require a calculation specifically to identify its purpose, scope, or conclusion. This is observed as a weakness in the procedure that has affected electrical calculation 5E010EC5004 for cable ampacity. Procedure EDP 4.37 also is not specific regarding identification of input data that are preliminary and require confirmation at a later date. It is suggested that Engineering Department procedures for preparing calculations be revised to include requirements in the calculation for defining the objective, conclusion, and assumptions that must be verified at a later date.
7	Document review procedure Engineering Department procedures for preparation and review of various design documents currently allow document review notices or equivalent review documents to be discarded, although they are defined as the only documents containing the interfacing groups' approvals. The requirement to discard the DRN should be reconsidered. Alternatively, consideration should be given to changing the procedure to require interdisciplinary concurrence signatures on issued documents.

Action Item Form

Review/assessment subject title: RHR/Safety Injection System, STP

Review/assessment no.: 83-2 Prepared by S. R. Basu

item no.	description of condition(s)
8	Procedures on design verification Engineering Department procedures relating to design verification limit the use of an originating group supervisor as reviewer to implement applicable regulatory requirements. However, the limitations are not the same in all procedures, and the terms "immediate supervisor" and "supervisor" are both used without appropriate clarification of intent. Conditions related to using supervisory personnel as reviewers should be consistent in all procedures.

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
1	A review of EDP 2.16 which provides guidelines, direction and delineates interdiscipline coordination activities has been performed. this review reveals that paragraph 3.4.2(3) does not specifically address furnishing Westinghouse systems information to Plant Design (PSSG). The procedure will be revised to establish the discipline responsibilities with regard to Westinghouse system interface. Procedure revision due October 31, 1983. A PED will be available by Oct. 31, 1983 which will provide additional guidance to engineers for transmittal of process system information.

Date action(s) scheduled to be complete: ~~10/31/83~~

M. G. Zaudtke
Manager, STP Engineering

8/25/83
Date

B035

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

Item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
2	A program has been established to identify the significant interface review (SIR) documents that should be provided to Westinghouse for confirmation that interface requirements have been fulfilled. (Westinghouse and Bechtel have agreed on a list of system for this interface program. A list of documents has been generated for the first pilot system, Boron Recycle. Similar system document lists are scheduled periodically, with an overall completion date for these lists for all systems of March 31, 1984.) 10/31/83

Date action(s) scheduled to be complete: _____

M. G. Zaleski 8/25/83

Manager, SIR Engineering Date

B035

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
3	The review of EDP 2.16 performed for Item 1 also indicated that the guidelines for stress group action with regard to nozzle loads, specifically paragraph 3.6.4.c, should be expanded. This procedure revision due October 31, 1983.

Date action(s) scheduled to be complete: 10/31/83

M. G. Gaeke for sam 8/25/83
Manager, STP Engineering Date

B035

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
4	For the specific instance cited, the person responsible for assigning distribution incorrectly assumed that the Civil/Structural discipline did not need to review these documents because of their existing installation status. The RE has been reinstructed to treat the Westinghouse drawings as initial issue by Westinghouse and to make distribution per procedural requirements. A review of other Westinghouse pump and heat exchanger drawings has been performed and only the cited drawings were not sent to Civil/Structural.

Date action(s) scheduled to be complete: _____

M-C Jaeger / FSMO
Manager, SIP Engineering

8/25/83
Date

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
5	BEC intends to perform these calculations. Calculations have not yet been entered into the CEBUS Calculation Control Log. This listing and scheduling will be completed by 9/15/83.

Date action(s) scheduled to be complete: 9/15/83

M-G Zaalouk / G Sarno — Manager, STP Engineering — 8/25/83 Date

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
6	Bechtel concurs with the identified concern and will revise the calculation procedure EDP 4.37 to more clearly define the requirements. This procedural revision will be issued by October 31, 1983.

Date action(s) scheduled to be complete: 10/31/83

M. G. Zaelke / Manager, STP Engineering — 8/25/83 Date

B035

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
7	Bechtel's program is identified in BQ-TOP-a, Appendix A, Regulatory Guide 1.64, as follows: Section 10, Records. In-process documentation, relating to checking and coordination of drawings (for example, check and coordination prints) or copies of marked-up specifications used to solicit comments shall be retained until the drawing or specification is approved and issued for use outside of Bechtel Engineering. Such in-process documents will be available for review/audit until the document has been approved. In the first sentence of the second paragraph the phrase "final design documents" shall mean those documents which are the latest revision that has been issued for use. Bechtel does not recommend a change to this program.

Date action(s) scheduled to be complete: _____

M-G Beckler / 8/25/83
Manager, STP Engineering / Date
GSMD

Action Item Reply Form

Review/assessment subject title: RHR/Safety Injection System

Review/assessment no: 83-2

item no.	Describe cause(s) and extent of adverse condition(s) and define proposed actions to resolve and prevent recurrence of adverse condition(s). Use additional sheets as necessary.
8	Bechtel concurs with the cited concern and will revise the procedures to clearly identify the immediate supervisor limitations and standardize the wording within the appropriate procedures. This activity will be complete by October 31, 1983.

Date action(s) scheduled to be complete: 10-31-83

M-G. [illegible] / ASMD
Manager, SIP Engineering

8/25/83
Date

B035

HL&P 1008A (12-82)

Houston Lighting & Power Company

OFFICE MEMORANDUM

September 15, 1983

To R. A. Frazar

ST-HL-29089
File No.: D27

From S. R. Basu

Subject Action Item Responses,
Design Process Review 83-2,
RHR/Safety Injection System

The responses of the South Texas Project (STP) to action items generated by Design Process Review 83-2 covering the RHR/safety injection system have been reviewed. Following are comments on these responses:

1 - Stress input preparation

The problem identified in the stress input preparation is that the responsible engineer does not provide the stress analyst with all possible significant system operating modes so the analyst can determine which of the modes to consider for stress analysis. To rectify the problem, a Project Engineering directive (PED) will be developed by October 31, 1983, providing guidance to engineers for transmitting process system information.

However, the response does not state whether the immediate effect has been corrected or other associated work has been affected. These need to be addressed by the project. Also, the Engineering Assurance Department needs to review the new PED and check some sample cases to verify that the problem of system operating mode input for stress analysis has been corrected.

2 - WNES interface with Bechtel

The project has established a program to identify design documents that need Westinghouse review to confirm that interface requirements have been met. The program, which is expected to be completed by March 1984, will resolve the identified deficiency. The response, however, does not indicate the reason the project procedure was not followed. The project should address the effect of not following the procedure and repercussions on other associated work. In addition, the completion date for the work seems unusually long.

3 - Interdisciplinary interface on nozzle loads

EDP 2.16 will be revised to include guidelines to be followed by the stress group to avoid possibly exceeding vendor-allowable nozzle loads. Revising the EDP as indicated in the action item response should resolve the identified problem. Again, as in action items 1 and 2, the response does not clearly indicate if the immediate effect of the absence of a procedure has been corrected or if any other associated work has been affected.

Houston Lighting & Power Company

OFFICE MEMORANDUM

September 15, 1983

To

ST-HL-29089
File No.: D27

From

Subject Action Item Responses,
Design Process Review 83-2,
RHR/Safety Injection System

4 - Vendor drawing review

The project has indicated that, except for the two sets of drawings identified as deficient in interdisciplinary review, they have not found any other drawings with the indicated problem. It is not clear from the reply if the drawings identified as deficient have been corrected or if the identified deficiency has affected any associated work.

The project is treating all W drawings as new drawings requiring interface review per procedure. This should correct any future problem.

5 - System calculations to meet WNES criteria

The project will perform calculations required to confirm that piping arrangements meet Westinghouse piping system pressure drop criteria. The calculation control log will be updated by September 15, 1983. The calculation log issued after September 15 needs to be checked to verify that these calculations have been scheduled.

The reply does not make clear the reason for not scheduling the calculations or whether not having the calculations completed earlier caused any problem with associated design.

6 - Calculation procedure

The project agrees with our finding that the present calculation procedure needs to be revised so that each calculation identifies its purpose, scope, conclusion, etc. The calculation procedure will be revised by October 31, 1983. This seems too long.

7 - Document review procedure

The Engineering Assurance Department suggested that, as a good practice, copies of document review notices (DRNs) bearing the signatures of interfacing disciplines be preserved or that drawings be signed by the interfacing discipline supervisors. The project maintains that this is not a regulatory requirement, and hence the practice need not be followed.

Houston Lighting & Power Company

OFFICE MEMORANDUM

September 15, 1983

To

From

ST-HL-29089
File No.: D27

Subject Action Item Responses,
Design Process Review 83-2,
RHR/Safety Injection System

In view of the project's posture on this matter, an Engineering Assurance audit of a few random samples of drawings, etc., is suggested. If an interface problem is still found to exist, as identified in this audit, we may insist on the maintenance of DRN copies or on the signature of interfacing group supervisors on the drawings.

8 - Procedures on design verification

The project will revise the procedures to clearly identify the immediate supervisor limitations and standardize the wording within the appropriate procedures by October 31, 1983. This time appears to be too long. The revised procedures should be checked to verify that the identified problem has been corrected.

Houston Lighting & Power Company

OFFICE MEMORANDUM

September 15, 1983

To

ST-HL-29089
File No.: D27

From

Subject Action Item Responses,
Design Process Review 83-2,
RHR/Safety Injection System

In the following matrix these responses are evaluated against our checklist:

questions for evaluating responses	action item number 1	2	3	4	5	6	7	8
Has the cause of the action item been specifically identified?	yes	no	yes	no	no	yes	n/a	yes
Is the proposed action sufficient to eliminate the cause? (See above.)	yes	yes	yes	yes	yes	yes	no	yes
Has the immediate effect been corrected?	1	1	1	1	n/a	n/a	n/a	yes
Has the possibility of other work being affected been analyzed and addressed?	no	no	no	no	no	n/a	n/a	n/a
Is follow-up by EA necessary to close out the item; i.e., do we need additional review, etc.?	yes	no	no	yes[2]	yes	no	yes	yes
Is the schedule for corrective work reasonable?	yes[3]	no[4]	yes[3]	n/a[2]	yes	no[4]	n/a	no[4]

Notes: 1 Not clear from response
2 Please see item 7.
3 Assuming that all corrective actions including the procedure change are completed by the date given
4 The time being taken is too long.

SRB:jog

cc: J. H. Goldberg
D. G. Barker
S. M. Dew
M. G. Zaalouk
STP RMS