Georgia Power Company
Project Management
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Vogtle Project

December 2, 1985

Mr. D. O. Foster
Vice President and General Manager
Vogtle Project
Waynesboro, Ga. 30830

RE: Readiness Review Program
Module 13A
Foundation Materials and Backfill

LOG: RR-589

FILE: X7BD102

Dear Mr. Foster:

Pursuant to your instructions I am enclosing Module 13A of the Readiness Review Program entitled Foundation Materials and Backfill. This module reports the work of the Readiness Review Team and has been prepared in order to present you with an accurate picture of the readiness for operations of the Vogtle Project, based upon a close examination of the plant foundation materials and backfill program.

The Readiness Review process included an initial assessment and review of basic licensing documents in order to identify Project commitments within the scope of the module. The Readiness Review Team then verified implementation processes designed to meet those commitments, including programs and controls relating to work within the scope of the module.

The team then engaged in a process designed to verify that implementation programs were operating as described in procedures and other descriptive documents. In concluding this verification process, the team then actually verified that the licensing commitments and the procedure and specification requirements identified were complied with.

VOGTLE ELECTRIC GENERATING PLANT

UNIT 1

READINESS REVIEW

MODULE 13A - FOUNDATION MATERIALS AND BACKFILL

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The team then engaged in a process designed to verify that implementation programs were operating as described in procedures and other descriptive documents. In concluding this verification process, the team then actually verified that the licensing commitments and the procedure and specification requirements identified were complied with.

We are confident that the verification methodology used allowed the Readiness Review Team to properly appraise the actual condition of the foundation materials and backfill program, and provided a valid means of assessing the quality of the program having also considered applicable past audits, inspection reports, and problems experienced by other utilities.

Based on the examinations, inspections, and evaluations of the review and the responses and corrective actions committed to by the project, it is the conclusion of the Readiness Review Team that the design and construction programs that govern the foundation materials and backfill processes have produced a final product that meets design requirements and licensing commitments. Additionally, none of the findings identified either individually or collectively, are such that the adequacy of the project foundation materials and backfill program is called into question. Therefore, the foundation materials and backfill program meets the FSAR commitments.

Members of the Readiness Review Team and I are prepared to discuss this module with you at your convenience. If we can provide you with any further information or assistance regarding this matter, contact me.

Very truly yours,

W. C. Ramsey

William C. Ramsey

WCR/bjd

cc: R. E. Conway
Readiness Review Board Members
Reading File
Document Control

0091m/322-5

VOGTLE ELECTRIC GENERATING PLANT

UNIT 1

READINESS REVIEW

MODULE 13A - FOUNDATION MATERIALS AND BACKFILL

PREFACE

Georgia Power Company (GPC), in order to gain added assurance of the operational readiness of the Vogtle Electric Generating Plant (VEGP), is conducting a pilot Readiness Review Program. The VEGP pilot Readiness Review Program is a systematic, in-depth self-assessment of work processes and verification of compliance with regulatory commitments. To accomplish the VEGP pilot Readiness Review Program, the work processes and regulatory commitments were divided into manageable segments called modules. There are approximately 20 modules. Each module is a predefined scope of VEGP activities.

Each module is intended to provide a brief description of the method of complying with project licensing commitments pertaining to the module scope and is not intended to make further commitments or to revise in any way prior commitments. If any differences exist between the commitments discussed in this document and the licensing documents, they are unintentional; and the licensing document governs.

Activities common to several modules are provided as General Appendixes. There are approximately 10 appendixes. These appendixes, as appropriate, are referenced in the modules and are augmented in each module with module-scope-specific details as needed.

The VEGP Readiness Review Program is being conducted on a schedule to provide added operational readiness assurance to GPC management in support of the VEGP Unit 1 operating license. However, conclusions reached regarding programmatic and technical adequacy through review of VEGP Unit 1 are indicative of Unit 2, since both units are being designed and constructed together under a single quality assurance program; with like management controls, procedures, etc.; and to the same specifications and criteria.

Stone and Webster Engineering Corporation has been contracted to provide technical management for, and technical personnel to implement, an independent design review as a part of the Readiness Review program. Additionally, Stone and Webster is reviewing project responses to Readiness Review findings for technical adequacy.

The VEGP Readiness Review Program is not intended to eliminate or to diminish any authorities or regulatory responsibilities now assigned to or exercised by the Nuclear Regulatory Commission or GPC. Further, the Readiness Review Program is not intended to change the techniques of inspections or assurance of quality program activities. Rather, the VEGP Readiness Review Program is an added program initiated by GPC management to assess the VEGP and to provide additional feedback to management so that they may initiate any needed corrective actions in an orderly and timely manner.

The scope of work processes and regulatory commitment compliance covered by each module will be assessed by, and the module prepared and reviewed by, individuals collectively familiar with the design, construction, and operational processes of nuclear power plants. It is the collective opinion of the Readiness Review Task Force, Readiness Review Board, and GPC management that, based on their experience, the methodology used in the module process will assess, on a programmatic basis, the adequacy of project commitment implementation.

Readiness Review Discrepancy Reports and resulting dispositions are reviewed by the Readiness Review Program quality assurance staff and are input into the normal project process for safety significance and potential reportability evaluations in accordance with regulatory requirements.

EXECUTIVE SUMMARY

Introduction

This module documents a review program to ascertain whether the design and construction aspects of the foundation materials and backfill for the Seismic Category I structures comply with licensing commitments and whether compliance is verifiable using existing project documentation.

The scope of this module includes those design and construction activities associated with foundation material (marl, lower sand stratum, etc.) design analysis, selection, and placement of Category I backfill.

The program consisted of three separate reviews: a design program verification, a construction program verification, and an Independent Design Review (IDR).

In implementing the above reviews, project documents such as design criteria, specifications, and procedures were reviewed along with results of past audits and inspections. In addition, the Readiness Review Board technical consultant provided independent technical oversight and concurrence, and Readiness Review quality assurance (QA) personnel provided QA surveillance of the review activities. Statements from the technical consultant and QA regarding their involvement and conclusions reached are provided in section 8 of this module.

A brief summary of the three reviews and the method used in classifying findings resulting from the reviews are provided below.

Finding Classification

Following evaluation, findings were subjected to categorization as follows to indicate their relative importance:

Level I - Violation of licensing commitments, project procedures, or engineering requirements with indication of safety concern.

Level II - Violation of licensing commitments or engineering requirements with no safety concern.

Level III - Violation of project procedures with no safety concern.

Design Program Verification

The verification of the design program was performed in two phases. Phase I consisted of a two-part review of design criteria and detail design documents to verify inclusion and implementation of commitments.

Phase II consisted of a review of selected detail design documents for compliance to applicable procedures and industry standards (e.g., ANSI N45.2.11) as committed to in the Final Safety Analysis Report (FSAR). Documents such as design criteria, calculations, drawings, specifications, design change documents, and related studies/reports, were included in this review.

The design program verification resulted in Finding 13A-18, which was classified as Level II. The finding involved noncompliance with the applicable procedures and requirements established for the geotechnical calculations for foundation materials and backfill. Several initially reviewed calculations had not clearly described purpose, references, assumptions, and design input/output correlations. The parameters supportive of liquefaction analyses committed to in the FSAR were not readily identifiable in the calculations without the help of the originator. Calculation checking was lacking in a few cases. The Project has resolved this finding by reviewing all (approximately 70) safety-related geotechnical calculations. Calculations were revised and upgraded, as necessary, to improve clarity, completeness, and conformance to project procedures. The Project has also developed an additional calculation (roadmap calculation) that provides reference to the parametric studies included in the calculations and the design values identified in the FSAR.

A reverification review of the upgraded calculations was conducted by a joint team consisting of members from both the IDR and the programmatic design verification teams. Their review has verified that the calculations met the programmatic design control requirements and the support design values and parameters included in the FSAR.

Details of the design program verification are included in section 6.1.

Construction Program Verification

The construction program verification consisted of commitment implementation assessment and construction assessment. Commitment implementation assessment determined whether construction incorporated licensing commitments into implementing documents, whereas construction assessment determined whether construction activities met the design requirements.

Commitment implementation assessment consisted of a review of the 24 construction commitments identified in the commitment matrix (section 3.4). Twenty-two of these commitments were adequately traced to implementing documents from the time of initial implementation to current status. The two remaining commitments were identified as Readiness Review Findings 13A-1 and 13A-2, both Level II.

Finding 13A-1 dealt with the allowable moisture range for Category I backfill. The FSAR required that backfill moisture content be within 2 percent of the optimum, whereas the specification allowed the moisture content to vary from 3 percent below, to 2 percent above, the optimum. Evaluation of this finding revealed that engineering had revised the specification after reviewing the test data from the Category I backfill test program and determining that the moisture range was acceptable. At the time the change was made to the specification, engineering failed to identify an FSAR change. An FSAR change will be made in a future amendment and is adequate corrective action to resolve this finding.

Finding 13A-2 involved differences between the settlement monitoring program after initial plant operation, as described in the FSAR, and with directions given in the implementing specification. The project response explained that the program for settlement monitoring has undergone change and is in accordance with a recent agreement with the NRC and that the FSAR and specification will be modified accordingly. Since the finding was against future work, there is no project impact.

Construction assessment consisted of a review of approximately 1100 records to ascertain whether construction correctly interpreted design documents and whether the as-built condition of Category I backfill complied with the design.

Four findings were identified during construction assessment, of which, one (13A-22) was a Level II finding and three (13A-3, 13A-5, and 13A-6) were Level III findings. There were no Level I findings.

Findings 13A-3, 13A-5, and 13A-6 were deviations from procedural requirements and did not indicate programmatic failures or physical discrepancies. Finding 13A-22 involved some borrow area gradation test results (secondary documents, i.e., documents that are redundant to other documents which are normally utilized for verifying acceptability of soils placement) that cannot be located in the QA records vault. The data represented by these missing records is available in the results of the powerblock backfill placemat gradation tests retrievable from the vault, and is verified as acceptable. Construction has initiated a program to evaluate vault record storage and to correct identified filing errors.

Details of the construction program verification are found in section 6.2.

Independent Design Review

The Independent Design Review (IDR), conducted by Stone and Webster Engineering Corporation, evaluated the technical content of the design documents related to the geotechnical design of the Category I foundations on a sample basis. The documents reviewed included calculations, engineering reports, design criteria, specifications, drawings, and deviation reports.

The IDR initially identified a total of 11 findings. Upon the presentation of additional information to the IDR team, one of them was classified as a nonfinding. The remaining 10 findings have all been classified Level II (one) or Level III (nine) since they were assessed to be documentation deficiencies with no safety concerns.

Finding 13A-15 (Level III) resulted from the collective nature of seven of the nine findings that related to either calculations or design criteria. Specifically, the IDR review process revealed inconsistencies in the use of such items as soil moduli and building loads, incomplete documentation of design assumptions, the absence of certain calculations as support for design values, and an overall lack of attention to detail in the calculation preparation process. The IDR team considered the calculations, design criteria, and associated cross-referencing to the FSAR to be insufficient in detail, documentation, and accuracy. This resulted in a commitment by the project to review and revise, as necessary, all project geotechnical calculations.

In order to evaluate the adequacy of the corrective action for the individual findings and the collective finding (13A-15), the IDR team reviewed numerous revised or newly created calculations. These calculations reviewed by the IDR team represent approximately one half of the total population that was reviewed and revised in response to Finding 13A-15. Based on this review, the IDR team concludes that the project has correctly implemented the corrective action committed to and is acceptable.

In summary, all of the IDR findings have been satisfactorily resolved. The IDR team has concluded that, due to good engineering judgement incorporated into the project documents and a very conservative basis for design, these findings have not resulted in any physical impact or impact on licensing commitments.

Readiness Review Conclusion

Having performed a review of project documentation, Readiness Review concludes that adequate controls exist to ensure the quality of work and the implementation of licensing commitments within the scope of this module. Moreover, none of the identified deficiencies, either collectively or individually, are such that the adequacy of any aspect of the VEGP foundation materials or backfill installation program is called into question. Therefore, the compliance of design and construction programs and processes is verifiable with existing project records.

TABLE OF CONTENTS

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1.0 INTRODUCTION

1.1 INTRODUCTION

This module is one in a series of modules that provides an evaluation of the design, procurement, construction, and readiness for operation of the Vogtle Electric Generating Plant Unit 1 and common facilities. It is intended to describe the method of compliance with the project commitments found in the FSAR and is not intended to make further commitments or revise in any way prior commitments. Any differences between the commitments discussed in this document and the FSAR, if any, are unintentional. In the unlikely event that a difference between this module and the FSAR should occur, the FSAR shall take precedence and shall define the project commitments.

The scope of this module includes those design and construction activities associated with foundation material (marl, lower sand stratum, etc.) design analyses, selection, and placement of Category I backfill.

The effective date of this module is July 1, 1985. That is, changes in the included programs, organizations, commitments, etc., occurring after this date are not addressed.

1.2 MODULE ORGANIZATION

This module is divided into the following sections:

1. Introduction.

2. Organization and Division of Responsibility - A brief description of the project organizations and their division of responsibilities as applicable to this module. The overall project organization is discussed in Appendix A - Organization.

3. Commitments - Project licensing commitments pertaining to soils and foundations within the scope of this module and as found in the FSAR, generic letters, and other documents. This section also lists documents that demonstrate implementation of these commitments.

4. Program Description - A brief description of the processes for design, and construction applicable to the scope of this module.

5. Audits - A description of the level of audit activity by QA or the NRC as it applies to this module. Also included in this section is a description of any special investigations performed on work contained in this module and past problems identified.

6. Program Verification - A description of the verification plan development, implementation, and results, including corrective actions.

7. Independent Design Review - A description of the design process technical review program, its implementation, results, and corrective actions.

8. Assessment - The evaluations and conclusion, by the applicant's Readiness Review Task Force, the VEGP Readiness Review board, Readiness Review program quality assurance staff, IDR team, and Readiness Review board module expert, of the subject work. This section also identifies any items still open and the scheduled closure date.

1.3 VOGTLE PROJECT STATUS

Site subsurface investigations began in January 1971 and were completed during excavation of the power block. Excavation work was started in May 1974 and curtailed on September 12, 1974. The excavation work was resumed in February 1977 and completed in October 1977.

Placement of Seismic Category I backfill in the power block area began in October 1977 and is scheduled for completion on November 1, 1987. This estimated backfill volume is 3,850,000 cubic yards. As of July 14, 1985, 3,785,256 cubic yards had been placed. Placement is now 98 percent complete.

2.0 ORGANIZATION AND DIVISION OF RESPONSIBILITY

Georgia Power Company (GPC), acting on its own behalf and as agent for the Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia, and the City of Dalton, is responsible for the design, procurement and construction of the Vogtle Electric Generating Plant (VEGP). The Western Power Division of Bechtel Power Corporation (Bechtel) is contracted by GPC to provide architect/engineering (A/E) services.

This module section includes a brief description of the organization and responsibilities of GPC and Bechtel starting with the functional group level for design and construction activities related to backfill. It also includes the organization and responsibilities of the site contractor involved in the construction process. The section does not describe all organizations and responsibilities, only those pertaining to the content of this module.

2.1 DESIGN ORGANIZATION

Details of overall organizations involved in the VEGP design, procurement, construction, and operations are provided in Appendix A of the Readiness Review program. Details of organizations which relate to this module are outlined briefly in the following sections.

2.1.1 CURRENT BECHTEL ORGANIZATION

The Bechtel Power Corporation employs the matrix organization concept with an individual assigned as project engineering manager (PEM) who is assisted by the project engineer (PE) home office, the PE-field office, and by functional group heads reporting to the PEM for the performance of functional tasks. Functional group heads receive project direction from the PE, while functional direction is provided to them by discipline chief engineers. The Bechtel PEM has been located at the VEGP site since February 1985. The current VEGP Bechtel Project Engineering Organization is shown in Figures 2.1-1 through 2.1-4.

Project engineering for the scope of geotechnical work related to foundation materials and Seismic Category I backfill is composed of Home Office Engineering (HOE) and Project Field Engineering (PFE) organizations in coordination with Bechtel Geotechnical Services (Geotech). Both HOE and PFE report to the PEM.

The HOE, responsible for the design and analysis of safety-related structures, is supervised by the PE-home office. He is assisted by the assistant project engineer-design, the civil/structural engineering group supervisor, the civil/structural building engineering group leaders, the drafting group supervisor, and the chief civil/structural engineer.

The PFE is an extension of the HOE and is supervised by the project engineer-field. He is assisted by the assistant project engineer-physical design, the civil/structural engineering group supervisor-field, the building construction support engineering group leaders, and other groups (see Figure 2.1-2). The PFE assists construction in interpreting drawings and specifications, solving field problems, and coordinating field activities with HOE.

Geotech is a branch of the Bechtel Hydro and Community Facilities Division (H&CF) and serves all Bechtel projects and divisions as an in-house consulting firm with a permanent staff of engineering geologists, soils engineers, hydrologists, and hydraulic engineers. The Geotech staff, headquartered in San Francisco, and a permanent staff located in the Bechtel Norwalk Office have supported the work covered in this module in the areas of engineering geology and soils engineering.

Geotech work included directing the development of site information; obtaining necessary laboratory testing and the reporting of results to determine design parameters; developing specific foundation design parameters and foundation design recommendations for each type of structure or facility; and typically, providing the results of such work in the form of soils and geologic investigation and foundation recommendation reports. In addition, Geotech is utilized in all phases of the project involving geotechnical work including:

- Providing support in the preparation of licensing documents;
- Reviewing and approving the application of soils and geologic data to the design of foundations, fill, and other geotechnical aspects of the project;
- Assisting project personnel reviewing the geotechnical aspects of design changes and field change orders, especially those which result in changes in foundation bearing pressures or loads or for load distribution on foundation elements;
- Developing technical specifications for foundations, earthwork, and related testing;
- Verifying that actual field conditions encountered during construction are consistent with interpretations used during the design phase and are satisfactorily covered in the design parameters.

Foundation engineering for the structures is performed by the project civil/structural group based on criteria provided by geotechnical specialists.

All geotechnical work related to this module is coordinated through the VEGP civil/structural discipline (see Figure 2.1-2).

2.1.2 BECHTEL ENGINEERING ORGANIZATION CHANGES

Bechtel PFE was established in April 1979 with the basic responsibilities of coordinating, reviewing, and approving Field Change Requests and Deviation Reports initiated by GPC Construction. They are responsible for assisting construction in the interpretation of design requirements and resolving field-related problems. Between April 1979 and December 1983, the basic responsibilities of HOE and the field organization for geotechnical and foundation-related work did not change.

The role and responsibilities of Bechtel PFE evolved during the period from 1980 to early 1985. Key milestones in this organizational change were assignment of a PE-field in

November 1983 and relocation of the PEM to the site in February 1985. However, these changes did not affect geotechnical work at VEGP.

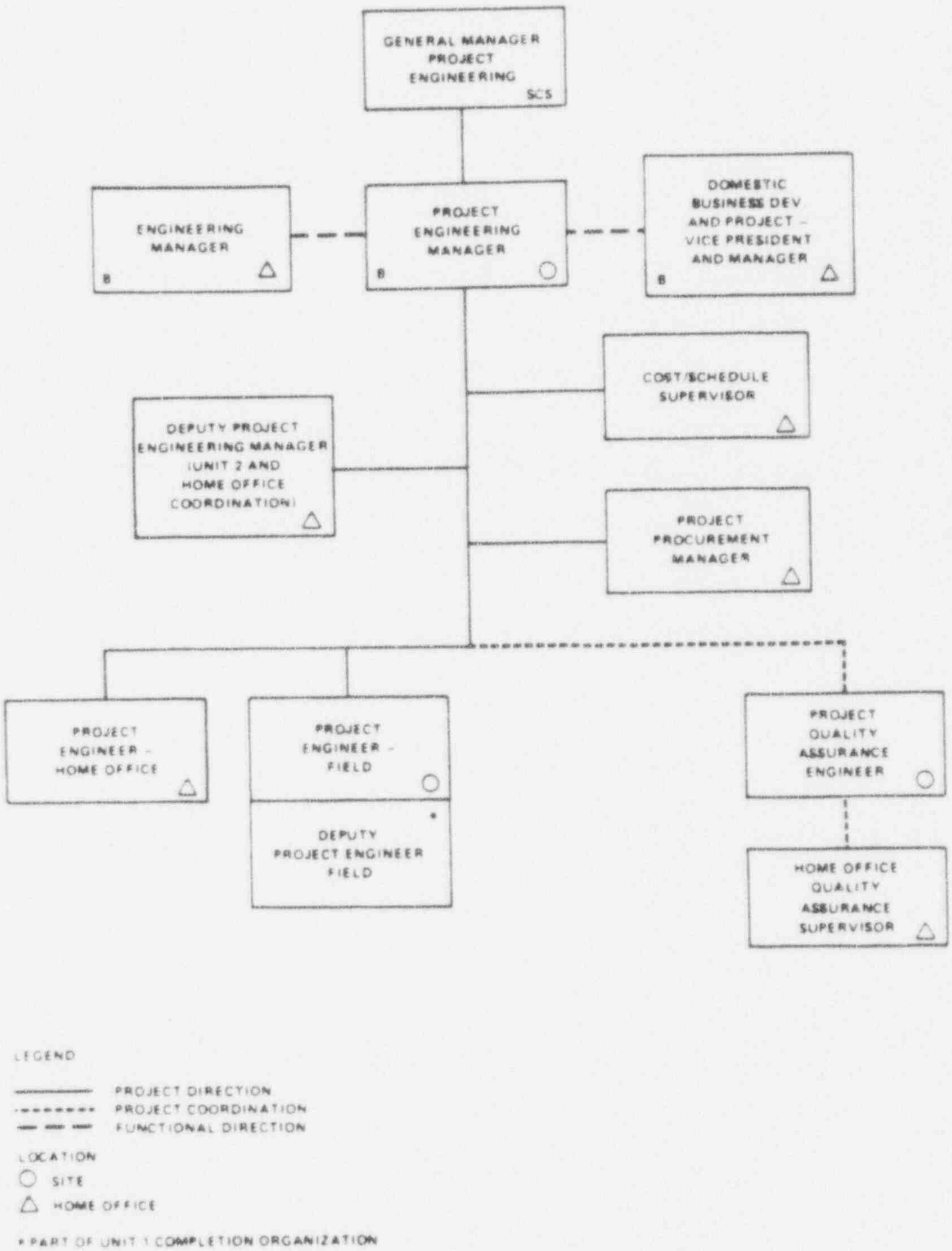

Figure 2.1-1 VEGP Bechtel Project Engineering Organization

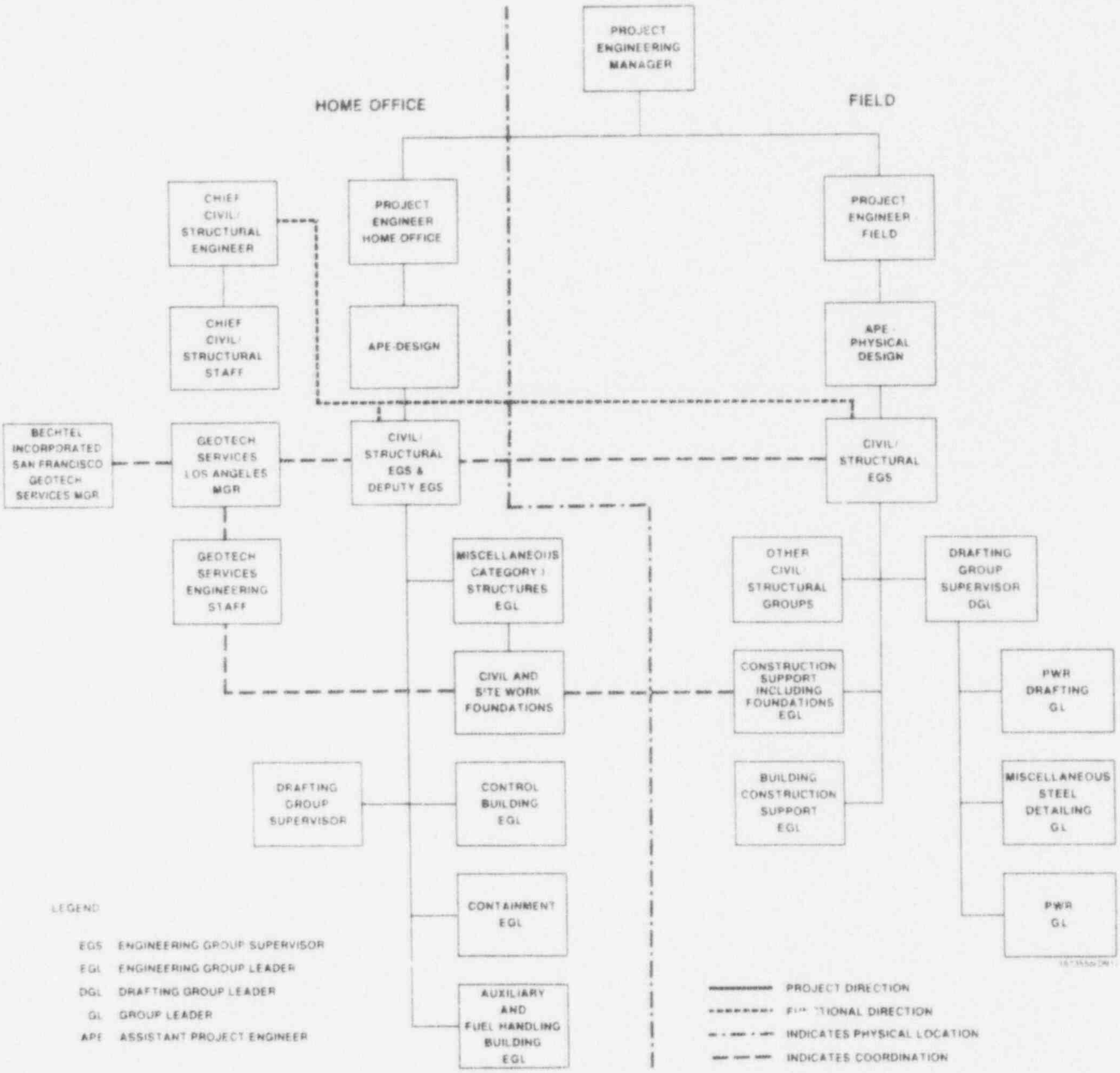

Figure 2.1-2 BPC Vogtle Project Civil/Structural Engineering Organization (February 1985 to Present)

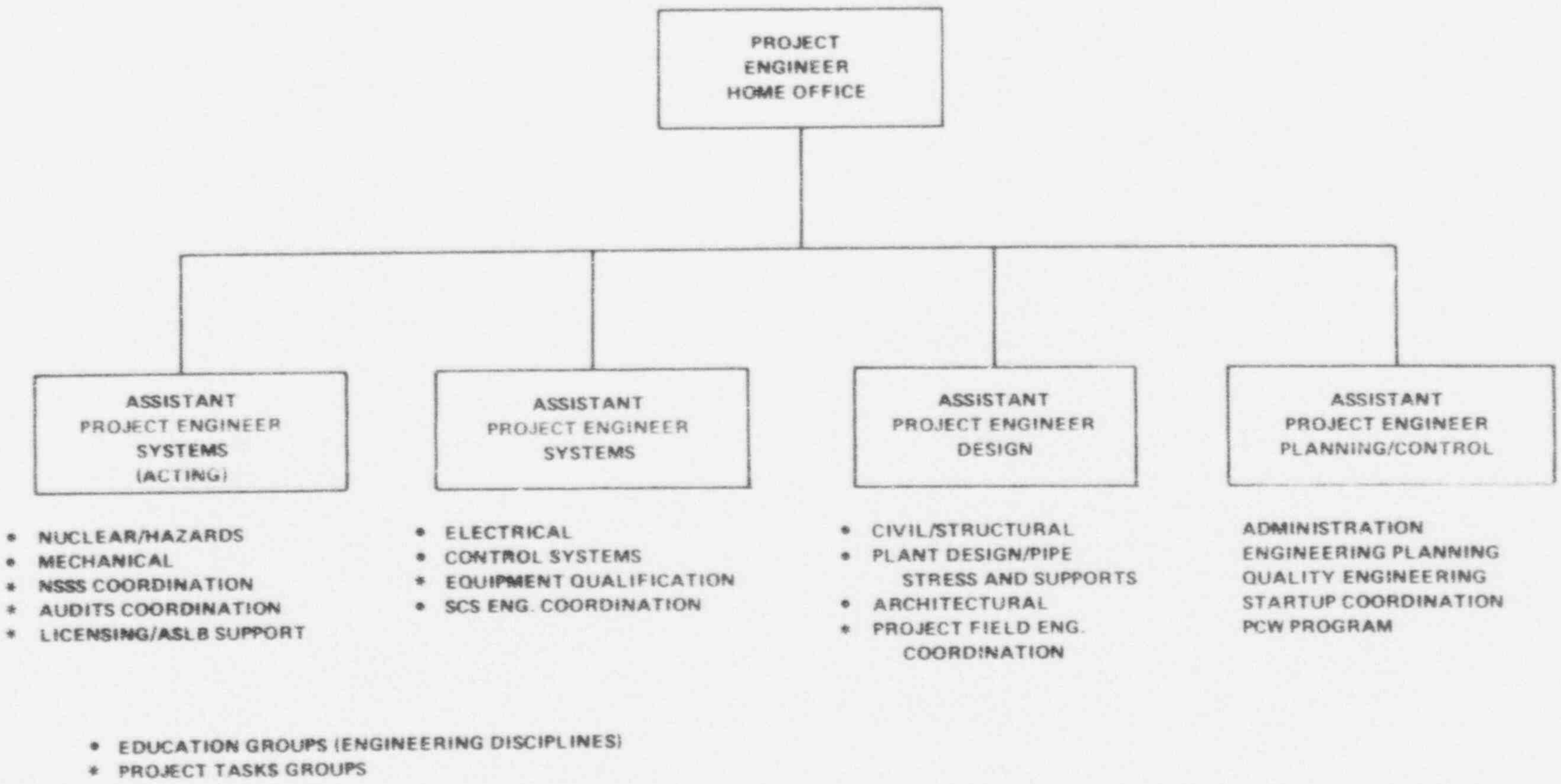

Figure 2.1-3 VEGP Bechtel Home (Functional) Engineering Organization

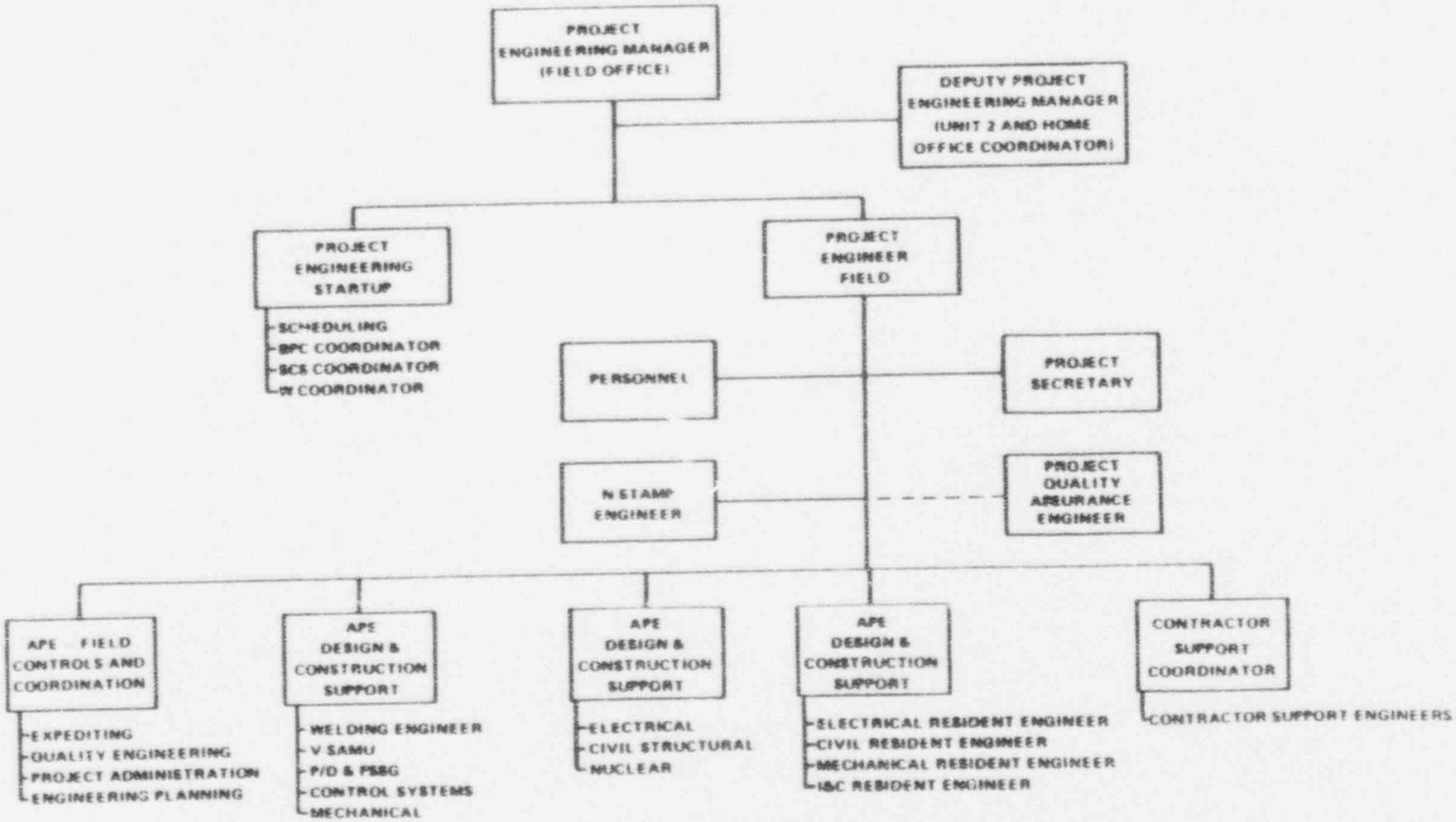

Figure 2.1-4 Bechtel Project Field Engineering

2.2 FIELD CONSTRUCTION ORGANIZATION

Georgia Power Company directs and maintains technical control of the backfill work through three departments working under the general manager Vogtle nuclear construction: Civil Project section, Civil Quality Control section, and Field Construction Operations (coordination). The administrative and schedule/budget sections also interface with the contractors but do not directly affect the quality of the work. The following is a description of the overall responsibility of each contractor and GPC section organization.

2.2.1 GPC CIVIL PROJECT SECTION

The Georgia Power Company Civil Project section provides coordination and support for contractors performing civil work. This includes providing assistance in the following areas:

- The development of civil construction procedures and assuring they are in compliance with Bechtel specifications and any applicable codes;
- The resolution of problems regarding civil work including constructability issues, Deviation Reports, trends, Field Change Requests, and open items;
- Dispositioning Deviation Reports and open items;
- Providing material for the contractors by initiating purchase orders and releases as required;
- Providing schedule and budget input to various site organizations;
- Extensively interfacing with coordination and Quality Control on problem identification and resolution.

2.2.2 GPC CIVIL QUALITY CONTROL

The Quality Control (QC) section implements the GPC field quality control program to verify quality compliance of field construction activities.

The Civil QC section assists GPC Civil Project section in developing implementing procedures and instructions, and verifies that field construction, erection, and installation conform to approved specifications, drawings, codes, and other requirements. QC section personnel assist in the development of forms, checklists, and other quality documents necessary to control activities and to demonstrate compliance with specified requirements.

The civil QC inspectors inspect in accordance with established quality control procedures as required by the Vogtle project quality assurance (QA) program. This includes inspection of the work as it is being performed by contractor craftsmen and documentation to verify the results.

2.2.3 GPC CIVIL FIELD CONSTRUCTION OPERATIONS - COORDINATION

The Site Coordination Group directs work at Plant Vogtle and ensures work is completed in a timely manner. The group interfaces with the site contractors to facilitate work flow. The lower tier coordination groups help bring field conflicts and problems to the attention of the area engineers and inform QC when inspection hold points are reached. They maintain a watch for productivity and quality problems. The Site Coordination Group is responsible for survey and layout work on the project.

2.2.4 HARBERT CONSTRUCTION COMPANY

Harbert Construction Company performed work on the VEGP site from May 1974 to September 1974. Harbert excavated the power block from elevation 220 to approximately elevation 145. Harbert received their work direction from the Civil Project section.

2.2.5 MANHATTAN-WALTON JOINT VENTURE

Manhattan-Walton Joint Venture was on the VEGP site from February 1977 to June 1979. Manhattan-Walton performed general grading work on the site and completed the power block excavation begun by Harbert Construction in 1974. Manhattan-Walton also placed some Seismic Category I backfill in the power block in the turbine building area.

Manhattan-Walton received its work sequence and direction from the Civil Project section. They coordinated with QC on work completion and acceptance.

2.2.6 WALSH CONSTRUCTION COMPANY

Walsh Construction Company, a division of Guy F. Atkinson Company, performed soils work after June 1979 in the power block under the guidance of the GPC QA program.

Walsh works with the Civil Project section to resolve constructability problems and to initiate change requests for drawings and specifications. They coordinate with Quality Control on work completion, acceptance, and resolution of deficiencies before soil placement. Walsh receives their work sequence and direction from the coordination group.

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3.0 COMMITMENTS

3.1 INTRODUCTION

This section contains, in matrix form, licensing and project commitments and the corresponding implementing documents. These are presented in two matrixes, the commitment matrix and the implementation matrix. A brief explanation of the development process for each matrix is also included.

Any differences between the commitments discussed in this section and the Vogtle Electric Generating Plant (VEGP) Final Safety Analysis Report (FSAR), if any, are accidental, and the FSAR prevails.

3.2 DEFINITIONS

Commitments are defined as the project obligations to regulatory guides, industry standards, branch technical positions, and other licensing requirements to the extent defined in the FSAR.

An implementing document is the working level document that identifies project commitments as they apply to the specific work activity.

3.3 SOURCES

Commitments covered by this report are identified from the following sources:

- o FSAR including responses to NRC questions;
- o Responses to Generic Letters;
- o Responses to I&E bulletins.

These sources are reviewed for commitments based upon guidelines developed from the definition.

Implementation of commitments stated in the commitment matrix are typically contained in:

- o Design criteria;
- o Construction specifications;
- o Construction procedures;
- o Technical specifications;
- o Operations procedures.

3.4 COMMITMENT MATRIX

Once identified by the Readiness Review Team, the commitments are placed on the commitment matrix. Information identifying the source, source section, subject, and module are also indicated on the matrix. Any relevant comments concerning the commitments or subject of the section are indicated in the remarks column.

COMMITMENTS

SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO.

EXPLANATION OF FIELDS

COMMITMENT SOURCE - The document containing the commitment (FSAR, Generic Letter, I.E. Bulletin Response, etc.)

COMMITMENT SECTION - Identifies the FSAR section, letter number, or question number

COMMITMENT SUBJECT - The subject of the FSAR section or Generic Letter

DOCUMENT/FEATURE - The document discussed in the FSAR section or the plant feature described in the FSAR section

MODULE - The Readiness Review modules applicable to the commitment under discussion

RESPONSIBILITY - An X is placed under the heading for the organization responsible for implementation of the commitment

REF. NO. - A reference number that corresponds to the appropriate line entry in the implementation matrix

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	CONST	REMARKS	REF NO
FSAR	1. 9. 59	DESIGN BASIS FLOODS FOR NUCLEAR POWER PLANTS	RG 1.59, REV 2, 8/77	13A	X		SEE FSAR 2.4.3, 2.4.4, 3.4.1	705
FSAR	1. 9.132	SITE INVESTIGATIONS FOR FOUNDATIONS OF NPP	RG 1.132, REV. 1, 03/79	13A	X		SEE 2.5	1870
FSAR	1. 9.138	LAB INVESTIGATIONS OF SOILS FOR ENGINEERING ANALYSIS AND DESIGN OF NPP.	RG 1.138, 04/78	13A	X		NOTE: SOIL INVESTIGATION FOR VEGP PERFORMED PRIOR TO ISSUANCE OF THIS GUIDE. SEE S2.5	1871
FSAR	2. 4. 2. 2	FLOOD DESIGN CONSIDERATIONS	ALL SAFETY-RELATED STRUCTURES HAVE A GRADE ELEV. OF 220 FT. MSL, WHICH IS WELL ABOVE THE PMF FLOOD STAGE.	13A	X			759
FSAR	2. 4. 12. 2	WATER LEVELS AND GROUND WATER MOVEMENT	A COMPREHENSIVE GROUND WATER MONITORING PROGRAM HAS BEEN IMPLEMENTED AT VEGP	13A		X	MONITORING OF GWT IN BACKFILL OF POWER BLOCK AREA	768
FSAR	2. 4. 12. 4	DESIGN BASIS FOR GROUND WATER LEVEL	MAXIMUM DESIGN GOUND WATER LEVEL 165.0 FT. MSL	13A	X			769
FSAR	2. 5. 2. 6	SEIMSIC DESIGN RESPONSE SPECTRA	RG 1.60, REV 1, 12/73	13A	X		SEE FSAR 3.7	771
FSAR	2. 5. 2. 7	OPERATING BASIS EARTHQUAKE	ACCELERATION 0.12g	13A	X		SEE FSAR 3.7	772
FSAR	2. 5. 4-12	SUMMARY OF RESULTS OF BEARING CAPACITY ANALYSIS (FACTOR OF SAFETY)	ULTIMATE BEARING PRESSURE AND FACTORS OF SAFETY IN TABLE	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1911

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2. 5. 4-2	ENGINEERING PROPERTIES FOR DESIGN	SOIL PROPERTIES (DENSITY, MOISTURE, ETC.)	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1906
FSAR	2. 5. 4-3	DESIGN VALUES OF SHEAR MODULUS	SHEAR MODULUS VALUES VS. ELEVATION	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1907
FSAR	2. 5. 4-4	IN SITU SOILS - BASIC SOIL PROPERTIES FOR DYNAMIC DESIGN	VALUES FOR EACH STRATA	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1908
FSAR	2. 5. 4-8	DESIGN STATIC PROPERTIES FOR BACKFILL COMPACTED TO 97% RELATIVE COMPACTION (ASTM D1557)	STATIC PROPERTY VALUES	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1909
FSAR	2. 5. 4-9	DESIGN DYNAMIC PROPERTIES FOR BACKFILL COMPACTED TO 97% RELATIVE COMPACTION (ASTM D1557)	DYNAMIC PROPERTY VALUES	13A	X		TABLE - PROPERTIES FOR FOUNDATION DESIGN	1910
FSAR	2. 5. 4. 2	PROPERTIES OF MARL BEARING STRATUM	UNDRAINED SHEAR STRENGTH DESIGN STRENGTH - 10KSF	13A	X			1941
FSAR	2. 5. 4. 5	SOIL-CEMENT-FLYASH BACKFILL	A PLASTIC BACKFILL MIX USED AS BEDDING FOR CAT. 2 CIRC. WATER LINES IN CAT. I BACKFILL ZONE.	13A	X	X	SEE FSAR FOR MIX DESIGN	773
FSAR	2. 5. 4. 5	SOURCES AND QUANTITIES OF BACKFILL MATERIAL	CAT. I BACKFILL SHOULD BE SAND & SILTY SAND WITH NOT MORE THAN 25% WEIGHT PERCENT PASSING THE U.S. NO. 200 SIEVE SIZE	13A		X	EXCEPTION IS BACKFILL AROUND SAFETY RELATED PIPING. SEE FSAR 2.5.4.5.2.	774

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2. 5. 4. 5	BACKFILL IN POWER BLOCK	COMPACTED TO AVERAGE 97% OF MAXIMUM DENSITY, DETERMINED BY ASTM D1557, WITH NO TESTS BELOW 93% AND NOT MORE THAN 10% OF TESTS BETWEEN 95 AND 93%	13A	X	X	SEE 2.5.4.5.2.7. NOTE: AREA NORTH OF THE TURBINE BLDG. WAS ONE EXCEPTION.	1887
FSAR	2. 5. 4. 5	BACKFILL	AREA NORTH OF TURBINE BLDG. COMPACTED TO AN AVERAGE OF 95% OF THE MAXIMUM DENSITY DETERMINED BY ASTM 1557 WITH NOT MORE THAN 10% OF TESTS BETWEEN 93% AND 95% AND NO TEST BELOW 93%	13A	X	X		1888
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D2487	13A	X			1889
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D2488	13A	X			1890
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D1140	13A		X		1891
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D422	13A		X		1892
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D423	13A	X			1893

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	CONST	REMARKS	REF NO
FSAR	2. 5. 4. 5	CRITERIA FOR CATEGORY 1 BACKFILL SUITABILITY	ASTM D424	13A	X			1894
FSAR	2. 5. 4. 5	TEST FILL FOR HEAVY EQUIPMENT COMPACTION	MOISTURE +OR-2% OPTIMUM FOR SAND/SILTY SAND MATERIAL AS DETERMINED BY ASTM D1557	13A		X		1895
FSAR	2. 5. 4. 5	TEST FILL FOR HEAVY EQUIPMENT COMPACTION	ASTM D1556 SAND CONE	13A		X	AS MODIFIED TO BE USED WITH ALL QC TESTING	1896
FSAR	2. 5. 4. 5	BACKFILL	AVERAGE OF 95% OF ASTM D1557 MAX. DENSITY WITH NO TESTS BELOW 93% AND NO MORE THAN 10% OF TESTS BETWEEN 93 AND 95%	13A		X	FOR LOCALIZED AREAS AROUND NON-SAFETY RELATED PIPING	1935
FSAR	2. 5. 4. 5	BACKFILL	STATIC CONE PENETROMETER READING OF 200 USED TO TEST CONC. SAND BACKFILL AROUND NON-SAFETY-RELATED PIPING	13A		X	WHERE ACCESS PREVENTS USE OF SAND CONE	1936
FSAR	2. 5. 4. 5	BACKFILL, SAFETY RELATED PIPING OR SIMILAR CONDUITS	COMPACTED TO 97% OF MAX. DRY DENSITY DETERMINED BY ASTM D1557 WITH NO TESTS BELOW 93% AND NO MORE THAN 10% OF TESTS BETWEEN 93 AND 95%	13A		X		1937

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	CONST	REMARKS	REF NO
FSAR	2. 5. 4. 5	BACKFILL	CAT. I BACKFILL BETWEEN AND IMMEDIATELY AROUND PIPES HAS A FINES CONTENT BELOW 10%	13A		X		1938
FSAR	2. 5. 4. 5	BACKFILL	STATIC CONE PENETROMETER READINGS USED TO TEST ADEQUACY OF COMPACTION WHERE ACCESS PREVENTS USE OF SAND CONE TEST.	13A		X	APPLIES TO CAT. I BACKFILL AROUND SAFETY RELATED PIPES. CORRELATED WITH SAND CONE.	1939
FSAR	2. 5. 4. 5	BACKFILL	LEAN CONCRETE USED TO FILL LOCALIZED AREAS WHERE PLACEMENT OF BACKFILL IMPRACTICAL	13A		X		1940
FSAR	2. 5. 4. 6	SITE GROUND WATER CONDITIONS	COMPREHENSIVE GROUNDWATER MONITORING PROGRAM HAS BEEN IMPLEMENTED AT THE VEGP.	13A		X		775
FSAR	2. 5. 4. 8	LIQUEFACTION POTENTIAL	BACKFILL HAS AN ADEQUATE FACTOR OF SAFETY AGAINST LIQUEFACTION FOR BACKFILL COMPACTED TO 97% OF MAX. DENSITY OBTAINED BY ASTM D1557.	13A	X			776
FSAR	2. 5. 4. 8	LIQUEFACTION POTENTIAL	SELECT SAND & SILTY SAND BACKFILL COMPACTED TO 97% OF MAX. DENSITY DETERMINED BY ASTM D1557 PLACED FROM TOP OF MARL TO DESIGN ELEVATION OF VARIOUS POWER BLOCK STRUCTURES	13A	X		SEE FSAR 2.5.4.8 FOR EXCEPTIONS.	1897

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	CONST	REMARKS	REF NO
FSAR	2. 5. 4.10	SETTLEMENT OF POWER BLOCK STRUCTURES ON MAT FOUNDATIONS	SEPOL (SETTLEMENT PROBLEM ORIENTED LANGUAGE - COMPUTER PROGRAM)	13A	X		SEE FSAR 2.5.4.10.2 FOR MORE DETAIL ON ASSUMPTIONS USED.	777
FSAR	2. 5. 4.10	CAISSON ULTIMATE DOWNWARD CAPACITY	REQUIRED CAPACITY/CAISSON IS 2,150K ACTUAL CAPACITY/CAISSON IS 5,280K	13A	X		SEE FSAR 2.5.4.10.3.1 FOR CLARIFICATION ON CALCULATIONS	778
FSAR	2. 5. 4.10	BEARING CAPACITY OF COMPACTED BACKFILL & MARL BEARING STRATUM SUPPORTING MAT FOUNDATIONS	SAFETY FACTOR GREATER THAN OR EQUAL TO 3 ACCEPTABLE FOR ALLOWABLE BEARING CAPACITY FOR STATIC LOADS	13A	X			1899
FSAR	2. 5. 4.10	BEARING CAPACITY OF COMPACTED BACKFILL & MARL BEARING STRATUM SUPPORTING MAT FOUNDATIONS	SAFETY FACTOR GREATER THAN OR EQUAL TO 2 REQUIRED FOR DYNAMIC LOADS	13A	X			1900
FSAR	2. 5. 4.11	DESIGN CRITERIA	ALL CAT. I STRUCTURES SUPPORTED ON CLAY MARL STRATUM OR SAND-SILTY SAND BACKFILL COMPACTED TO 97% MAX. DENSITY MEASURED BY ASTM D1557	13A	X			1901
FSAR	2. 5. 4.11	DESIGN CRITERIA	A MINIMUM FACTOR OF SAFETY OF 3 AGAINST SHEAR FAILURE OF FOUNDATION MATERIAL UNDER SUSTAINED DEAD LOAD PLUS LIVE LOAD.	13A	X		SEE 2.5.4.10.1	1902

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2. 5. 4.11	DESIGN CRITERIA	LIQUEFACTION POTENTIAL OF CATEGORY 1 BACKFILL IS BASED ON A MINIMUM FACTOR OF SAFETY OF 1.5 AGAINST LIQUEFACTION.	13A	X		SEE 2.5.4.8	1903
FSAR	2. 5. 4.11	DESIGN CRITERIA	A MINIMUM FACTOR OF SAFETY OF 2 AGAINST SHEAR FAILURE OF FOUNDATION MATERIAL UNDER SUSTAINED DEAD LOAD PLUS MAXIMUM LIVE LOAD.	13A	X		SEE 2.5.4.10.1	4687
FSAR	2. 5. 4.12	FOUNDATIONS IN SOIL	CAT. I FOUNDATION IN SOIL SUPPORTED ON SAND AND SILTY SAND BACKFILL COMPACTED TO 97% OF MAX. ASTM D1557 DENSITY.	13A	X		SEE 2.5.4.5	1904
FSAR	2. 5. 4.13	SETTLEMENT MONITORING	SURVEY READING 60-DAY INTERVALS PRIOR TO AND 30-DAY INTERVALS AFTER START-UP.	13A		X		780
FSAR	2. 5. 5. 1	(STABILITY OF SLOPES) - SLOPE CHARACTERISTICS	A TOTAL STRESS DESIGN SHEAR STRENGTH OF C=0, phi=34 DEGREES WAS USED FOR THE UPPER SAND STRATUM AND C=10,000 LB./FT.(2), phi=0 DEGREES FOR THE CLAY-BEARING STRATUM	13A	X		SEE T.2.5.4-2 PROPERTIES FOR FOUNDATION DESIGN.	1912

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2. 5. 5. 1	(STABILITY OF SLOPES) SLOPE CHARACTERISTICS	DESIGN EFFECTIVE STRESS PARAMETERS OF C(1)=0, phi=34 DEGREES WERE USED IN ANALYZING TEMPORARY FILL SLOPES.	13A	X		PROPERTIES FOR FOUNDATION DESIGN	1913
FSAR	2. 5. 5. 2	(STABILITY OF SLOPES) DESIGN CRITERIA AND ANALYSIS	THE STABILITY OF THE EXCAVATION CUT SLOPES IN IN SITU SOIL WAS DETERMINED USING A COMPUTER PROGRAM BASED ON A MODIFICATION OF THE SWEDISH SLIP CIRCLE METHOD OF SLICES ANALYSIS.	13A	X			1914
FSAR	2. 5. 5. 2	(STABILITY OF SLOPES) DESIGN CRITERIA AND ANALYSIS	IN A DEWATERED CONDITION, THE FACTOR OF SAFETY AGAINST SLIDING FOR A TEMPORARY SLOPE OF TWO HORIZONTAL TO ONE VERTICAL WAS DETERMINED TO BE 1.3.	13A	X			1915
FSAR	2. 5. 5. 2	(STABILITY OF SLOPES) DESIGN CRITERIA AND ANALYSIS	FOR TEMPORARY FILL SLOPES (1.5 HORIZONTAL TO ONE VERTICAL) SLOPE STABILITY ANALYSIS WAS PERFORMED USING THE INTEGRATED CIVIL ENGINEERING SYSTEMS "LEASE" COMPUTER PROGRAM	13A	X			1916

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2. 5. 5. 2	(STABILITY OF SLOPES) DESIGN CRITERIA AND ANALYSIS	INFINITE SLOPE ANALYSIS BASED ON THE DESIGN FRICTION ANGLE OF 34 DEGREES INDICATED THAT TEMPORARY FILL SLOPES WILL HAVE A MINIMUM FACTOR OF SAFETY AGAINST RAVELING OF 1.01.	13A	X			1917
FSAR	2. 5.A	GEOLOGY, SEISMOLOGY, & GEOTECHNICAL ENGINEERING	10CFR100, APPENDIX A	13A	X		SEE 2.5.1 THROUGH 2.5.6	1885
FSAR	2. 5.C	SUMMARY OF SEISMOLOGY	SAFE SHUTDOWN EARTHQUAKE 0.20 PHA -OPERATING BASIS EARTHQUAKE 0.12 PHA	13A	X			781
FSAR	2.B. 3. 1	REPORT OF GEOLOGY & FOUNDATION CONDITIONS, INTRODUCTION	DOCUMENTATION FOR THE APPROVED FOUNDATION AREAS WAS SUMITTED TO GEORGIA POWER CO. FOR PERMANENT RETENTION.	13A		X		1919
FSAR	2.B. 3. 3. 2	GEOLOGIC CONDITIONS, GEOLOGIC MAPPING PROCEDURES	DOCUMENTATION OF THE GEOLOGIC INSP. & APPROVAL OF FOUND. AREAS HAS BEEN TRANSMITTED FROM THE INSPECTING BECHTEL GEOLOGISTS TO GPC SITE PERSONNEL FOR PERMANENT RETENTION.	13A		X		1920
FSAR	2.B. 3. 4. 6	EXCAVATION AND FOUNDATION CONSIDERATIONS, FDN. INSPECT. AND APPROVAL PROCEDURES	THE INSPECTING GEOLOGIST DOCUMENTED THE APPROVAL OF THE AREA ON FIELD FOUNDATION APPROVAL FORMS. THESE FIELD APPROVAL FORMS WERE TRANSMITTED TO THE GPC SITE PERSONNEL FOR PERMANENT RETENTION.	13A		X		1921

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
FSAR	2.B. 3. 4. 6	EXCAVATION AND FOUNDATION CONSIDERATIONS, FDN. INSPECTION AND APPROVAL PROCEDURES	PHOTOGRAPHS OF THE FOUNDATION AREAS WERE TAKEN. THESE WERE LOGGED AND TRANSMITTED TO GPC FOR PERMANENT RETENTION IN THE FIELD OFFICE.	13A		X		1922
FSAR	3. 4. 1. 1	FLOOD PROTECTION FROM NATURAL CAUSES	SITE IS GRADED TO OFFER PROTECTION TO SEISMIC CAT. I STRUCTURES BY A MINIMUM OF 1% SURFACE SLOPE	13A	X			923
FSAR	3. 7.B. 1. 4	SUPPORTING MEDIA FOR SEISMIC CAT. I STRUCTURES	SELECT COMPACTED BACKFILL PLACED FROM TOP OF CLAY MARL BEARING STRATA TO DESIGN ELEVATION OF CAT. I STRUCTURES EXCEPT AUXILIARY BUILDING & NSCW TOWERS	13A	X			982
FSAR	3.B. 1. 8	COMPUTER PROGRAMS USED FOR STRUCTURAL, SEISMIC & GEOTECHNICAL ANALYSIS	CLASSI	13A	X		USED TO COMPUTE IMPEDANCE FUNCTION OF A LAYERED MEDIUM	1287
FSAR	3.B. 1.14	COMPUTER PROGRAMS USED FOR STRUCTURAL SEISMIC & GEOTECHNICAL ANALYSIS	ICES-LEASE (McAUTO VERSION)	13A	X		USED TO DETERMINE FACTOR OF SAFETY AGAINST SLIDING OF EXCAVATED SLOPES.	1292
FSAR	3.B. 1.15	COMPUTER PROGRAMS USED FOR STRUCTURAL, SEISMIC & GEOTECHNICAL ANALYSIS	ICES - SEPOL (McAUTO VERSION)	13A	X		USED TO ESTIMATE SETTLEMENTS OF POWER BLOCK STRUCTURES	1293

COMMITMENTS

MODULE 13A - SORTED BY SOURCE AND SECTION

COMMITMENT SOURCE	COMMITMENT SECTION	COMMITMENT SUBJECT	DOCUMENT/ FEATURE	MODULE	RESPONSIBILITY DESIGN	RESPONSIBILITY CONST	REMARKS	REF NO
GENERIC LETTER CORR.	C-77/07/25	CATEGORY I BACKFILL	NO COMPACTION TESTS BELOW 93% AND NOT LESS THAN 10% BELOW 95% IN SET OF 20 TESTS. TEST DEPTH NOT EXCEEDING 24 INCHES.	13A		X		1833
GENERIC LETTER CORR.	C-77/07/25	CATEGORY I BACKFILL	IN-SITU DENSITY WILL BE MADE AT A MIN. FREQUENCY OF 1 PER 20,000 SF OF FILL PLACED PER 1 FT. DEPTH.	13A		X		1834
GENERIC LETTER CORR.	C-84/02/07	COMPACTION AROUND PIPES - CAT. I BACKFILL	NO COMPACTION TESTS BELOW 93% AND NOT LESS THAN 10% BELOW 95% IN SET OF 20 TESTS	13A		X		1838
NRC QUEST. CORRES.	Q241. 3	CLAY MARL BEARING STRATUM BASIS FOR SELECTION OF MODULUS VALUES	EMP. RELATIONSHIP FOR UNDRAINED YOUNG'S MODULUS E=400Su. Su = UNDRAINED SHEAR STRENGTH. (4000KSF) LOWER BOUND.	13A	X		RESPONSE TO QUESTION	1480
NRC QUEST. CORRES.	Q241. 18	FOUNDATION DESIGN - CAT. I TUNNELS, WATER STORAGE TANKS, AND DIESEL FUEL OIL STORAGE TANK PUMP HOUSES	FOUNDATION DESIGN FOR STRUCTURES IS CONSISTENT WITH THAT FOR OTHER CAT. I STRUCTURES.	13A	X		RESPONSE TO QUESTION	4139
NRC QUEST. CORRES.	Q241. 21	DESIGN METHODS & CRITERIA FOR CALCULATION LATERAL EARTH PRESS. ON CATEGORY I STRUCTURES	MINIMUM FACTORS OF SAFETY	13A	X		S. F. TABULATION RESPONSE	1479

3.5 IMPLEMENTATION MATRIX

After the commitments are identified, each team reviews the documents controlling its areas of responsibility to verify compliance with commitment requirements. The depth of verification is to the next level of detail below that stated in the commitment matrix. As an example, if a code is stated as a commitment, the verification will be to the sections within the code. If a code chapter is stated, the verification will be to the subchapters.

IMPLEMENTATION

SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO.

EXPLANATION OF FIELDS

DOCUMENT/FEATURE - The document discussed in the FSAR section or the plant feature described in the FSAR section. (See Commitment Matrix.)

SECTION - The section of the document/feature that is being discussed

MODULE - The Readiness Review modules applicable to the section under discussion

DESIGN LAST, CONST LAST - "Last" indicates the project document currently containing the information found in the commitment

DESIGN FIRST, CONST FIRST - "First" indicates the project document that contained the information found in the commitment when the a ctivities governed by the document first began.

REF NO. - A reference number that corresponds to the appropriate line entry in the commitment matrix.

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
RG 1.59, REV 2, 8/77		13A	DC-1000-C, REV. 3, 9-30-83, APPENDIX E	DC-1000-C, REV. 2, 12-29-81, APPENDIX E				705.00
ALL SAFETY-RELATED STRUCTURES HAVE A GRADE ELEV. OF 220 FT. MSL, WHICH IS WELL ABOVE THE PMF FLOOD STAGE.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 4.1, 219'-6", SECT. 3.5.3, 220'-0"	DC-1000-C, REV. 0, 2-28-74, SECT. 4.1, 219'-0				759.00
A COMPREHENSIVE GROUND WATER MONITORING PROGRAM HAS BEEN IMPLEMENTED AT VEGP		13A			E2AP01 C2.18, REV. 9, 4-9-85	E2AP01 C2.18, REV. 0, 1-23-79		768.00
MAXIMUM DESIGN GOUND WATER LEVEL 165.0 FT. MSL		13A	DC-1000-C, REV. 3, 9-30-80, SECT. 4.1.7	DC-1000-C, REV. 0, 2-28-74, SECT. 4.1.7				769.00
RG 1.60, REV 1, 12/73		13A	DC-1000-C, REV. 3, 9-30-80, APPENDIX E	DC-1000-C, REV. 3, 9-30-80, APPENDIX E				771.00
ACCELERATION 0.12g (OBE)		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 4.3, 5.6.1A	DC-1000-C, REV. 1, 11-22-77, SECT. 4.3, 5.6.1A				772.00
A PLASTIC BACKFILL MIX USED AS BEDDING FOR CAT. 2 CIRC. WATER LINES IN CAT. I BACKFILL ZONE.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3	DC-1000-C, REV. 1, 11-22-77, SECT. 4.3, 5.6.1	E2AP01, C2.4, REV. 4, 6-18-81, CD-T-22, REV. 4, 7-6-84	E2AP01 C2.4, REV. 0, 6-18-81, CD-T-22, REV. 0, 10-1-81		773.00
CAT. I BACKFILL SHOULD BE SAND & SILTY SAND WITH NOT MORE THAN 25% WEIGHT PERCENT PASSING THE U.S. NO. 200 SIEVE SIZE		13A			E2AP01 C2.2, REV. 13, 11-9-84, E2AB01, REV. 4, 9-27-79, CD-T-01, REV. 16, 2-6-85	E2AP01 C.2.2, REV. 0, 2-20-79, E2AB01, REV. 2, 6-23-78, CD-T-01, REV. 10, 9-22-80		774.00

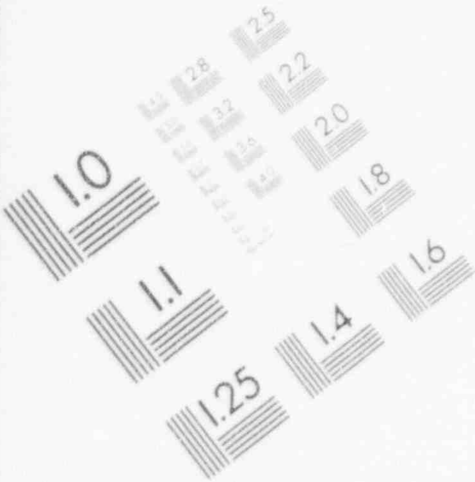
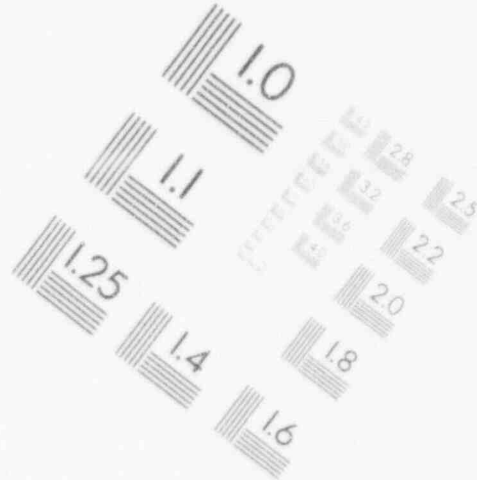
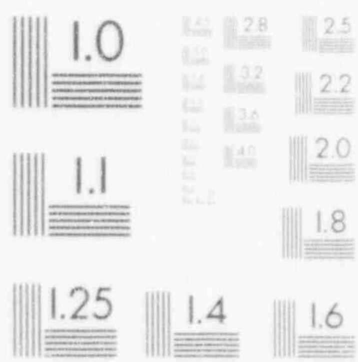
IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
COMPREHENSIVE GROUNDWATER MONITORING PROGRAM HAS BEEN IMPLEMENTED AT THE VEGP.		13A			X2AP01 C2.18, REV. 9, 4-9-85	X2AP01 C2.18, REV. 0, 1-23-79		775.00
BACKFILL HAS AN ADEQUATE FACTOR OF SAFETY AGAINST LIQUEFACTION FOR BACKFILL COMPACTED TO 97% OF MAX. DENSITY OBTAINED BY ASTM D1557.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: SECT. 9.10	DC-1000-C, REV. 1, 9-30-83, SECT. 2.2B: SECT. 9.10			ALSO SEE REF. 1903	776.00
SEPOL (SETTLEMENT PROBLEM ORIENTED LANGUAGE COMPUTER PROGRAM)		13A	DC-1000-C, REV. 3, 9-30-83, APPENDIX A, SECT. B.4	DC-1000-C, REV. 3, 9-30-83, APPENDIX A, SECT. B.4				777.00
REQUIRED CAPACITY/CAISSON IS 2,150K ACTUAL CAPACITY/CAISSON IS 5,280K		13A	DC-2165, REV. 1, 3-17-83, SECT. 2.1	DC-2165, REV. 1, 3-17-83, SECT. 2.1				778.00
SURVEY READING 60-DAY INTERVALS PRIOR TO AND 30-DAY INTERVALS AFTER START-UP.		13A			X2AP01 C10.1, REV. 8, 01-06-85	X2AP01 C10.1, REV. 0, 11-04-77	SEE MODULE SECTION 6.2	780.00
SAFE SHUTDOWN EARTHQUAKE 0.2G PEAK HORIZON ACCELERATION (PHA) - OPERATING BASIS EARTHQUAKE 0.12 PHA		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 5.6.1A	DC-1000-C, REV. 1, 11-22-77, SECT. 5.6.1A				781.00

2

IMAGE EVALUATION TEST TARGET (MT-3)

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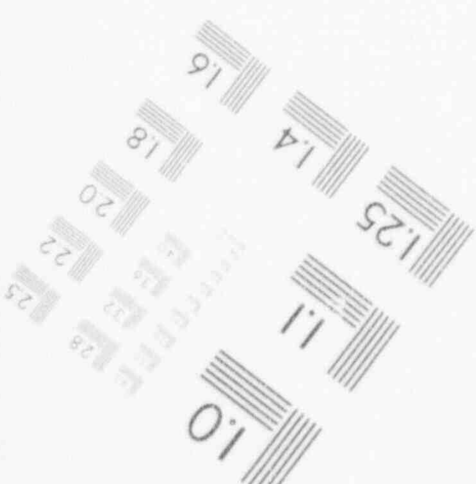
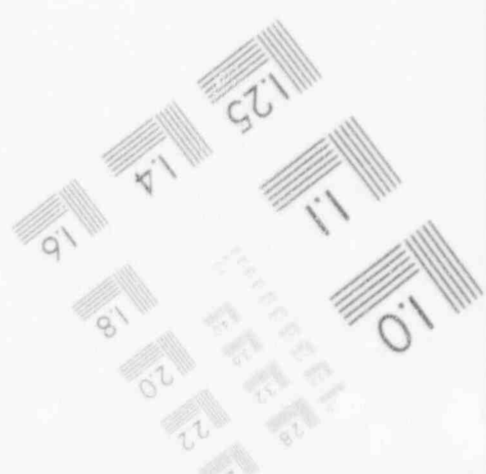

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2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
SITE IS GRADED TO OFFER PROTECTION TO SEISMIC CATEGORY I STRUCTURES BY A MINIMUM OF 1% SURFACE SLOPE	FSAR SECT. 3.4.1.1	13A	DRAWINGS: AX2D45V001-REV.1, AX2D458001-REV.1, AX2D458002-REV. 18, AX2D458003-REV.1, AX2D458004-REV.1	SAME AS LAST			INDEX DRAWING AND FINAL GRADING DRAWINGS	923.00
SELECT COMPACTED BACKFILL PLACED FROM TOP OF CLAY MARL BEARING STRATA TO DESIGN ELEVATION OF CAT. I STRUCTURES EXCEPT AUXILIARY BUILDING & NSCW TOWERS		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.2	DC-1000-C, REV. 1, 11-22-77, REV. 3.5.2,				982.00
CLASSI		13A	DC-1000-C, REV. 3, 9-30-83, APP. A-9	DC-1000-C, REV. 3, 9-30-83, APP. A-9				1287.00
ICES-LEASE (McAUTO VERSION)		13A	DC-1000-C, REV. 3, 9-30-83, APP. A, SECT. B.3	DC-1000-C, REV. 3, 9-30-83, APP. A. SECT. B.3				1292.00
ICES - SEPOL (McAUTO VERSION)		13A	DC-1000-C, REV. 3, 9-30-83, APPENDIX A, SECT. B.4	DC-1000-C, REV. 3, 9-30-83, APPENDIX A, SECT. B.4			SEE ALSO REF. NO. 777	1293.00
MINIMUM FACTORS OF SAFETY		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 6.2	DC-1000-C, REV. 2, SECT. 6.2				1479.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
EMP. RELATIONSHIP FOR UNDRAINED YOUNG'S MODULUS E=400Su. WHERE Su = UNDRAINED SHEAR STRENGTH. (4000KSF) LOWER BOUND.		13A	DC-1000-C, REV. 3, 9-30-83, FIG. 13	DC-1000-C, REV. 3, 9-30-83, FIG. 13				1480.00
NO COMPACTION TESTS BELOW 93% AND NOT LESS THAN 10% BELOW 95% IN SET OF 20 TESTS. TEST DEPTH NOT EXCEEDING 24 INCHES.		13A			X2AP01 C2.2, REV. 13, 11-9-84, X2AB01, REV. 4, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 1, CD-T-01, REV. 7, 5-1-78		1633.00
IN-SITU DENSITY WILL BE MADE AT A MIN. FREQUENCY OF 1 PER 20,000 SF OF FILL PLACED PER 1 FT. DEPTH.		13A			X2AP01 C2.2, REV. 13, 11-9-84, X2AB01, REV. 4, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 1, CD-T-01, REV. 7, 5-1-78		1834.00
NO COMPACTION TESTS BELOW 93% AND NOT LESS THAN 10% BELOW 95% IN SET OF 20 TESTS		13A			X2AP01 C2.2, REV. 13, 11-9-84, CD-T-01, REV. 16, 7-6-85	X2AP01 C2.2, REV. 11, 2-17-84, CD-T-01, REV. 15, 2-27-84		1838.00
RG 1.132, REV. 1, 03/79		13A	DC-1000-C, REV. 3, 9-30-83, APP. E	DC-1000-C, REV. 2, 12-29-81, APP. E				1870.00
RG 1.138, 04/78		13A	DC-1000-C, REV. 3, 9-30-83, APPENDIX E	DC-1000-C, REV. 2, 12-29-81, APPENDIX E				1871.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
10CFR100, APPENDIX A		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.5.1C	DC-1000-C, REV. 0, 2-28-74, SECT. 2.5.1C				1885.00
COMPACTED TO AVERAGE 97% OF MAXIMUM DENSITY, DETERMINED BY ASTM D1557, WITH NO TESTS BELOW 93% AND NOT MORE THAN 10% OF TESTS BETWEEN 95 AND 93%		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B, 3.5.3	DC-1000-C, REV. 0, 2-28-74, SECT. 3.5.3	X2AP01 C2.2, REV. 13, 11-9-84, X2AB01, REV. 4, CD-T-01, REV. 16, 2-8-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 1, CD-T-01, REV. 7, 5-1-78		1887.00
AREA NORTH OF TURBINE BLDG. COMPACTED TO AN AVERAGE OF 95% OF THE MAXIMUM DENSITY DETERMINED BY ASTM 1557 WITH NOT MORE THAN 10% OF TESTS BETWEEN 93% AND 95% AND NO TEST BELOW 93%		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3	X2AP01 C2.2, REV. 13, 11-9-84, AX2D46T001, REV. 12, 3-1-82, AX2D46T004, REV. 11, 3-1-82, CD-T-01, REV. 16, 2-26-85	X2AP01 C2.2, REV. 5, 10-23-81, AX2D46T001, REV. 11, 5-29-81, AX2D46T004, REV. 10, 5-29-81, CD-T-01, REV. 13, FPCN #24, 2-9-83		1888.00
ASTM D2487		13A	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.1	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.1				1889.00
ASTM D2488		13A	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.1	X2AP01-C2.13, REV. 2, 1-4-79 SECT. 2.13.14B 1				1890.00
ASTM D1140		13A			X2AP01 C2.2, REV. 13, 11-9-84, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 3, 9-3-80, CD-T-01, REV. 10, 9-22-80		1891.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
ASTM D422		13A			X2AP01 C2.2, REV. 13, 11-9-84, X2AB01, REV. 4, 9-27-79, CD-T-01, REV. 16, 2-26-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 2, 6-23-78, CD-T-01, REV. 10, 9-22-80		1892.00
ASTM D423		13A	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.5, X2AP01-C2.2, REV. 13	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.5, X2AP01-C2.2, REV. 0				1893.00
ASTM D424		13A	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.5	X2AP01-C2.13, REV. 2, 1-4-79, SECT. 2.13.14B.5				1894.00
MOISTURE +OR-2% OPTIMUM FOR SAND/SILTY SAND MATERIAL AS DETERMINED BY ASTM D1557		13A			X2AP01 C2.2, REV. 13, 2-20-79, X2AB01, REV. 4, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 1, CD-T-01, REV. 9, 11-19-79	SEE MODULE SECTION 6.2	1895.00
ASTM D1556 SAND CONE		13A			X2AP01, C2.2, REV. 13, 11-9-84, X2AB01, REV. 4, 9-27-79, CD-T-01, REV. 16, 2-26-85	X2AP01 C2.2, REV. 0, 2-20-79, X2AB01, REV. 1, 11-15-76, CD-T-01, REV. 7, 5-1-78		1896.00
SELECT SAND & SILTY SAND BACKFILL COMPACTED TO 97% OF MAX. DENSITY DETERMINED BY ASTM D1557 PLACED FROM TOP OF MARL TO DESIGN ELEVATION OF VARIOUS POWER BLOCK STRUCTURES		13A	DC-1000-C, REV. 3, 9-30-80, SECT. 3.5.3, AX2D46T004, REV. 11, 3-1-82	DC-1000-C, REV. 0, 2-28-74, SECT. 3.5.3, AX2D46T004, REV. 10, 5-31-81				1897.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
SAFETY FACTOR GREATER THAN OR EQUAL TO 3 ACCEPTABLE FOR ALLOWABLE BEARING CAPACITY FOR STATIC LOADS		13A	CALC. X2CF-S-103, REV. 0, SHEETS 18 AND 24, TABLES	CALC. X2CF-S-103, REV. 0, SHEETS 18 AND 24, TABLES				1899.00
SAFETY FACTOR GREATER THAN OR EQUAL TO 1 REQUIRED FOR DYNAMIC LOADS		13A	CALC. X2CF-S-103, REV. 0, SHEETS 18 AND 24, TABLES	CALC. X2CF-S-103, REV. 0, SHEETS 18 AND 24, TABLES				1900.00
ALL CAT. I STRUCTURES SUPPORTED ON CLAY MARL STRATUM OR SAND-SILTY SAND BACKFILL COMPACTED TO 97% MAX. DENSITY MEASURED BY ASTM D1557		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3	DC-1000-C, REV. 0, 2-28-84, SECT. 3.5.3				1901.00
A MINIMUM FACTOR OF SAFETY OF 3 AGAINST SHEAR FAILURE OF FOUNDATION MATERIAL UNDER SUSTAINED DEAD LOAD PLUS LIVE LOAD.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.2	DC-1000-C, REV. 0, 2-28-84, SECT. 5.3.2				1902.00
LIQUEFACTION POTENTIAL OF CATEGORY 1 BACKFILL IS BASED ON A MINIMUM FACTOR OF SAFETY OF 1.5 AGAINST LIQUEFACTION.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: SECT. 9.10	DC-1000-C, REV. 0, 2-28-74, SECT. 2.2B: SECT. 9.10				1903.00

IMPLEMENTATION

MODULE 13A SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
CAT. I FOUNDATION IN SOIL SUPPORTED ON SAND AND SILTY SAND BACKFILL COMPACTED TO 97% OF MAX. ASTM D1557 DENSITY.		13A	DC-1000-C, REV. 3, 4-30-83, SECT. 3.5.3, AX2D46T004, REV. 11, 3-1-82	DC-1000-C, REV. 0, 2-28-74, SECT. 3.5.3, AX2D46T004, REV. 0, 4-8-74				1904.00
SOIL PROPERTIES (DENSITY, MOISTURE, ETC.)		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: TABLE 7	DC-1000-C, REV. 1, 11-22-77, SECT. 2.2B: TABLE 7				1906.00
SHEAR MODULUS VALUES VS. ELEVATION		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 4.2.6A.2	DC-1000-C, REV. 2, 12-29-81, SECT. 4.2.6A.2				1907.00
VALUES FOR EACH STRATA		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: TABLE 10	DC-1000-C, REV. 1, 11-22-77, SECT. 2.2B: TABLE 10, DC-1000-C, REV. 0, 2-28-74, SECT. 4.2.1C, 4.2.6B				1908.00
STATIC PROPERTY VALUES		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 4.2.1C, 4.2.6B, 4.2.6C	DC-1000-C, REV. 1, 11-22-77, SECT. 4.2.6C				1909.00
DYNAMIC PROPERTY VALUES		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 4.2.1C, SECT. 4.2.6A, SECT. 4.2.6B	DC-1000-C, REV. 0, 2-28-74, SECT. 4.2.1C, FIG. 12, SECT. 4.2.6A, SECT. 4.2.6B				1910.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
ULTIMATE BEARING PRESSURE AND FACTORS OF SAFETY IN TABLE		13A	CALC. E2CF-8-103, REV. 0, PG. 18 AND 24	CALC. E2CF-8-103, REV. 0, PG. 18 AND 24				1911.00
A TOTAL STRESS DESIGN SHEAR STRENGTH OF C=0, phi=34 DEGREES WAS USED FOR THE UPPER SAND STRATUM AND C=10,000 LB./FT.(2), phi=0 DEGREES FOR THE CLAY-BEARING STRATUM		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2.B: TABLE 7	DC-1000-C, REV. 1, 11-22-77, SECT. 2.2B: TABLE 7				1912.00
DESIGN EFFECTIVE STRESS PARAMETERS OF C(1)=0, phi=34 DEGREES WERE USED IN ANALYZING TEMPORARY FILL SLOPES.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: TABLE 7	DC-1000-C, REV. 1, SECT. 2.2B: TABLE 7				1913.00
THE STABILITY OF THE EXCAVATION CUT SLOPES IN IN SITU SOIL WAS DETERMINED USING A COMPUTER PROGRAM BASED ON A MODIFICATION OF THE SWEDISH SLIP CIRCLE METHOD OF SLICES ANALYSIS.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2.B: SECT. 10.1	DC-1000-C, REV. 1, 11-22-77, SECT. 2.2.B: SECT. 10.1				1914.00
IN A DEWATERED CONDITION, THE FACTOR OF SAFETY AGAINST SLIDING FOR A TEMPORARY SLOPE OF TWO HORIZONTAL TO ONE VERTICAL WAS DETERMINED TO BE 1.3.		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: TABLE 13, SECT. 10.1	DC-1000-C, REV. 1, 11-22-77, SECT. 2.2B: TABLE 13, SECT. 10.1				1915.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
FOR TEMPORARY FILL SLOPES (1.5 HORIZONTAL TO ONE VERTICAL) SLOPE STABILITY ANALYSIS WAS PERFORMED USING THE INTEGRATED CIVIL ENGINEERING SYSTEMS "LEASE" COMPUTER PROGRAM		13A	DC-1000-C, REV. 3, 9-30-83, APPENDIX A, SECT. B.3, CALC. X2CF-S-065, REV. 1, PAGE 6	DC-1000-C, REV. 2, 12-29-81, APPENDIX A, SECT. B.3, CALC. X2CF-S-065, REV. 1, PAGE 6				1916.00
INFINITE SLOPE ANALYSIS BASED ON THE DESIGN FRICTION ANGLE OF 34 DEGREES INDICATED THAT TEMPORARY FILL SLOPES WILL HAVE A MINIMUM FACTOR OF SAFETY AGAINST RAVELING OF 1.01.		13A	CALC. X2CF-S-062, REV. 0, PAGE 2	CALC. X2CF-S-062, REV. 0				1917.00
DOCUMENTATION FOR THE APPROVED FOUNDATION AREAS WAS SUMITTED TO GEORGIA POWER CO. FOR PERMANENT RETENTION.		13A			SEE REMARKS		DOCUMENTS WERE FOUND STORED IN GPC CONSTRUCTION VAULT	1919.00
DOCUMENTATION OF THE GEOLOGIC INSP. & APPROVAL OF FOUND. AREAS HAS BEEN TRANSMITTED FROM THE INSPECTING BECHTEL GEOLOGISTS TO GPC SITE PERSONNEL FOR PERMANENT RETENTION.		13A			SEE REMARKS		DOCUMENTS WERE FOUND STORED IN GPC CONSTRUCTION VAULT	1920.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
THE INSPECTING GEOLOGIST DOCUMENTED THE APPROVAL OF THE AREA ON FIELD FOUNDATION APPROVAL FORMS. THESE FIELD APPROVAL FORMS WERE TRANSMITTED TO THE GPC SITE PERSONNEL FOR PERMANENT RETENTION.		13A			SEE REMARKS		DOCUMENTS WERE FOUND STORED IN GPC CONSTRUCTION VAULT	1921.00
PHOTOGRAPHS OF THE FOUNDATION AREAS WERE TAKEN. THESE WERE LOGGED AND TRANSMITTED TO GPC FOR PERMANENT RETENTION IN THE FIELD OFFICE.		13A			SEE REMARKS		PHOTOGRAPHS AND LOG WERE FOUND STORED IN GPC CONSTRUCTION VAULT	1922.00
AVERAGE OF 95% OF ASTM D1557 MAX. DENSITY WITH NO TESTS BELOW 93% AND NO MORE THAN 10% OF TESTS BETWEEN 93 AND 95%		13A			X2AP01 C2.2, REV. 13, 11-9-84, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 11, 2-17-84, CD-T-01, REV. 15, 2-27-84		1935.00
STATIC CONE PENETROMETER READING OF 200 USED TO TEST CONC. SAND BACKFILL AROUND NON-SAFETY-RELATED PIPING		13A			X2AP01 C2.2, REV. 13, 11-9-84, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 11, 2-17-84, CD-T-01, REV. 15, 2-27-84		1936.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
COMPACTED TO 97% OF MAX. DRY DENSITY DETERMINED BY ASTM D1557 WITH NO TESTS BELOW 93% AND NO MORE THAN 10% OF TESTS BETWEEN 93 AND 95%		13A			X2AP01 C2.2, REV. 13, 11-9-84, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2, REV. 11, 2-17-84, CD-T-01, REV. 15, 2-27-84		1937.00
CAT. I BACKFILL BETWEEN AND IMMEDIATELY AROUND PIPES HAS A FINES CONTENT BELOW 10%		13A			X2AP01 C2.2, REV. 13, 11-9-84	X2AP01 C2.2, REV. 11, 2-17-84		1938.00
STATIC CONE PENETROMETER READINGS USED TO TEST ADEQUACY OF COMPACTION WHERE ACCESS PREVENTS USE OF SAND CONE TEST.		13A			X2AP01 C2.2.7C, REV. 13, 11-9-84, CD-T-01, REV. 16, 2-6-85	X2AP01 C2.2.7C, REV. 11, 2-17-84, CD-T-01, REV. 15, 2-27-84		1939.00
LEAN CONCRETE USED TO FILL LOCALIZED AREAS WHERE PLACEMENT OF BACKFILL IMPRACTICAL		13A			X2AP01 C2.2, REV. 13, 11-9-84, AX2D46T011, REV. 18, 2-19-81, AX2D46T012, REV. 14, 3-12-81, AX2D46T013, REV. 5, 4-14-80, AX2D46T014, REV. 2, 9-19-84	X2AP01 C2.2, REV. 11, 2-17-84, AX2D46T011, REV. 0, 7-18-74, AX2D46T012, REV. 0, 7-18-74, AX2D46T013, REV. 0, 3-1-78, AX2D46T014, REV. 0, 4-14-80		1940.00
UNDRAINED SHEAR STRENGTH DESIGN STRENGTH - 10KSF		13A	DC-1000-C, REV. 3, 9-30-83, SECT. 2.2B: TABLE 7, X2AP01, C.2.2, REV. 13, SECT. 2.2.6.C.5	DC-1000-C, REV 1, 11-22-77, SECT. 2.2B: TABLE 7				1941.00

IMPLEMENTATION

MODULE 13A - SORTED BY REFERENCE NUMBER

DOCUMENT/FEATURE	SECTION	MODULE	DESIGN LAST	DESIGN FIRST	CONST LAST	CONST FIRST	REMARKS	REF NO
FOUNDATION DESIGN FOR STRUCTURES IS CONSISTENT WITH THAT FOR OTHER CAT. I STRUCTURES.	NRC Q241.15, CAT. 1 TUNNELS, TANKS	13A	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3, APPENDIX F.5, CALC. X2CF-8-103, REV. 0, PAGES 18 AND 24	DC-1000-C, REV. 3, 9-30-83, SECT. 3.5.3, APPENDIX F.5, CALC. X2CF-8-103, REV. 0				4139.00
A MINIMUM FACTOR OF SAFETY OF 2 AGAINST SHEAR FAILURE OF FOUNDATION MATERIAL UNDER SUSTAINED DEAD LOAD PLUS MAXIMUM LIVE LOAD.		13A	CALC. X2CF-8-103, REV. 0, PAGES 18 AND 24	CALC. X2CF-8-103, REV. 0, PAGES 18 AND 24			REF. 1899	4687.00

4.0 PROGRAM DESCRIPTION

This section contains a description of the work process utilized by design and construction associated with foundation materials and backfill.

The program description is divided as follows:

4.1 Design
4.2 Materials
4.3 Training and qualification
4.4 Construction

This section should be reviewed with the following appendixes that will expand on certain phases of the operation as they apply:

Appendix A Organization
Appendix B Design Control
Appendix C Procurement
Appendix D Document Control
Appendix E Material Control
Appendix F Inspector Qualification/Certification
Appendix G Measuring and Test Equipment
Appendix H Nonconformances

4.1 DESIGN

This section provides a description of design engineering scope, work flow, documentation, design control, and As-Built activities related to the design of foundation materials and Seismic Category I backfill used to support the major power block structures including all Category I structures.

Site foundation investigations were conducted under the direction of Law Engineering Testing Company and Bechtel Geotechnical Services (Geotech) in accordance with Regulatory Guide 1.132, Regulatory Guide 1.70, ANSI/ANS 2.11, and ANSI/ANS 2.7. The foundation investigations include surface and subsurface studies, seismological evaluation, geohydrological evaluation, in-situ testing, laboratory testing, and analysis of data. These studies resulted in the development of geotechnical design parameters and foundation design criteria which were documented in the Report on Foundation Investigation (reference 1) and were transmitted to the project for use in the preparation of design documents; e.g., design criteria, calculations, specifications, and engineering design drawings. The geotechnical design parameters are described and documented in the PSAR, FSAR, and Report on Investigation (reference 1). Site investigations are described in section 4.1.1.

Additional related geotechnical foundation and backfill work was performed during construction. This work, described in section 4.1.2, included excavation, mapping of the powerblock, backfilling, and settlement monitoring.

Design documents, including calculations, drawings, and specifications are presented with a discussion of design control and design change documents, in section 4.1.3.

4.1.1 SITE INVESTIGATIONS

The surface study included reconnaissance mapping and evaluation of surface features of the site and adjacent areas. The work was performed in 1970 through 1972 by Law Engineering and Bechtel. The results of the surface investigation, together with the conclusions derived from the study of relevant geotechnical and geohydrological literature, seismological reports and data, previous work, maps, and aerial photography were analyzed and used as the basis for PSAR section 2.5.1, issued in August 1972. Under the direction of Bechtel, additional surface studies were conducted in 1976 and 1977 after resumption of construction activities which had been interrupted in 1974. The new surface studies were conducted to comply with updated NRC regulations requiring surface mapping of a 5-mile radius around the plant site. This mapping is documented by FSAR section 2.5.1.

A geohydrological investigation was conducted to evaluate the effects of the groundwater regimen on the foundations of the power block structures. This study included the collection and review of groundwater data (e.g., regional water well canvas, water well data such as depths to water, water well logs, and water well production records). Observation wells were drilled at the site to provide water level elevations for use in developing design criteria for the power block structures. Conclusions developed from the analysis of the groundwater data, including water level measurements of the site observation wells and the study of geohydrologic literature, were used to prepare PSAR section 2.4.13 and FSAR section 2.4.12. The conclusions were also used to establish the design basis for subsurface hydrostatic loading parameters documented in PSAR section 2.4.13 and FSAR section 2.4.12.

Ongoing water level monitoring provided information used to update and verify the initial design basis for subsurface hydrostatic loading. Water level measurements and hydrographs supporting the design parameters are contained in the Groundwater Supplement issued in March 1985.

A seismological investigation was conducted to evaluate the seismicity of the site and region and to develop seismic design parameters. This investigation included the study and analysis of relevant literature, earthquake records, public media records, and unpublished reports. Conclusions derived from the investigation provided the basis for development of hypothetical design basis earthquake criteria; e.g., operating basis earthquake (OBE) and safe shutdown earthquake (SSE). The analysis, description of calculations, and supporting data are included in FSAR sections 2.5.2 and 2.5.3.

Subsurface foundation studies comprise the bulk of the investigation of foundations. The subsurface studies include drilling, standard penetration tests, logging, collection of disturbed and undisturbed samples, core samples, downhole geophysical testing, cross-hole seismic testing, permeability testing, and Menard Pressuremeter tests. Samples collected from the investigative drilling were tested by laboratory methods to evaluate the engineering properties of subsurface materials. The data is documented in the form of drilling logs, geologic logs, laboratory test results, geophysical logs, and seismic velocity profiles included in the FSAR or in laboratory test reports.

Table 4.1-1 lists the geotechnical design documents pertaining to the foundation investigations.

4.1.1.1 Results of Foundation Investigations

The geologic and soils investigation of the VEGP site has been completed and the results are described in detail in FSAR subsection 2.5.1. This section summarizes the results of the work performed.

4.1.1.1.1 Subsurface Conditions

The subsurface conditions in the plant site may be subdivided into three principal strata. The top stratum consists of sands, silty sands, and clayey sands with occasional clay seams. This stratum (Barnwell Group) is about 90 ft thick. At the base of the upper sand stratum is a shelly limestone (Utley Limestone) which averages about 5 ft thick. Below the shelly limestone is a stratum consisting of a very hard calcareous clay marl (Blue Bluff Marl), ranging in thickness from 60 to 100 ft. This stratum is referred to as the marl bearing stratum. The stratum beneath the marl bearing stratum consists principally of dense, coarse to fine sand with minor interbedded silty clay and clayey silt. This unit (Ellenton Formation) is called the lower sand stratum. The thickness of this stratum is estimated to be at least 750 ft.

Based on the results of the site exploration, the existing in-situ upper sand stratum was determined to have a potential for liquefaction in the event of a seismic occurrence equivalent to the safe shutdown earthquake (SSE). It was also determined that the shelly limestone layer is characterized by solution channels, cracks, and discontinuities.

The marl bearing stratum is a zone of hard, slightly sandy, cemented, calcareous clay. It is the uppermost stratum capable of supporting heavy structural loads. Consistency of the marl varies from hard to very hard, moderately brittle material resembling a calcareous siltstone or claystone. The properties of the marl bearing stratum are described in FSAR paragraph 2.5.4.2.2.

There is no evidence that the Blue Bluff Marl bearing stratum has been subjected to or is potentially subject to subsidence, collapse, or uplift from earthquake, solution processes, or other geological phenomena (FSAR paragraph 2.5.1.2).

4.1.1.1.2 Structural Recommendations

Based on the evaluation of the subsurface conditions, it was concluded that the upper sand stratum materials and the shelly limestone layer should be excavated down to the marl bearing stratum and replaced with select sand and silty sand backfill compacted to a sufficient degree to preclude the possibility of liquefaction and to reduce settlement to a tolerable level.

As a result, foundations for the structures consist of either the bearing stratum (marl) or backfill. Structures, based on the functional requirements, are founded at various elevations on the marl, embedded in the marl, or at various elevations within compacted Category I backfill material placed on the marl stratum. The auxiliary building, nuclear service cooling water towers, and instrumentation cavity of the containment are founded on the marl bearing stratum; other Category I powerblock structures including the containment basemat are founded on Category I backfill.

The location and orientation of site structures are shown on Figure 4.1-1. A north-south section is shown on Figure 4.1-2. These structures include the following:

- o Category 1
  - Containment building,
  - Control building,
  - Auxiliary building,
  - Fuel handling building,
  - Nuclear service cooling water (NSCW) towers and valve house,
  - Diesel fuel oil storage tank pumphouse,
  - Auxiliary feedwater pumphouse,
  - Tanks,
  - Tunnels,
  - Diesel generator building.

In addition, the following Category II structures are founded partially or totally on the Category I backfill:

- o Non-Category I
  - Radwaste transfer building[a],
  - Radwaste transfer tunnel[a],
  - Radwaste solidification building,
  - Turbine building[a],
  - Additional minor structures and pads.

A description of Category I structures is provided in sections 3.8.1 and 3.8.4 of the FSAR. The turbine building and radwaste facilities are described in FSAR section 1.2.2.

4.1.1.1.3 Development of Soils Parameters

The foundation design parameters for power block structures were based on measured soil parameters obtained by field exploration and laboratory testing.

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a. Indicates structures that are adjacent to Category 1 structures. These structures were evaluated to assure that they would not change the design basis loadings for Category 1 structures.

The results of the subsurface investigation and laboratory testing were analyzed and the geotechnical parameters of the foundation materials were developed and transmitted to the project. The geotechnical parameters that are used in structural design are documented and discussed in FSAR section 2.5.4.

These parameters were established with close interaction with the project civil/structural discipline; based on applicable licensing commitments, industry codes, and standards; and implemented in accordance with established and controlled procedures.

The foundation design parameters, such as soil structures interaction data, bearing capacity, and lateral soil pressures, used in the design are documented in the Report on Foundation Investigation (reference 1). These parameters provide the basis for the design of concrete basemat foundations, allowable bearing pressures on foundation materials and backfill, coefficient of subgrade reactions for static and dynamic analyses, lateral active and passive soil pressures, and engineering design properties of soils. Typically, soils properties required in the design of structures consist of dry and moist densities, shear strength, Poisson ratio, and modulus of elasticity. The results of all the field and laboratory work and data evaluation are covered in the reports and are listed in Table 4.1-1.

The initial criteria for the design of foundations and backfill are contained in the PSAR and were submitted to the Nuclear Regulatory Commission (NRC) in August 1972. These criteria were incorporated in the Design Manual (reference 2). The civil/structural general design criteria (section DC-1000-C of reference 2) were first issued in February 1974.

A discussion and summary of the static and dynamic soil properties of the upper sand, marl, and lower strata are presented in the FSAR (paragraphs 2.5.4.2.1, 2.5.4.2.2, and 2.5.4.2.3, respectively). The static and dynamic soil properties of compacted Category I backfill are summarized and discussed separately in FSAR paragraph 2.5.4.5.2.

4.1.2 GEOTECHNICAL ACTIVITIES RELATED TO CONSTRUCTION AT VEGP

A number of geotechnically related activities have taken place in coordination with the construction of VEGP. The procedures required to implement these activities were shown and specified in project design documents and carefully coordinated with construction. Periodic observations and assessments of these activities were made by BPC HOE and Geotech in the field. The activities include:

- o Excavation and geologic mapping for the powerblock;
- o Groundwater control;
- o Groundwater monitoring;
- o Monitoring of marl heave;
- o Preparation of the marl;
- o Identification of backfill sources;
- o Test fill program;
- o Backfill erosion evaluation;
- o Verification of soil parameters;
- o Settlement observation;
- o Postulated Millet Fault studies;
- o Geotechnical verification program.

The above activities are briefly described below:

4.1.2.1 Excavation and Geologic Mapping for the Powerblock

Prior to excavation, the soil in the power block consisted of an upper sand stratum, followed by a 70 ft layer of the marl bearing stratum, and a lower stratum of dense sand with clay to a 750 ft depth. All of the upper sand stratum was removed in the power block area. Mass excavations were carried out from the existing grade elevation of 210 ft to the top of the clay bearing stratum at an approximate elevation of 130 ft. The excavation commenced in May 1974 and continued through September 1974. Because of project suspension, no excavation was done from September 1974 to February 1977. Further excavation was resumed upon restart of the project construction activities in February 1977 and was completed in October 1977.

Within the excavation, a deeper localized excavation into the marl bearing stratum was made for the auxiliary building basemat. The four nuclear service cooling water towers are founded directly on the marl just south of the auxiliary building. The other major power block structures are founded on structural backfill at elevations above the floor of the excavation. As excavation progressed, the exposed materials were geologically mapped, including the deeper localized excavation for the auxiliary building (FSAR Figures 2.5.1-23, 2.5.1-24, and 2.5.1-25). A discussion of the mapping is included in FSAR paragraphs 2.5.4.1 and 2.5.4.5.1. There were no deformational zones, irregular weathering, jointing or fracturing systems, crushed zones, or other indications of structural weakness in the marl bearing stratum.

Bechtel provided geotechnical support through onsite inspection of the marl and the in-situ soils to assure acceptable foundations. This foundation inspection documentation is provided by Inspection Reports and Daily Field Reports.

4.1.2.2 Groundwater Control

Two aquifers underlie the VEGP site. They are hydraulically separated by an aquiclude identified as the Blue Bluff Marl. Groundwater in the aquifer underlying the marl is under artesian conditions, while water table conditions exist in the aquifer overlying the marl. Since no power block excavations extend through the marl, only the water table aquifer affects excavation, fill placement, and other construction activities in the power block area. The water table in the power block area stood between 155 and 160 ft, approximately 30 ft above the bottom of the excavation; therefore, groundwater control has been an integral part of the construction process. Requirements for groundwater control were developed from the evaluation of site investigative data and were included on the drawings and in specification X2AP01. These requirements included the installation of subdrain and educator dewatering systems and groundwater monitoring wells. Groundwater control implementation is discussed in section 4.4.2.

Site and regional groundwater conditions are discussed in detail in FSAR subsection 2.4.12.

4.1.2.3 Groundwater Monitoring

A comprehensive groundwater monitoring program has been implemented at the VEGP. This program has been designed to:

- o Monitor groundwater levels and movement in both the confined and unconfined aquifers for the life of the plant;
- o Monitor levels of groundwater accumulating in the compacted backfill inside the power block excavation throughout construction.

A dewatering system was installed in the excavation to control groundwater levels during construction and placement of backfill. Effectiveness of the dewatering system was monitored through the use of observation wells.

A discussion of observation wells and groundwater conditions is contained in FSAR section 2.4.12.

Observation wells were installed in accordance with specification X2AP01 C2.18. Records of the groundwater monitoring are contained in FSAR section 2.4.12.

4.1.2.4 Monitoring of Marl Heave

During the powerblock excavation period, the heave of the marl stratum resulting from the removal of the overburden and the dewatering process was frequently observed and recorded by GPC. Heave values were measured at different locations within the powerblock area.

The heave of the marl bearing stratum was monitored during the power block area excavation from 1974 to 1977. An average heave of approximately 1.25 in. was measured in the power block area. Field records indicate that most of the heave resulting from the excavations occurred during the excavation period.

Measurement of heave was performed by measuring the elevation of survey points placed in the marl relevant to benchmarks established far outside the excavation and away from all related construction activity. The locations of these heave points are shown in FSAR Figure 2.5.4-9.

4.1.2.5 Preparation of the Marl

Evaluation of the marl bearing statrum resulted in the development of acceptance, preparation, and protection criteria. These criteria are included as marl preparation and approval procedures in specification X2AP01-C2.2. These procedures are discussed in FSAR paragraphs 2.5.4.1.5 and 2.5.4.1.6.

Construction activities associated with excavation and preparation of the marl are described in section 4.4.4.

4.1.2.6 Identification of Backfill Sources

Surface and subsurface investigations were conducted at the Vogtle site to evaluate the location and availability of sand and silty sand suitable for use as Category 1 backfill. These investigations included the development of specifications, acceptance criteria, placement procedures, and the delineation of borrow areas. The investigations, which were initiated in early 1977, included drilling and sampling of test borings, excavation and sampling of test pits, and laboratory testing to determine the properties of the sampled materials. Soil classification test data from the investigations were obtained in accordance with ASTM D 2487, D 2488, D 1140, D 422, and D 424 (specification X2AP01-C2.2 and -C2.13) and were used to identify and evaluate suitability of materials for use as Category I backfill from the borrow areas and the stockpiled material taken from the excavation.

The exploration programs are discussed in FSAR paragraphs 2.5.4.5.2.2 and the laboratory testing program is discussed in FSAR paragraph 2.5.4.5.2.3. The specification and acceptance criteria are included in FSAR section 2.5.4.

4.1.2.7 Test Fill Program

A test fill program was conducted to verify suitability of equipment and excavated materials for use as Category I backfill and to develop inprocess testing, specifications, acceptance criteria, and placement procedures. The program also was used to develop the appropriate compaction procedures required to achieve an average maximum density of 97 percent according to ASTM D 1557, with no tests below 93 percent and not more than 10 percent of the tests between 93 and 95 percent. The results of the test fill program are discussed in FSAR paragraph 2.5.4.5.2.7 and a Bechtel report, Test Fill Program, Phase II (October 1978). The compaction and testing procedures that were developed and the equipment requirements are incorporated into field procedure CD-T-02 and specification X2AP01.

Control of backfill placement was the responsibility of GPC Construction. Initially, compliance with backfill material specifications and compaction and moisture control procedures was monitored by Bechtel.

4.1.2.8 Backfill Erosion Evaluation

Category I backfill erosion occurred during the later part of 1979. This was a reportable deficiency under the requirements of 10 CFR 50.55(e). A special investigation led to specifications and procedures for remedial work. The work plan was described in a letter from D. E. Dutton (GPC) to J. P. O'Reilly (NRC), January 8, 1980. The work was documented in the Final Report on Deviations and Repair of Erosion in Category I Backfill, BPC and GPC, August 1980.

4.1.2.9 Verification of Soil Parameters

Geotechnical investigations were conducted during construction to verify the geotechnical design parameters established as a basis for the foundation design during the PSAR phase for licensing. These studies consisted of the detailed mapping of the power block excavations, sampling, in-situ testing, and coring of the marl foundation. Instrumentation for monitoring heave/settlement was installed and monitored. The verification program is documented in FSAR section 2.5.4 and FSAR appendix 2B.3. Field work is supported by field notes, field maps and drawings, daily field reports, field test results, and laboratory test results.

Geohydrologic design parameters were verified by studies of the information obtained from the observation well monitoring program. Supporting data are included in the Groundwater Supplement issued in March 1985.

4.1.2.10 Settlement Observation

The structures and the interconnecting process piping are designed for building settlement. A settlement monitoring program was initiated to record settlements at various locations in the structures. The monitoring program consists of two permanent benchmarks installed as reference points for measurement and a large number of settlement marker points. The locations of the settlement markers are shown on drawing AX2D55V001, revision 10. Measurements are taken at each marker at approximately 60-day intervals prior to startup. The measurements are recorded on drawings AX2D55V002 through -V028 and AX2D55V050 through -V063. The total settlements and differential settlements for the various structures are determined from these readings.

4.1.2.11 Postulated Millet Fault Studies

A special investigation conducted to evaluate the purported presence and capability of a fault alleged to be near the site has been completed and provides additional documentation to verify that the design earthquake criteria established for the VEGP site are conservative. The investigation is documented in a special report, Studies of the Postulated Millet Fault, issued in October 1982.

4.1.2.12 Geotechnical Verification Program

In response to questions raised by NRC staff during the preparation of the Safety Evaluation Report, additional geotechnical confirmatory testing and evaluation were performed in 1984 and 1985. This program included additional coring of the marl, backfill testing evaluation, installation of additional observation wells, and settlement analysis. The program concluded:

- The marl is an impermeable stratum with properties consistent with those presented in the FSAR.
- The backfill has been densely compacted in accordance with licensing commitments and engineering design requirements.

- o Structure settlement and differential settlement are within tolerable limits consistent with assumptions made for structures and piping analysis.
- o Although the groundwater evaluation is a continuing program, it is expected to confirm the groundwater elevation criteria used in the analysis of the plant.

In addition to the above, standard penetration testing of the backfill was conducted during this period. Based on the results of this testing, Bechtel consultant, Dr. H. Bolton Seed, concluded that there is no possibility of liquification occurring for any level of ground shaking at the VEGP site and that liquification is simply not a credible mode of failure for the fill.

The results of the geotechnical clarification program are discussed in the NRC Questions and Responses section of the FSAR and in letter BS 6079, file X2AP01.

4.1.3 DESIGN DOCUMENTS

The design documents pertaining to foundation materials and Category I backfill are design criteria, calculations, specifications, and design drawings. In addition to the specifics of the above documents, this section discusses design control and review, design change documents, and reconciliation of As-Built conditions.

Commitments made in the FSAR are included in the design criteria, construction specifications, and engineering drawings listed in Table 4.1.-3.

4.1.3.1 Design Criteria

The portions of DC-1000C and DC-2146 related to foundation materials and backfill were prepared by the BPC Home Office Engineering Group (HOE) civil/structural disciplines based on licensing commitments and soil parameters developed during site investigations. They are periodically reviewed by Geotech. In addition to providing criteria for the installation of the backfill, these design criteria provide parameters used by the civil/structural discipline in the design and analysis of structures. Project design criteria are listed in Table 4.1-3 and were developed based on the data provided in the reports and calculations listed in Tables 4.1-1 and 4.1-2.

4.1.3.2 Calculations

All calculations related to foundation materials and backfill are the responsibility of Geotech.

The foundation and backfill calculations include:

- o Determination of an acceptable safety factor against liquification;
- o Estimation of structure settlements and differential settlements;
- o Determination of soil bearing capacity and appropriate safety factor;
- o Determination of engineering properties and parameters pertaining to soils and foundation materials described in section 4.1.1.1.3.

In addition, foundation and backfill calculations are performed to support construction activities and to evaluate specific site situations that develop during construction.

Table 4.1-2 lists the calculations supporting the geotechnical design parameters developed in the course of the foundation investigations.

4.1.3.3 Specifications

Foundation materials and backfill specifications are prepared by Bechtel HOE civil/structural engineering group in coordination with Geotech. These specifications are developed primarily to provide construction requirements.

The specifications are included as sections of the civil/structural construction specification X2AP01, and are listed in Table 4.1-3.

4.1.3.4 Drawings

The drawings related to foundation materials and backfill work are developed and controlled by the HOE civil/structural group with input from Geotech. Basically, they involved foundation excavation plans and sections and settlement observation marker locations, details, and tables.

Table 4.1-3 provides a list of drawings relative to foundations and geotechnical work. A large number of other drawings and sketches based on the design drawings were also prepared to support the FSAR.

4.1.3.5 Design Control and Review

The VEGP Project foundation materials and backfill design input by Geotech are prepared in accordance with BPC Hydro and

Community Facility (H&CF) engineering procedures (reference 3) and ANSI/ANS 2.11, ANS 2.7, and ANS 2.10 (references 4, 5, and 6). The work execution and internal reviews for the soils engineering and engineering geology groups are governed by H&CF Division engineering functional procedures FP-6547 and FP-6548, respectively. Required calculations are performed in accordance with engineering procedure FP-6437. These procedures were reviewed and accepted by VEGP Quality Assurance (QA) for adequacy for use in VEGP related work.

Foundation materials and backfill calculations are reviewed and approved by the chief soils engineer in the Bechtel H&CF San Francisco office. The calculations are controlled by the Bechtel Geotech manager in Norwalk, California. When completed, the original calculations are transmitted to the project for retention in accordance with project procedures.

Civil/structural general instruction number C-18 (reference 7) provides guidance to civil design groups for foundation engineering and the use of the geotechnical group to support the project. All requests for geotechnical services are coordinated through the civil/structural EGS, who is responsible for coordination with other disciplines involved in the work (e.g., construction).

In addition, Geotech supports the chief civil engineer's review of the geotechnical and foundation aspects of all projects (general instruction C-1.4). The chief civil engineer's geotechnical and foundation reviews for VEGP were conducted on April 12, 1977 (preliminary), March 16, 1978 (interim), and November 21, 1978 (final). The civil EGS is responsible for obtaining Geotech's review of applicable project criteria, specifications, and drawings.

The results of work performed by Geotech are typically presented to the project in report form. The reviews of the reports pertaining to site conditions relevant to the design of structures and construction are made by the Project. Changes in design or construction of the plant which may affect prior geotechnical considerations are evaluated by Geotech. The results of these reviews, and changes in design or construction procedures are documented in the project files.

Drawings, specifications, and design criteria are developed and controlled by the BPC HOE civil/structural discipline in accordance with the VEGP Project Reference Manual (PRM). Design control and review for project activities are outlined in section 4.1.5 of Readiness Review Module 1, Reinforced Concrete Structures (reference 8).

4.1.3.6 Design Change Documents

The design change documents relative to foundation materials and backfill involve the following:

- o Field Change Request (FCR);
- o Deviation/Nonconformance Reports (DR/NCR).

These change documents are reviewed and approved by Bechtel civil/structural disciplines.

4.1.3.6.1 Design Change Control and Construction Support

Design engineering supports construction by preparing design changes and in taking appropriate action on deviations. Subsequent to the revision 0 issue of design documents, changes may be made by approving FCRs, by issuing change notices against the design documents, by directly revising documents generated by responsible design groups, and by taking appropriate action on Deviation Reports (DRs). These changes, considered part of the design documentation, are logged, tracked, and approved by the discipline engineering group supervisors, regardless of where they are generated. Approval of FCRs by the Bechtel project field engineer is sufficient to implement changes; however, a followup coordination with the HOE engineering group supervisor (EGS) is performed for those items designed by Bechtel HOE. For a further description of the FCR process, refer to section 6.1.3.

The processing of reviews and approvals for the FCRs has shifted from what was primarily an HOE activity, at the beginning of construction, to primarily a PFE activity. Since that time, however, the basic approval requirements have not changed; i.e., FCRs were approved by the project engineer or his designee, the PFE.

The evaluation of the FCR process is described in detail in Readiness Review Module 8, section 4.1.6 (reference 9).

4.1.3.6.2 Reconciliation of As-Built Condition

A description of the process used by the project to control, approve, and document changes in design and the associated construction support is given in Readiness Review Module 1, section 4.1.6 (reference 8).

During this phase, the engineering group, including Geotech, provides support for such activities as Field DCRs, DRs, and Construction Specification Change Notices. These activities ensure that the As-Built condition is taken into account and is evaluated.

4.1.4 REFERENCES

1. Report on Foundation Investigation, Volumes I, II, and III; by Bechtel Incorporated, San Francisco for Alvin W. Vogtle Nuclear Project, Georgia Power Company, (July 1974).

2. Design Manual, Alvin W. Vogtle Nuclear Plant, Georgia Power Company (Various Sections).

3. Hydro and Community Facility (H&CF) Division of Bechtel Power Corporation Engineering Functional Procedure Manual.

   FP-6547 EP-4.7 H&CF Soils Engineering Group Work Execution and Internal Review.

   FP-6548 DP-4.8 H&CF Engineering Geology Group Work Execution and Internal Review.

   FP-6437 Design Calculation.

4. ANSI/ANI 2.11 Guidelines for Evaluating Site-Related Geotechnical Parameters at Nuclear Power Sites.

5. ANSI/ANS 2.7 Guidelines for Assessing Capability for Surface Faulting at Nuclear Power Sites.

6. ANSI/ANS 2.10 Guidelines for Retrieval, Review, Processing and Evaluation of Records Obtained from Seismic Instrumentation.

7. Civil/Structural General Instructions, Bechtel Power Corporation - Los Angeles Division.

8. Vogtle Readiness Review Module 1, Reinforced Concrete Structures.

9. Vogtle Readiness Review Module 8, Structural Steel.

TABLE 4.1-1

GEOTECHNICAL DESIGN DOCUMENTS (Sheet 1 of 2)

Part A FOUNDATIONS

Alvin W. Vogtle Nuclear Power Plant Units 1, 2, 3, and 4 Preliminary Safety Analysis Report (PSAR) and its amendments, USAEC Docket No. 50-424, 50-425.

Report on Foundation Investigations, Vol. 1, July 1974; and Vol. 2 (Vol. 2 is in two parts) - September 1974, Bechtel Incorporated, S.F.

Vogtle Electric Generating Plant Units 1 and 2 (FSAR) and its amendments, to NRC Docket Nos. 50-424 and 50-425.

Vogtle Electric Generating Plant, Ground Water Supplement, Bechtel Inc., March 1985.

Report on Foundation Investigations for Radwaste Solidification Building, Bechtel Chemical and Mineral, Inc. (C&MI), December 1981.

Completion Report Radwaste Solidification Building Caissons, Bechtel C&MI, April 1983.

Report of Coring and Laboratory Testing Marl Samples, Law Engineering Testing Company, November 1977.

Studies of Postulated Millet Fault, 2 Vol., Bechtel, Inc. October 1982.

Report of Marl Investigation, Vogtle Nuclear Power Plant, BPC, December 1974.

Part B BACKFILL

Report on Backfill Material Investigations, Vol. 1 and Vol. 2 (three parts) - Bechtel Incorporated, Los Angeles, January 1978.

Report on Backfill Material Investigations, Addendum No. 1 - Bechtel Incorporated, Los Angeles, October 1978.

Report on Backfill Material Investigations, Addendum No. 2 - Bechtel Incorporated, Los Angeles, November 1979.

Report on Dynamic Properties for Compacted Backfill - Bechtel Incorporated, Los Angeles, February 1978.

TABLE 4.1-1

GEOTECHNICAL DESIGN DOCUMENTS (Sheet 2 of 2)

Part B BACKFILL (Continued)

Plant Vogtle Units 1 and 2, Borrow Investigation Report, Additional Category 1 Backfill Material Borrow Area 1C, prepared by GPC, Power Supply Engineering and Services Department, May 1982.

Report on Backfill Material Investigation Addendum No. 3 - Bechtel Civil and Minerals, Inc., August 1984.

Report on Conformatory Laboratory Testing Program for Category I Backfill - Bechtel Civil and Minerals, Inc. September 1984.

Plant Vogtle Settlement Review, Bechtel Power Corporation, September 1984.

Letter with attachments from D. E. Dutton (GPC) to V.P. O'Reilly (NRC) dated January 8, 1980; subject: erosion of backfill.

Test Fill Program Phase II, report prepared by Bechtel, Inc. January 1978.

Final report on dewatering and repair of Erosion in Category I Backfill in power block area, prepared by Bechtel Power Corporation and Georgia Power Company, August 1980.

TABLE 4.1-2

GEOTECHNICAL SERVICES CALCULATIONS (Sheet 1 of 4)

Calculation Number	Subject
X2CF-S-SF02	In situ densities and water contents
X2CF-S-SF03	Specific gravity for clay bearing layers
X2CF-S-SF04	Maximum compaction, dry density, and content optimum moisture
X2CF-S-SF05	Relative density of in situ sand
X2CF-S-SF06	Atterberg limits
X2CF-S-SF07	Results of unconsolidated undrained triaxial and elastic moduli
X2CF-S-SF08	Consolidated undrained triaxial test results and elastic modulus
X2CF-S-SF09	Void ratio and compression index
X2CF-S-SF12	Heave due to excavations
X2CF-S-SF14	Soil densities with depth
X2CF-S-SF15	D50 Grain size vs depth
X2CF-S-SF16	Liquefaction analysis in situ soil
X2CF-S-SF17	Liquefaction analysis compacted soil
X2CF-S-SF22	Subgrade reaction modulus for turbine mat
X2CF-S-SF23	Stability analysis of open cut
X2CF-S-SF24	Cyclic triaxial test result
X2CF-S-001	Lateral surcharge pressure on tendon gallery wall
X2CF-S-003	Lateral pressure on control building wall by turbine mat
X2CF-S-003A	Lateral pressure on control building wall by turbine mat
X2CF-S-004	Surcharge equipment loads on backfill behind tendon gallery

TABLE 4.1-2

GEOTECHNICAL SERVICES CALCULATIONS (Sheet 2 of 4)

Calculation Number	Subject
X2CF-S-005	Uplift pressure below marl
X2CF-S-006	Elastic moduli for compacted backfill
X2CF-S-007	Lateral pressure on auxiliary building north wall
X2CF-S-008	Drain in power block check filter gradation
X2CF-S-010	Drain in power block check onsite #9 stone
X2CF-S-017	Static modulus of elasticity of marl from soils data
X2CF-S-018	Settlement of diesel generator building on stockpile B backfill
X2CF-S-019	Filter design for limestone cavities
X2CF-S-024	Static Young's modulus of compression of sandy, silty-sand
X2CF-S-025	Strength parameters of compression of sandy, silty-sand
X2CF-S-030	Lateral soil pressure of backfill compaction to 95% maximum density
X2CF-S-031	Index and compression strength properties of backfill borrow
X2CF-S-032	Dynamic soil properties
X2CF-S-033	Flush model for liquefaction study
X2CF-S-034	Preliminary liquefaction analysis to 93% compaction
X2CF-S-035	Liquefaction analysis to 95% compaction preliminary shear strength
X2CF-S-036	Liquefaction analysis to 95% final soil properties

TABLE 4.1-2

GEOTECHNICAL SERVICES CALCULATIONS (Sheet 3 of 4)

Calculation Number	Subject
X2CF-S-037	Earthquake induced settlement
X2CF-S-038	Subgrade reaction for steam tunnel - turbine building
X2CF-S-039	Stability of construction slope adjacent to control building tunnel
X2CF-S-040	Drain in power block area - filter gradation
X2CF-S-057	Sheet piling at electrical tunnel
X2CF-S-062	Stability of temporary fill slopes in power block
X2CF-S-064	Sheet piling for turbine building sumps without surcharge
X2CF-S-064A	Sheet piling for turbine building sumps with 200 PSF
X2CF-S-070	Containment building sheet pile analysis
X2CF-S-074	Dynamic lateral pressures
X2CF-S-076	NSCWT 1-A sliding stability
X2CF-S-080	Control building differential settlement Unit 1 schedule
X2CF-S-087	Settlement of CST, AFWPH, RWST, RMWST, and Tunnels
X2CF-S-090	4600 Ringer crane surcharge to 1T4 Tunnel
X2CF-S-092	Tendon gallery access shaft containment bases
X2CF-S-095	Coefficient of subgrade reaction
X2CF-S-100	Stability of cut under Lampson crane load

TABLE 4.1-2

GEOTECHNICAL SERVICES CALCULATIONS (Sheet 4 of 4)

Calculation Number	Subject
X2CF-S-101	Differential settlement (containment and fuel building)
X2CF-S-102	NSCW tower - valve house differential settlement
X2CF-S-103	Backup calculation for revised Table 2.5.4-12 of FSAR
X2CF-S-104	Heave analysis
X2CF-S-105	Review of measured settlment
X2CF-S-106	Settlement analysis

TABLE 4.1-3

PROJECT DESIGN DOCUMENTS
(SHEET 1 OF 2)

Document	Section No.	Revision	Date	Description
Design Criteria Manual (civil)	DC-1000-C	3	9/30/83	General civil criteria
Construction Specification	X2AP01	44	4/23/82	Civil-structural
Division	C2.1			Subsurface exploration
	C2.2	5	10/23/81	Earthwork and related site activities
	C2.4	1	1/6/82	Mixing and placing plastic backfill
	C2.12	4	1/4/79	Soil testing services
	C2.13	2	1/4/79	Exploration and testing for additional backfill material
	C2.15	2	1/4/79	Obtaining and testing marl core samples in the power block area
	C2.18	5	8/7/81	Piezometers and dewatering wellpoints
	C10.1	4	3/14/80	Obtaining and recording foundation settlement data

TABLE 4.1-3

PROJECT DESIGN DOCUMENTS
(SHEET 2 OF 2)

Document	Section No.	Revision	Date	Description
	C12.1	4	4/15/82	Installation of steel sheet piling
	C12.3	0	3/11/82	Caissons
Drawing	AX2D46T001			Excavating plan Unit 1 and 2 power block
	AX2D46T004			Excavating sections Unit 1 and 2 power block sheet 1
	AX2D55V001			Settlement observation markers location and detail
	AX2D55V002-V028			Settlement observation re:ord tables and graphs
	AX2D55V050-V063			Major structure settlement summaries

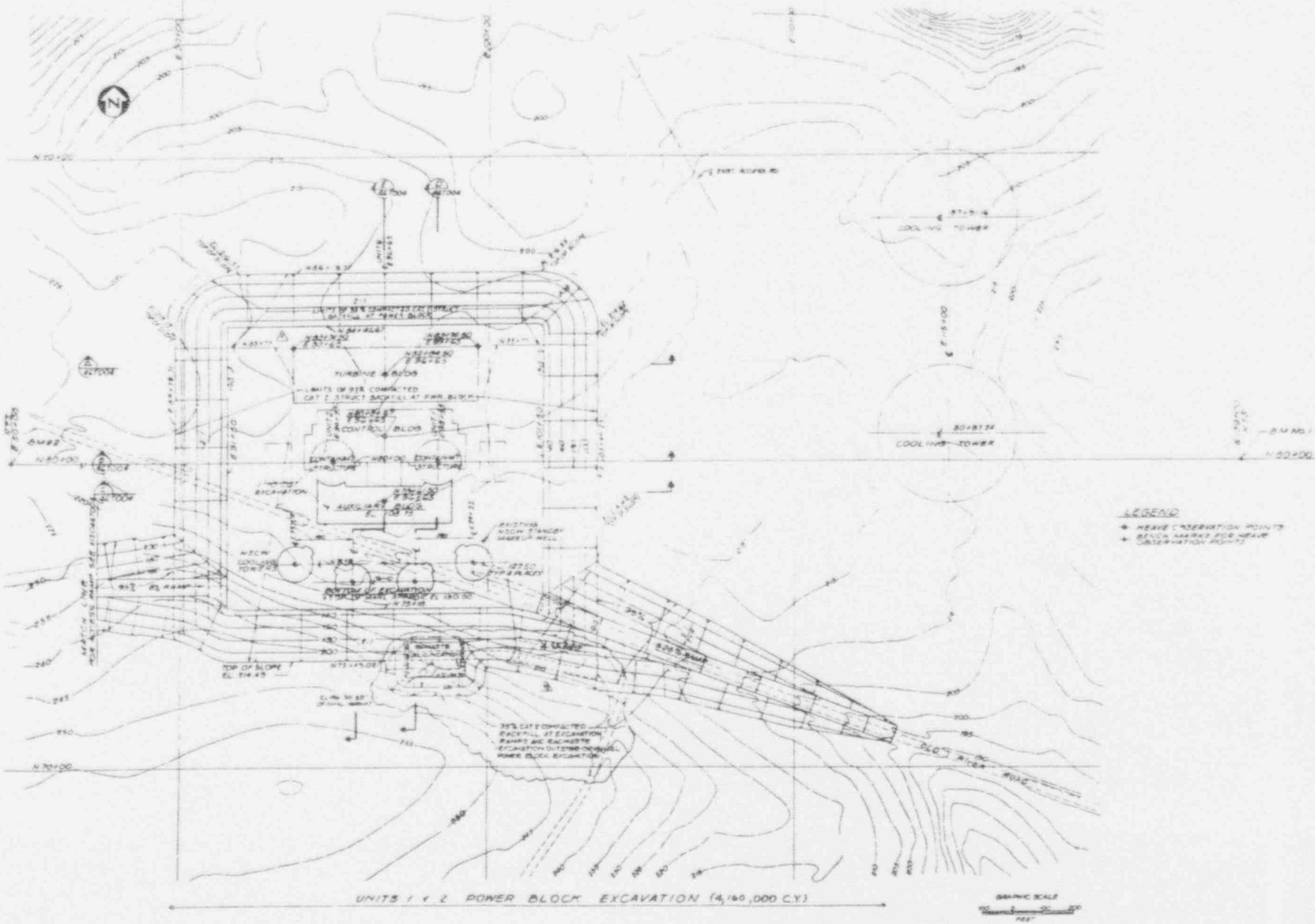


Figure 4.1-1 Plot Plan

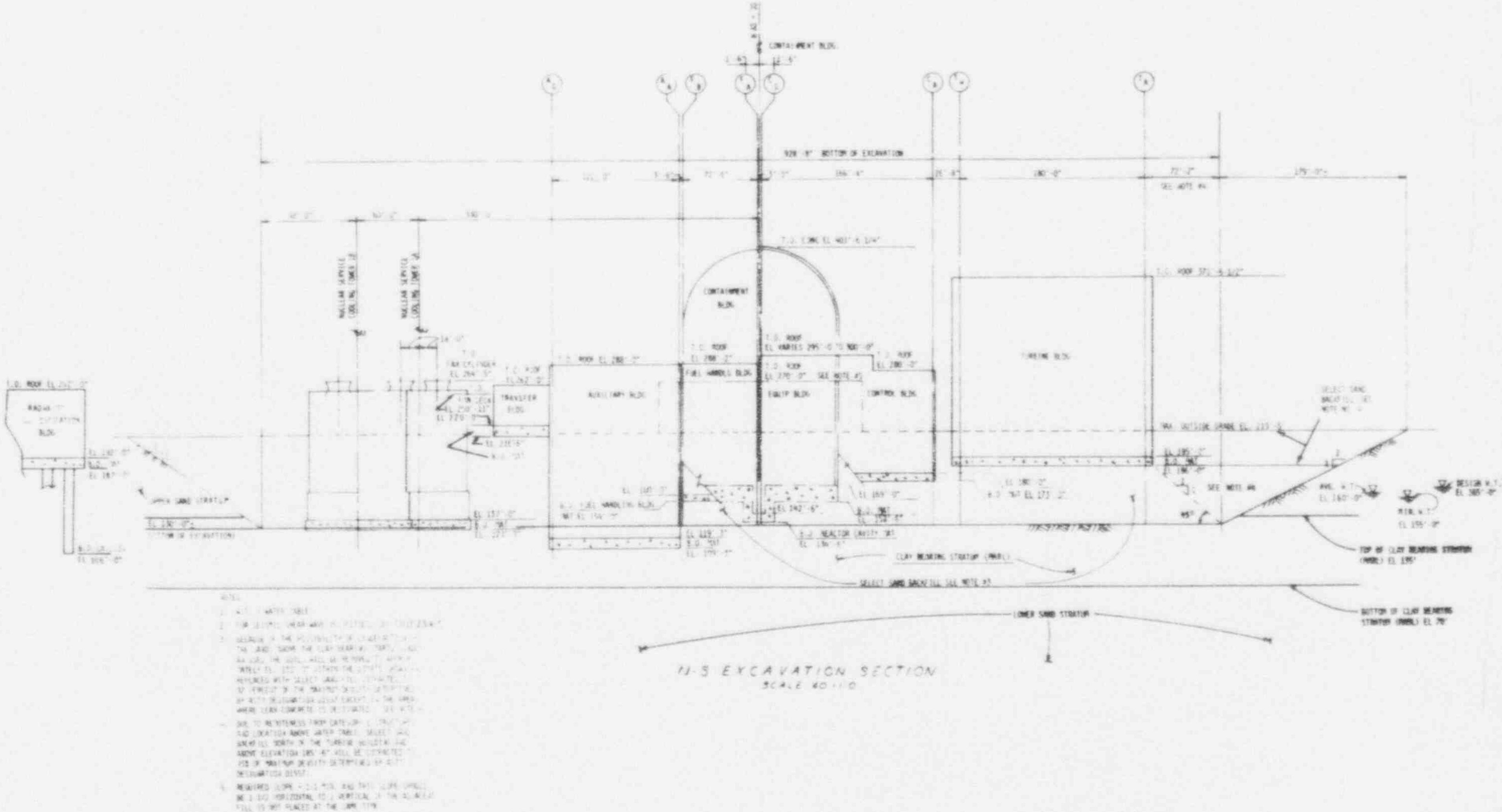


Figure 4.1-2 Cross Section Through Power Block Looking West

4.2 MATERIALS

This section describes the program for the procurement of safety-related materials. Within the scope of this module, no safety-related materials required procurement from offsite sources.

The program description for the borrow of backfill material is given in sections 4.1 and 4.4 of this module.

4.3 TRAINING AND QUALIFICATION

This section contains a description of the project programs for training and qualification of design engineers, GPC construction engineers, contractor staff and craft, and GPC inspectors.

For inspectors the information contained should be reviewed along with Appendix F, Inspector Qualification/Certification.

4.3.1 ENGINEERS (DESIGN)

Engineering personnel assigned to the home office engineering (HOE) organization and the project field engineering (PFE) organization receive training to familiarize them with project procedures governing their assigned responsibilities. Section 6, part A of the Project Reference Manual establishes the program structure and requirements for indoctrination and training of Bechtel Power Corporation (BPC) personnel assigned to the Vogtle Electric Generating Plant project. It defines procedures, responsibilities, documentation, and records maintenance for the BPC project training program. Participation in the program is mandatory for permanently assigned home office and jobsite personnel.

The overall training program includes training in the following subject areas:

- o Quality Program;
- o Engineering Indoctrination Program;
- o Project Reference Manual (PRM);
- o Technical and specialized training;
- o New arrival orientation;
- o Quality Concern Program.

The project engineering manager or his designees are responsible for the formulation and implementation of the training program. The civil engineering group supervisor (EGS) is responsible for ensuring that assigned personnel attend mandatory training classes, receive training in the requirements and the use of this PRM, and learn the unique technical aspects of their work. The civil EGS identifies the training requirements for each individual in the civil group commensurate with assigned tasks, and maintains training records in accordance with the PRM, section 6. The project administrator receives and stores personnel training records for persons no longer assigned to the project.

4.3.2 GEORGIA POWER COMPANY CONSTRUCTION ENGINEERS

This section discusses the training and qualification of Georgia Power Company (GPC) construction engineers and other personnel who perform work related to the activities of this module and report to the civil project section supervisor.

Candidates for construction engineering positions are either degreed engineers or have construction experience. Normally, the new engineer is assigned pertinent procedures to read. Newly assigned engineers work with an experienced engineer who provides instruction on specifications, procedures, and use of design drawings. They also familiarize the new engineer with plant orientation and site organization.

The civil project section supervisor is responsible for making certain his personnel are capable of performing the tasks assigned to them. Therefore, in addition to on-the-job training just described, the supervisor trains his personnel on changes and revisions to specifications and procedures and provides them formalized training as necessary to maintain or upgrade job skills.

4.3.3 CONTRACTOR

The training and certification of contractor personnel to perform installation work associated with backfill is discussed in this section. The primary contractor that employs personnel to perform this work is Walsh Construction Company.

Georgia Power Company reviews and approves training programs established by the contractors.

4.3.3.1 Walsh

Walsh Construction Company is responsible for the installation of compacted soils in and around the power block at Plant Vogtle.

Walsh employs personnel that are classified as operators, teamsters, and laborers working out of the various local union halls to perform excavation and backfill operations.

All craft personnel go through Walsh's training program. Training that is of a generic requirement is provided throughout their term of employment. Other training that is of a specific requirement is given prior to the craft personnel performing the work (i.e., operator, teamster, or laborer performing any work in that area). The Contractor Training section, managed by GPC, gives a directive to the training coordinator on certain areas with the craft's responsibility.

The superintendents employed by Walsh are familiar with the general placing techniques of soils work and, after having received instructions for site requirements, trains the craft personnel in these techniques.

The training coordinator interfaces with the superintendent over backfill operations while providing instructions that entail any construction specification revisions or change notices. Training is generally conducted during gang box meetings prior to the craft starting work for their assigned shift. It may also be necessary to provide training to close out a corrective action request should a nonconforming trend develop. These verbal instructions entail a review of the applicable procedure/specification requirements as they relate to the contractor's responsibility and hold points that would involve Quality Control. The training also includes hands-on practical (skills) training.

4.3.4 INSPECTORS

This section contains descriptions of the training courses used to qualify civil QC inspectors employed by GPC and Soil and Material Engineers, Inc., a contractor specializing in inspection services. Appendix F contains a detailed explanation of the certification programs.

The Level I inspector records inspection, examination, and testing data along with implementing inspection, examination, and testing procedures. The Level II inspector performs the actual evaluation of the validity and acceptability of inspection, examination, and testing results. Prior to certification, inspectors are not allowed to independently inspect for acceptance, but are used in data-taking or inspection assignments, provided they are under the direction of a certified inspector who is participating in the inspection, examination, or test.

The following paragraphs list the types of inspections performed on the materials and construction processes discussed in this module. Each paragraph defines the certification titles used to perform the inspection and a description of the course content for the individual course(s) that qualify the inspector to perform the inspection.

4.3.4.1 Soils Lab Inspection

To perform inspection in this area the inspector must be certified in either soils inspection or civil lab inspection. An inspector certified in either of these areas is qualified to perform inspection in the soils lab. The primary training course for the inspector performing work in this area is Soils Lab Inspection.

Soils Lab Inspection is a 40-hr course that provides general information and inspection and testing techniques relevant to Plant Vogtle. The inspector learns to properly inspect and test soils in the Civil Quality Control laboratory to the degree necessary to ensure compliance with construction specifications, procedures, and design drawings. As with soils inspection, emphasis is placed on the ASTM Handbook, Selected ASTM Standards for Soils Inspection and Testing. Completion of the course will enable the inspector to test soils in the laboratory and to classify soils both visually and by laboratory testing.

In this course the inspector will:

- o Be able to locate, read, and understand specification codes, standards, and procedures that apply to soils lab work at Plant Vogtle;
- o Become familiar with the composition of soils and the recommended practices for identifying and describing soils for engineering purposes;
- o Be able to use the Unified Soil Classification System;
- o Be able to locate, read, and follow specified documents that describe in detail the methods of conducting laboratory soil tests that are performed at Plant Vogtle;
- o Exhibit understanding of the principles of various soils tests;
- o Demonstrate the ability to perform the ASTM tests or other relevant laboratory soils tests listed below:
  - ASTM D2216-71 - Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures,
  - ASTM D1140-54 (1971) - Test for Amount of Material in Soils Finer than the No. 200 (75 Mm) Sieve,
  - ASTM D422-63 (1972) - Particle - Size Analysis of Soils,
  - ASTM D423-66 (1972) - Test for Liquid Limit of Soils,
  - ASTM D424-59 (1971) - Test for Plastic Limit and Plasticity Index of Soils,
  - ASTM D1556-64 (1974) - Density of Soil in Place by the Sand-Cone Method,
  - ASTM D1557-70 - Moisture - Density Relations of Soils Using 10 lb. (4.5 kg.) Rammer and 18 in. (457 mm) Drop;

- Be able to evaluate soil lab test results in relation to Plant Vogtle specifications and to determine acceptance/rejection of inspection.

4.3.4.2 Soils Inspection (Field)

To perform inspections in this area the inspector must be certified in soils inspection. An inspector certified in this area is qualified to perform soils inspection (field), soils inspection (lab), and waterproofing. The applicable training course for this is Inspection of Grading, Excavation, and Compacted Fill.

Soils Inspection is an 80-hr course that provides general information, inspection, and testing techniques relevant to Plant Vogtle. The course also includes laboratory instruction, discussed in section 4.3.4.1 of this module. The inspector learns to properly inspect and test earthwork operations to the degree necessary to ensure compliance with construction specifications, procedures, and design drawings. Major emphasis is placed on the ASTM Handbook and selected ASTM Standards for Soils Inspection and Testing. Completion of the course will enable the inspector to classify soils both visually and by laboratory testing, to test soils in the field and laboratory, and to interpret earthwork drawings.

In this course the inspector will:

- Become familiar with the composition of soils and means for visually classifying soil;
- Be able to use the Unified Soil Classification system;
- Be familiar with various types of earthwork equipment;
- Understand the fundamentals of earthwork operations;
- Be able to use relevant earthwork drawings;
- Understand the principle behind and be able to run, correctly and safely, required soils lab and field tests using relevant codes, standards, specifications, and procedures.

Some standards the inspector becomes proficient in the use of are:

- Moisture content of soils

  Oven dry method (ASTM D2216);

- Particle size analysis of soils samples
  - Wash 200 (ASTM D1140),
  - Sieve analysis (ASTM D422),
  - Hydrometer test (ASTM D422);
- Atterberg limits
  - Liquid limit of soils (ASTM D423),
  - Plastic limit and plasticity index of soils, (ASTM D424);
- Moisture/density relations of soils
  - Standard proctor (ASTM D698),
  - Modified proctor (ASTM D1557);
- Sand cone method of field testing (ASTM D1566);
- Drive-cylinder (Shelby Tube) method of field testing (ASTM D2937);
- Nuclear gauge method of field testing (ASTM D2922) (ASTM D3017).

4.4 CONSTRUCTION

4.4.1 CLASSIFICATION AND PLACEMENT OF BACKFILL

4.4.1.1 Backfill Sources and Selection

Select Seismic Category I backfill (sand/silty sand) was obtained from two sources, the power block excavation and selected borrow areas. Materials removed from the power block excavation were tested for suitability for use as Category I or other backfill and stockpiled accordingly. An exploration program was conducted to identify borrow areas for additional materials. Nine borrow areas were identified.

Sources, quantities, and criteria for suitability of materials are discussed in detail in FSAR paragraphs 2.5.4.5.2.1 and 2.5.4.5.2.4.

4.4.1.2 Backfill Placement

Compacted backfill is placed in the power block area from the top of the marl stratum at approximately el 130 ft to the design elevation for each structure. The auxiliary building, the nuclear service cooling water towers, the containment instrumentation cavity, and the radwaste solification building are supported directly on the marl stratum. The radwaste solification building foundation consists of large diameter drilled caissons extending into the marl stratum. The other safety related power block structures are supported on compacted backfill.

With the exception of an area north of the turbine building and in localized areas around nonsafety-related piping buried above the water table, backfill in the power block area is compacted to an average of 97 percent of the maximum density determined by ASTM D1557, with no tests below 93 percent, and not more than 10 percent of the tests between 95 and 93 percent. The procedure used to achieve the required degree of compaction was developed in a test fill program described in section 4.1.4.3.2 and discussed in detail in FSAR paragraph 2.5.4.5.2.7.

The area north of the turbine building was compacted to an average of 95 percent of the maximum density as determined by ASTM D 1557, not more than 10 percent of tests between 93 and 95 percent, and no test below 93 percent compaction.

Placement of backfill in localized areas and the use of lean concrete and plastic backfill are discussed in FSAR paragraphs 2.5.4.5.2. Criteria and procedures required for placement of Category I backfill, non-Category I backfill, and lean concrete or plastic backfill are contained in specification X2AP01 and field procedures CD-T-01, CD-T-02, and CD-T-22.

4.4.2 GROUNDWATER CONTROL

Site and regional groundwater conditions are discussed in detail in FSAR subsection 2.4.12.

Prior to excavation, the water table in the power block area stood between elevation (el) 155 and 160 ft. When excavation progressed below this level, significant slope seepage began and temporary construction dewatering was begun (described in FSAR paragraph 2.4.12.1.2.2.1 and appendix 2B). Clay seams in the upper sands caused local perching of groundwater, and seepage continued from the slopes at the top of the clay seams, even though the water table was drawn down elsewhere in the excavation.

When excavation extended into the marl, a perimeter drainage system was installed (FSAR paragraph 2.4.12.1.3.3.1) and work progressed under dry conditions. Seepage from the slopes of the power block excavation continued with a gradual decline in the elevation of the top of the seepage zone. As a part of the dewatering system, the zone of seepage was covered with a filter blanket up to el 160 ft. The filter blanket provides protection against sloughing while acting as a conduit to the perimeter drain.

The subdrain system continued to be effective in maintaining reduced water levels as required for placement of Category I backfill in the power block excavation. However, as the placement of backfill progressed, subdrain control of water levels in the backfill became less effective during the periods of heavy rain which occurred in 1979. Consequently, a well point dewatering system was designed and installed to supplement the subdrain system.

4.4.3 STABILIZATION AND PREPARATION OF OVERBURDEN CUT SLOPES

Slope protection is discussed in detail in FSAR paragraph 2.5.4.5.1.4.

During the early stages of excavation, intense rainfall caused erosion of the 2:1 side slopes of the power block excavation. The uncemented sands above the marl were eroded, resulting in deeply incised gullies in some areas. These gullies were backfilled with the native soil material, and local areas of the slope were regraded. After regrading of the eroded areas, berms were constructed around the tops of the slopes to control runoff. The surfaces of the slopes were sprayed with the chemical stabilizing agent Petroset, a colorless liquid which sets up and tends to bond the sand grains together. These measures proved to be successful in controlling further erosion on the upper slopes. As excavation proceeded, erosion problems farther down the slopes were encountered as a result of seepage of the perched groundwater out of the slopes. Since stabilizing agents were expected to be ineffective under these conditions, the lower portions of the slopes were blanketed with a transition zone material and covered with riprap to improve stability.

4.4.4 EXCAVATION AND PREPARATION OF MARL

4.4.4.1 Excavation

Excavation work was started in May 1974 and completed in October 1977, including a construction postponement from September 1974 to February 1977. The power block area was excavated and graded to an elevation of approximately 130 to 135 ft near the top of the marl bearing stratum. The excavation for the power block structures at the VEGP site was roughly square; there were three access ramps, one each in the northwest, southeast, and southwest corners of the excavation. It measures approximately 1400 ft on an edge at the top and 1000 ft on an edge at the toe. The side slopes were cut at a gradient of two horizontal to one vertical. The total excavated volume in the power block was approximately 5,000,000 cubic yards. Within the excavation, a deeper localized excavation into the marl bearing stratum was made for the auxiliary building basement. Excavation procedures are discussed in FSAR paragraph 2.5.4.5.1.1.

4.4.4.2 Preparation of Marl

The Blue Bluff Marl (marl bearing stratum) at final grade in foundation areas was exposed using either a motor grader or Gradall. Loose material was then removed by shovel, broom, and air hose. On the vertical walls of the auxiliary building excavation, final trim to neat line was accomplished with backhoe, followed by pick and shovel and air hose techniques.

In cases where final grade was exposed and cleaned, the marl surface had to be covered in an approved manner within 24 hrs of exposure. Before placing the permanent cover material in any foundation area, the marl was inspected and approved by the geologist or soils engineer in accordance with prescribed procedures, including preparation of approval documents.

Marl preparation and approval procedures are included in specification X2AP01-C2.2 and described in FSAR paragraphs 2.5.4.1.5 and 2.5.4.1.6.

4.4.5 SITE SETTLEMENT MONITORING PROGRAM

A settlement monitoring program was initiated at VEGP to record settlements at various locations within the structures. The monitoring program consists of two permanent benchmarks installed as reference points for measurements and a total of 111 monitoring points. The locations of settlement markers are given in Figure 2.5.4-11 of the FSAR.

After installation of each settlement marker, the construction group recorded the initial elevation using first order leveling procedures. After establishing the initial settlement marker, elevation settlement surveys are conducted at a maximum interval of 60 days. GPC construction then transmits the settlement data to Bechtel Civil/Structural Engineering.

The settlement monitoring program for power block structures is described in detail in specification X2AP01 C10.1 and FSAR section 2.5.4.13.2.

4.4.6 SEISMIC CATEGORY I BACKFILL PLACEMENT

After preparation of the marl, the backfill placement was begun in the turbine building area by Manhattan-Walton in accordance with specification X2AB01. In May 1979 a new contract was awarded to Walsh Construction Company for backfill operations under specification X2AP01.

The following section contains a brief description, flow chart, and list of procedures and specifications applicable to the placement of Seismic Category I backfill.

The flow charts illustrate the contractors' work activity as well as the resulting inspection and engineering activities required to support, inspect, and document these work processes. Each organization listed in the left hand margin of the flow chart is responsible for all activities shown to the right. The nodes (circles) denote the starting and completion points of work activities. Between the nodes are descriptions of the work activities performed and the applicable procedure governing that work activity. The dotted lines with directional arrows indicate the flow of documentation or instructions for an activity. The flow chart does not contain the flow of documents, such as Deviation Reports or Field Change Requests, as they may be generated at any time; their approval, distribution, and resolution processes are described in Appendix B, Design Control, and Appendix H, Nonconformances.

The description preceding the flow chart defines which contractor is responsible for the work noted on the flow chart and which QC organization performs the required inspection.

4.4.6.1 Flow Chart Activity Description

This section covers the borrowing, placement, and inspection of Category I backfill. Figure 4.4-1 is a flow chart of activities for the installation of Category I backfill.

The Category I backfill is placed within the confines of the power block excavation and provides support for Category I foundations not founded on the marl bearing stratum.

Category I material was obtained from sources located at the plant site. Nine borrow areas and a stockpile of material from the power block excavation were evaluated and designated as acceptable sources of Category I backfill material.

Category I backfill material was placed in the power block from the top of the marl bearing stratum, approximate elevation (el) 130, to the design elevation for each structure or finish grade, approximate el 210. The marl bearing stratum was inspected by a geologist prior to being covered by Category I backfill.

Sands and silty sands were placed in six inch uncompacted lifts for heavy compaction areas and four inch lifts for hand compacted areas, moisture conditioned by water truck or waterhose, and then inspected by QC. QC then inspected the material to assure the moisture content was within a range of +2 percent to -3 percent of the optimum moisture content. The material was then compacted.

After a second lift of material was placed as described above, QC performed a sand cone density test. After the sand cone test is performed and accepted, the next lift is placed.

Specification X2AP01 section C2.2 and Field Procedure CD-T-01 are used as the controlling requirements for the excavation, inspection and testing of Category I backfill.

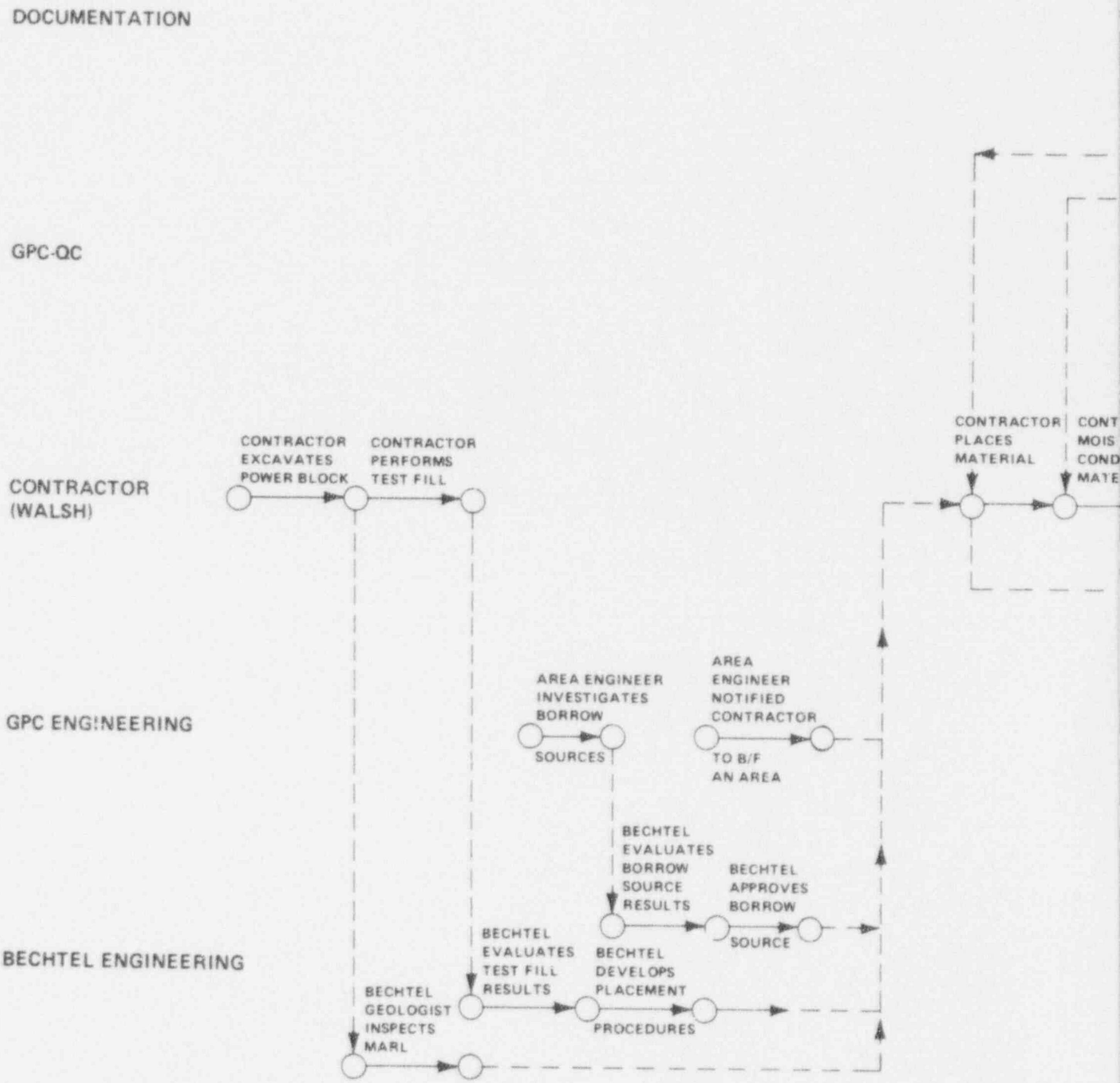
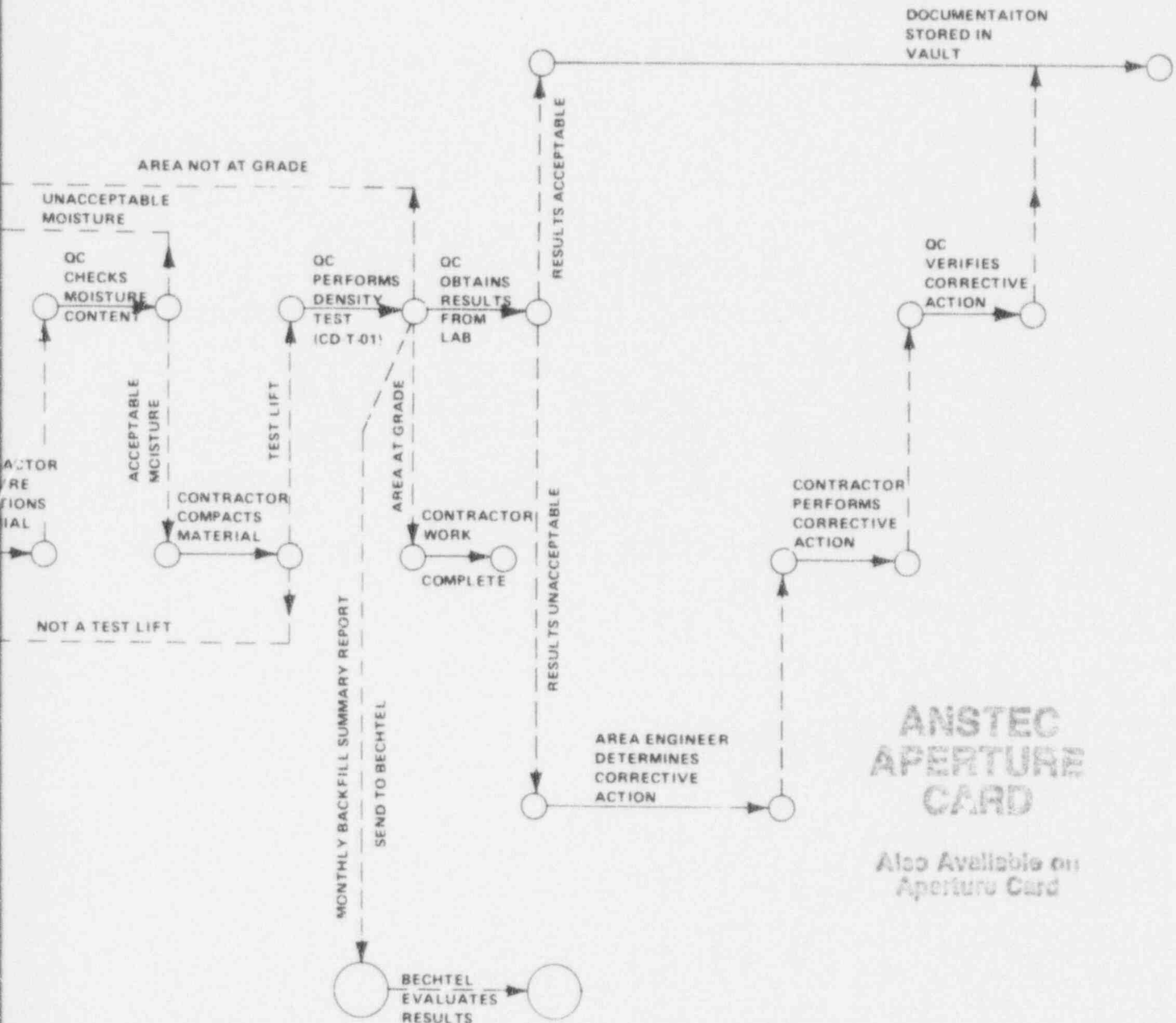


Figure 4.4-1 Seismic Category



SOILS

I Backfill Flowchart

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5.0 AUDITS AND SPECIAL INVESTIGATIONS

This module section contains a discussion of the Quality Assurance (QA) audit process, NRC inspections, and special evaluations performed in the area of foundations and backfill. Throughout the Plant Vogtle construction program, onsite audits have been performed by Georgia Power Company (GPC) QA. In addition, regularly scheduled and periodic NRC inspections and investigations have been conducted. These included the Systematic Assessment of Licensee Performance (SALP) evaluations and a special investigation performed by the Regional Construction Assessment Team (CAT). Plant Vogtle was also 1 of 22 utility sites that initially participated in the formation of onsite investigations by Institute of Nuclear Power Organizations (INPO). An off-shoot of the pilot INPO program and the subsequent follow-up onsite investigation was the formation of the Self-Initiated Evaluation (SIE) program.

The content of this section is divided into three subsections: 5.1 Design, 5.2 Construction, and 5.3 Past Construction and Design Problems. The subsection, Design, is limited to discussion of audits and NRC inspections pertaining to design related items. The subsection, Construction, is limited to discussion of audits and NRC inspections pertaining to construction related items. The subsection, Past Construction and Design Problems, includes both the design and construction aspects of the problem areas.

5.1 DESIGN

Design audit activities provide assurance to Georgia Power Company management that design control processes were accomplished as required by 10 CFR 50 Appendix B and commitments defined in the FSAR, Design (Criteria) Manual, and Project Procedures Manual. The auditing process is described in detail in Appendix I.

Project audits include the auditing and evaluation activities conducted by Georgia Power Company (GPC), Southern Company Services, and Bechtel Power Corporation (BPC). Special investigations including the Institute of Nuclear Power Operations (INPO) and the Self-Initiated Evaluation, have also been conducted to review the design control process. Routine inspections performed by the Nuclear Regulatory Commission (NRC) at the Vogtle jobsite have involved various aspects of design control processes.

Section 5.1 identifies audits and resulting findings/violations associated with Module 13A, Foundation Materials and Backfill, for design control activities related to that subject. Audits with findings that specifically pertain to foundation materials and backfill include inspections by Georgia Power Company, Bechtel, and the NRC. These activities are briefly described in the following paragraphs.

If a finding or deficiency occurred in construction because the construction specifications requirements were not met, it constituted a finding in construction and not design. However, if the construction specification requirements did not accurately reflect codes or standards, or required clarification through revision, the finding was considered related to design, even if originally the deficiency was discovered during a review of construction activities.

5.1.1 GEORGIA POWER QA AUDITS

The determination of audits applicable to this module was accomplished by establishing specific considerations. Only those audit findings applicable to the design of foundation materials and backfill were considered.

Regularly scheduled audits are conducted by GPC Quality Assurance (QA) to verify compliance to project requirements for all contractors.

Although several audits conducted by GPC addressed foundations and backfill, the majority of the audits and related findings addressed construction and inspection deficiencies, not design deficiencies. As indicated in the Design Audit Matrix, only four audits conducted by GPC pertain to design, of which two reflected deficiencies in design control.

5.1.2 BECHTEL AUDITS

Each BPC project maintains a group of qualified QA personnel to schedule, plan, and conduct audits of project activities. When some design activities are performed off project by support groups within BPC, the audits of that activity are generally conducted by the BPC management QA organization.

The major design effort for activities within the scope of Module 13A was accomplished by the Hydro and Communities Facilities (H&CF) Geotechnical Services Group. Therefore, design audits specifically addressing foundations and soils were not conducted by BPC Vogtle Project QA, but were conducted by the BPC management QA and H&CF QA group. However, only the BPC management audits specifically applied to Vogtle.

The following is a summary of design audits and findings conducted by BPC management QA:

Audit Number	Date	Number of Findings
3.006-A-4/77	04/18 - 04/22/77	6
3.006-1/78	01/16 - 01/29/78	3
3.006-1/79	01/22 - 02/02/79	4
3.006-2/80	02/04 - 02/08/80	0

Two of the above findings related to deficiencies with procedures and interfacing with internal design groups. When procedures were revised by H&CF, they were implemented prior to review and received concurrence from the project. The Vogtle project had not received and concurred with the design procedure prior to its implementation. Corrective action was taken immediately in that all procedures were reviewed, revised accordingly, and approved by the Project.

One procedure indicated a deficiency in the Design Control Checklist (DCCL) program. Design Review Notices, were not submitted and approved with the applicable document. Procedures were reviewed and training was conducted addressing procedural requirements for the DCCL.

The remaining 10 findings related to calculations. Several non-technical deficiencies such as filing, micro-filming, page-numbering, checking, missing references, and approvals were described. All deficiencies were corrected to the satisfaction of BPC management QA auditors and closed.

5.1.3 NRC INSPECTIONS

There were a number of NRC inspections relating to soils and foundations which were mostly directed at construction activities. Two of the four inspections, during the tim period from 1977 through 1981, revealed design document deficiencies. The four inspections involved design criteria, PSAR requirements, drawings, specifications, and procedures specific to backfill, soils, and foundations.

DESIGN AUDITS

SORTED BY INITIATING ORGANIZATION AND AUDIT NUMBER

EDIT NO.	INIT ORGAN	AUDIT NUMBER	DATE	MOD	DESIGN CRIT	CALCU-LATIONS	DRAW-INGS	SPEC	SUPPLR DATA	DEVIAT. REPORTS	TRAIN PRGM	DESIGN REVIEW	DESIGN DOC CNT	DESIGN CHANGES	MISC

EXPLANATION OF FIELDS

For convenience, categories were combined where appropriate. The following is a listing of combinations and explanations:

EDIT NO.	- Used for complete entry/corrections
INIT ORGAN	- Initiating or responsible organization: BPC, GPC, NRC, SCS
AUDIT NUMBER	- Number applicable to specific audit
DATE	- Date of audit, finding, or report
MOD	- Module addressing finding
DESIGN CRIT	- Design Criteria, FSAR
CALCULATIONS	- Calculations, Failure Modes and Effects Analyses (FMEAs), engineering studies
DRAWINGS	- (Self explanatory)
SPEC	- Design specifications, procurement specs, construction specs, bid evaluations
SUPPLR DATA	- Supplier data includes expediting, inspections, Supplier Deviation Disposition Requests (SDDRs)
	- Supplier data package problems
DEVIAT. REPORTS	- Deviation Reports, Nonconformance Reports, reportable items
TRAIN PRGM	- Training program for design personnel
DESIGN REVIEW	- Design reviews of engineering documents, Design Review Notices (DRNs), and interface between engineering disciplines
DESIGN DOC CNT	- Document Control - records, correspondence, design control (of design documents), manual control Project Reference Manual (PRM)
DESIGN CHANGES	- Field Change Requests (FCRs), Design Change Notices (DCNs), greenlining, Field Engineering Change Orders (FECOs)
MISC	- Licensing deviation disposition requests procedures, miscellaneous design audits

DESIGN AUDITS

MODULE 13A

EDIT NO	INIT ORGAN	AUDIT NUMBER	DATE	MOD	DESIGN CRIT	CALCUL ATIONS	DRAW-INGS	SPEC	SUPPLR DATA	DEVIAT. REPORTS	TRAIN PRGM	DESIGN REVIEW	DESIGN DOC CNT	DESIGN CHANGES	MISC	WEST. SCOPE
288	GPC-QA	CD01-80/31	07-23-80	13A				134				X				
289	GPC-QA	CD01-81/43	06-25-81	13A	X		X	X				X	X			
290	GPC-QA	CD01-82/57	05-17-82	13A				X								
291	GPC-QA	CD01-82/92	08-09-82	13A			X	322				X	X			
293	GPC-QA	CD01-83/33	05-04-83	13A				X								
599	NRC-INS	77-01	02-15-77	13A	X		X	X				X				
606	NRC-INS	78-01	03-10-78	13A	X		X	78-01-0 1				X		X	URI	
633	NRC-INS	79-17	12-11-79	13A	X		X	79-17-0 1,79-17 -02		X		X		X	VIOL	
648	NRC-INS	80-07	05-01-80	13A				X					X			
673	NRC-INS	81-09	10-22-81	13A	X		X	X	X			X	X			

5.2 CONSTRUCTION

5.2.1 PROJECT AUDITS

5.2.1.1 Georgia Power Audit Findings

The GPC Quality Assurance (QA) Department conducts regularly scheduled audits to verify project compliance with the applicable project documents. Any finding from an audit is reported to the management of the audited organization for corrective action.

The QA audits discussed in this section provided in-depth reviews of foundations and backfill activities during the life of the project. These audits focused principally on the work activities as they were conducted, including field work and primary QA documentation. The matrixes in this section outline the specific areas covered and the types of documentation issues that were raised and resolved.

Audit findings have been tracked in four ways by QA. These methods are Audit Finding Reports (AFR), Observations (OBS), Deficiencies (DEF), and Corrective Action Requests (CAR). Of the four methods, only two, AFR and CAR, are currently being used on the project. A more detailed explanation of the audit process is found in Appendix I.

Twenty-two audits addressed the programs and processes involved with foundations and backfill. Those 22 audits resulted in 11 findings, 2 observations, and 2 deficiencies that are listed in the findings matrix at the end of this section.

Each audit was reviewed and classified into one or more of the eight categories listed below:

Category	Audit Frequency	No. of Audit Findings
Materials	4	0
Training/Qualification	5	1
Fabrication	11	0
Inspection	12	2
Testing	20	6
M&TE	7	4
Document Control	4	0
QA Records	9	2

Each finding was reported to project management and received an evaluation that included an assessment of its impact on the project, corrective action, and action to preclude recurrence.

No audit findings within the scope of Module 13A were reportable in accordance with 10 CFR 50.55(e).

The findings, observations, and deficiencies were evaluated by the construction team who determined that no major problems were identified. Three of the potential problem areas involved correct use of moisture correlation curves (020-DEF and 023-OBS) and the proper grouping of sand cone test results (AFR 321). These areas were reviewed as part of the Readiness Review assessment. After evaluation by the assessment team and by the project, it was determined that the corrective action taken to resolve the audit findings has corrected the problems with no identified recurrences.

5.2.1.2 INPO Evaluations

The Vogtle project has participated in two INPO construction project evaluations, one in 1982 and one in 1984. The 1982 pilot evaluation was the first time the evaluation criteria had been applied in the industry.

There were no findings during either of these evaluations which pertained to foundations and backfill.

5.2.1.3 Self-Initiated Evaluation

During September and October 1982, the project initiated an evaluation of design and construction activities that was conducted by a team of non-project senior technical and management personnel from GPC, Southern Company Services, and Bechtel Power Corporation (BPC). The evaluation assessed many of the programs and activities on the project using the INPO criteria for construction project evaluations.

There were no SIE findings in the area of foundations and backfill.

5.2.2 NRC INSPECTIONS

Forty-seven NRC inspections have addressed foundations and backfill resulting in 5 violations within the scope of the construction assessment for Module 13A.

NRC inspection coverage and findings were reviewed and classified into one or more of the eight different categories used to classify the GPC QA audits. The results are summarized in the table below.

Category	Audit Frequency	No. of Violations
Materials	2	1
Training/Qualification	0	0
Fabrication	30	0
Inspection	22	2
Testing	20	1
M&TE	9	1
Document Control	0	0
QA Records	9	0

The five violations are discussed below.

Of the five violations identified by the NRC, three were isolated violations of procedures or specifications. The remaining two, 79-13-01 and 80-07-01, although not isolated, were evaluated at the time of detection and determined not to affect the acceptability of any test or hardware. Corrective action resulting from the findings included correction of existing procedures to preclude recurrence.

The Readiness Review construction assessment included a review of the documentation for examples of recurrence of the above referenced violations. The only area where other examples were found was in the area of moisture control. All identified instances occurred prior to the audit finding and none were identified by Readiness Review since implementation of the corrective action. Discrepancies identified by the assessment team were documented as Readiness Review Findings.

All NRC inspections are listed in the audit matrix at the end of this section and the violations are listed in the findings matrix. NRC violations are circled, whereas inspector followup items, unresolved items, or licensee-identified items assigned a tracking number by the NRC are not circled.

5.2.3 SUPPLEMENTARY INVESTIGATIONS

During the second quarter of 1985, 10 standard penetration soil test borings were performed to evaluate the Seismic Category I backfill at the Vogtle plant site. This testing was done in response to questions by the NRC concerning the adequacy of Category I backfill.

These soil investigations were performed by Law Engineering Testing Company to a specification prepared by Bechtel. The boring locations were selected to provide wide coverage of areas where Category I backfill was placed. The standard penetration tests were made at 2.5 ft intervals through the fill. The procedures for drilling and testing conformed to those discussed in The Influence of Standard Penetration Tests Procedures in Soil Liquefaction Resistance Evaluations by Seed, Tokimatso, Harder and Chung.

Dr. H. Bolton Seed evaluated the results of the standard penetration tests in Category I backfill and concluded that the blow counts are consistent with a very dense, reasonably uniform fill. He concluded that there is no possibility of liquefaction occurring in this soil for any level of ground acceleration that may develop at the Vogtle site and that liquefaction is simply not a credible mode of failure for this fill.

The high densities encountered have been attributed to the construction procedures used at the Vogtle site. The results of the standard penetration test program provide significant data demonstrating that the Vogtle fill meets the licensing commitment.

0066m/322-5

CONSTRUCTION AUDITS

EDIT NO.	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATE-RIAL	TRAIN/QUAL	FABRI-CATION	INSPEC-TION	TEST-ING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS

EXPLANATION OF FIELDS

EDIT NO. - Internal reference numbers

INITIATING ORGANIZATION - The organization performing audit or inspection:

G - QA = Georgia Power Company QA Department

HART-N-616 = Hartford Steam Boiler and Inspection Company

NISCO = Nuclear Installation Service Company

NRC-INS = Nuclear Regulatory Commission Inspection Report

West = Westinghouse

BPC = Bechtel Power Corporation

SCS = Southern Company Services

INPO = Institute of Nuclear Power Operations

AUDIT NUMBER - Identification number of audit or inspection assigned by initiating organization

DATE - Date of audit or report receipt date

MODULE - Readiness Review module number

MATERIAL - Material, storage, damage, handling, cleanliness, etc.

TRAIN/QUAL - Training and qualification of personnel

FABRICATION - Manufacturing/installation activities

INSPECTION - Inspection and nondestructive examination

TESTING - Pressure tests, flow tests, load tests, etc.

MEASURE & TEST EQ - Measurement and test equipment

DOCUMENT CONTROL - Document control

QA RECORDS - Quality Assurance records

CONSTRUCTION AUDITS

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EDIT NO	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATERIAL	TRAIN/ QUAL	FABRIC-ATION	INSPECT-ION	TESTING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS
4	GPC-QA	CD01-77/02	07-26-77	13A			X						
5	GPC-QA	CD01-77/05	10-21-77	13A					011				
6	GPC-QA	CD01-77/09	01-05-78	13A			X		X				
8	GPC-QA	CD01-80/20	05-14-80	13A		X	X	X	X	X	X		
9	GPC-QA	CD01-80/31	07-23-80	13A			X	X	134		X	X	
10	GPC-QA	CD01-81/12	02-24-81	13A	X			172	X				
11	GPC-QA	CD01-81/25	05-04-81	13A		X	X	X	X			X	
12	GPC-QA	CD01-81/43	06-25-81	13A	X		X	X	X	X			
13	GPC-QA	CD01-82/15	02-05-82	13A					X			X	
14	GPC-QA	CD01-82/57	05-17-82	13A		X	X			X			
15	GPC-QA	CD01-82/92	08-09-82	13A				024-OBS	020-DEF ,321,32 2,023-O BS				
16	GPC-QA	CD01-82/97	08-25-82	13A				X	X			026-DEF	
17	GPC-QA	CD01-83/07	02-08-83	13A				X	X				
18	GPC-QA	CD01-83/33	05-04-83	13A			X	X	X			X	
19	GPC-QA	CD01-83/65	08-09-83	13A					X			X	
20	GPC-QA	CD01-83/95	11-16-83	13A	X		X	X	X				
95	GPC-QA	CD05-79/26	10-19-79	13A		X	X				X	X	

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MODULE 13A

EDIT NO	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATERIAL	TRAIN/ QUAL	FABRIC-ATION	INSPECT-ION	TESTING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS
96	GPC-QA	CD05-81/32	05-19-81	13A	X				X				
179	GPC-QA	CP12-85/42	05-28-85	13A			X	X	X				CATEGORY I BACKFILL
284	GPC-QA	GD04-80/35	08-13-80	13A					X		X		
303	GPC-QA	GD06-78/01	02-16-78	13A						015,016, 018,019		017	
755	GPC-QA	TR01-81/62	08-27-81	13A		240		X				X	
823	NRC-INS	74-03	09-17-74	13A	X		X	X	X				
827	NRC-INS	75-01	06-02-75	13A				X					
830	NRC-INS	76-01	11-24-76	13A				X					
835	NRC-INS	77-01	02-15-77	13A					X				
1599	NRC-INS	77-03	07-06-77	13A				X	X				
842	NRC-INS	77-04	12-01-77	13A			X	77-04-01					
844	NRC-INS	77-05	12-01-77	13A			X	X	X	X		X	
846	NRC-INS	78-01	03-10-78	13A			X	78-01-01					
848	NRC-INS	78-02	03-13-78	13A			X		X	X			
864	NRC-INS	78-07	10-19-78	13A									
891	NRC-INS	79-08	05-24-79	13A				79-08-01 (V)				X	
895	NRC-INS	79-11	07-05-79	13A	79-11-01 (V)		X	79-11-02 (V)					

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EDIT NO	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATERIAL	TRAIN/ QUAL	FABRIC- ATION	INSPECT- ION	TESTING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS
899	NRC-INS	79-13	08-08-79	13A						79-13-01 (V)		X	
907	NRC-INS	79-14	09-11-79	13A			X		X				
910	NRC-INS	79-15	10-05-79	13A			X		X			X	
915	NRC-INS	79-18	12-27-79	13A			79-18-0 1						
917	NRC-INS	79-19	01-23-80	13A				X	X				
919	NRC-INS	80-01	02-21-80	13A			X	X					
924	NRC-INS	80-03	02-22-80	13A			X	X	X			X	
925	NRC-INS	80-04	03-24-80	13A			80-04-0 1						
927	NRC-INS	80-05	03-28-80	13A			X		X				
928	NRC-INS	80-06	06-29-81	13A			80-06-0 1	X					
933	NRC-INS	80-07	05-01-80	13A			X		80-07-0 1(V)				
936	NRC-INS	80-08	05-01-80	13A			X						
937	NRC-INS	80-09	06-18-80	13A				X	X				
943	NRC-INS	80-10	07-03-80	13A			X						
958	NRC-INS	80-14	10-23-80	13A								X	
965	NRC-INS	80-15	10-28-80	13A			X	X					

CONSTRUCTION AUDITS

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EDIT NO	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATERIAL	TRAIN/ QUAL	FABRIC- ATION	INSPECT- ION	TESTING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS
989	NRC-INS	81-09	10-22-81	13A				X	X	X			
995	NRC-INS	81-11	12-02-81	13A			X						
998	NRC-INS	81-13	12-28-81	13A				X					
1006	NRC-INS	82-01	01-29-82	13A			X						
1011	NRC-INS	82-03	03-09-82	13A					82-03-01				
1023	NRC-INS	82-06	04-12-82	13A			X	X					
1031	NRC-INS	82-09	05-26-82	13A			X		X	X			
1045	NRC-INS	82-12	06-15-82	13A				X					
1057	NRC-INS	82-14	07-19-82	13A			X						
1062	NRC-INS	82-15	06-21-82	13A			X		X				
1103	NRC-INS	82-26	11-22-82	13A					X				
1130	NRC-INS	83-06	03-14-83	13A					X			X	
1178	NRC-INS	83-20	11-17-83	13A			X			X			
1190	NRC-INS	83-24	12-22-83	13A			X			X			
1224	NRC-INS	84-09	05-11-84	13A			X	84-19-02				X	
1242	NRC-INS	84-13	06-28-84	13A			X	X	X	X			
1250	NRC-INS	84-16	07-17-84	13A			X						
1296	NRC-INS	84-27	10-19-84	13A				X	X	X		84-27-01	

CONSTRUCTION AUDITS

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EDIT NO	INITIATING ORGANIZATION	AUDIT NUMBER	DATE	MODULE	MATERIAL	TRAIN/ QUAL	FABRIC- ATION	INSPECT- ION	TESTING	MEASURE &TEST EQ	DOCUMENT CONTROL	QA RECORDS	REMARKS
1365	NRC-INS	85-04	03-08-85	13A			X						
1578	NRC-INS	85-30	09-10-85	13A			X	X				X	

FINDINGS

MODULE 13A

INIT ORG	AUDIT NUMBER	FINDING NUMBER	LEVEL	DATE	MODULE	SUBJECT	REMARKS	NUM BER
GPC-QA	CD01-77/05	011		09-20-77	13A	BACKFILL - TESTING - NUCLEAR DENSITY MEASURING DEVICE.	CD-T-03,04 10CFR31.	480
GPC-QA	GD06-78/01	015		02-08-78	13A	BACKFILL - M & T.E. - CALIBRATION OF LEVEL	GD-A-04, PARA V. B.1, 10CFR50 APP. B.	492
GPC-QA	GD06-78/01	016		02-08-78	13A	BACKFILL - M & T.E. - CALIBRATION OF LEVEL.	GD-A-04, PARA V, A.	495
GPC-QA	GD06-78/01	017		02-08-78	13A	BACKFILL - M. & T.E.	GD-A-04, PARA. VI. B	498
GPC-QA	GD06-78/01	018		02-08-78	13A	BACKFILL - M.& T. E.	GD-A-04, PARA. VI.A, CD-T-C/3, PARA VI.4.a	501
GPC-QA	GD06-78/01	019		02-08-78	13A	BACKFILL - M & T.E.	10CFR50 APP. B., CRITERION XII	504
GPC-QA	CD01-82/92	020-DEF		07-31-82	13A	INSPECTION TESTING - MOISTURE CORRELATION CURVE WAS NOT UPDATED IN A TIMELY MANNER.	CD-T-01 VIL, C2.B.3.b.	508
GPC-QA	CD01-82/92	023-OBS		07-31-82	13A	TESTING MATERIALS - MISREADING OF CORRELATIVE CURVE INFORMATION.	(AUDIT REF. X2AP01 C2.2.7.C.1:)	518
GPC-QA	CD01-82/92	024-OBS		07-31-82	13A	INSPECTION TESTING - INCONSISTENT AND/OR OMITTED LIFT MOISTURE CURVE.	(AUDIT REF. X2AP01 C2.2.7.C.1:)	521
GPC-QA	CD01-82/97	026-DEF		08-11-82	13A	INSPECTION - FAILURE TO FOLLOW PROCEDURE.	CD-T-01 PARA. VII.D.4.a.	526
GPC-QA	CD01-80/31	134		07-08-80	13A	BACKFILL - TESTING - GRADATION TESTING USING WET SIEVE PROCESS.	SPEC. X2AP01, SECT. C.2.2.7.C.1, ASTM D-422, SECT. 4.2.2.6.H.3.b.7	691
GPC-QA	CD01-81/12	172		02-16-81	13A	BACKFILL - INSPECTION, DESIGN - REVISE PROCEDURE TO IMPROVE INSPECTION RESULTS.	10CFR50 APP. B, CRITERIA XVII, PARA 4. PROC. CD-T-01.	729

FINDINGS

MODULE 13A

INIT ORG	AUDIT NUMBER	FINDING NUMBER	LEVEL	DATE	MODULE	SUBJECT	REMARKS	NUMBER
GPC-QA	TR01-81/62	240		08-17-81	13A,21F	BACKFILL - TRAINING - ESTABLISH PROGRAM FOR SOIL ENGINEERS.	10CFR50, APP. B. CRITERIA II	797
GPC-QA	CD01-82/92	321		07-25-82	13A	BACKFILL - TESTING - PERFORM REP. SAND CONE TEST FOR UP TO SEVEN CONGRUENT SAMPLES.	CD-T-01, VII C.1.C.	878
GPC-QA	CD01-82/92	322		07-25-82	13A	BACKFILL - TESTING - ESTABLISH FIELD CONTROLS FOR DENSITY TESTS	X2AP01 - C2.2.7.C.1	879
NRC-INS	77-04	77-04-01	URI	09-22-77	13A	NORTH HIGHWALL CAVITATION		1497
NRC-INS	78-01	78-01-01	URI	03-22-78	13A	CORRECTION OF REJECTED FILL COMPACTION		1501
NRC-INS	79-08	79-08-01	VIOL	04-27-79	13A	FAILURE TO PERFORM AND DOCUMENT COMPACTION TESTS		1513
NRC-INS	79-11	79-11-01	VIOL	06-13-79	13A	BACKFILL MOISTURE CONTROL		1511
NRC-INS	79-11	79-11-02	VIOL	06-13-79	13A	BACKFILL WORK STOPPAGE		1530
NRC-INS	79-13	79-13-01	VIOL	07-25-79	01,13A	FAILURE TO CALIBRATE SOILS/CONCRETE LABORATORY SCALES		1525
NRC-INS	79-18	79-18-01	LIC.I. DEF.	12-04-79	13A	EROSION OF CATEGORY I BACKFILL		1529
NRC-INS	80-04	80-04-01	LIC.I. DEF.	03-17-80	13A	UNDERMINING OF THE CONTROL BUILDING ELECTRIC TUNNEL		1541
NRC-INS	80-06	80-06-01	IFU	03-31-80	13A	EROSION AND RUNOFF CONTROL		1542
NRC-INS	80-07	80-07-01	VIOL	04-14-80	13A	FAILURE TO EVALUATE SOILS MOISTURE TESTS RESULTS		1544

FINDINGS

MODULE 13A

INIT ORG	AUDIT NUMBER	FINDING NUMBER	LEVEL	DATE	MODULE	SUBJECT	REMARKS	NUM BER
NRC-INS	82-03	82-03-01	URI	02-09-82	13A	COMPACTION CONTROL		1583
NRC-INS	84-09	84-09-02	IFU	04-17-84	01,13A	EFFECT OF MOISTURE VARIATION BETWEEN LAB OPTIMUM AND AVERAGE LAB OP.		1667

5.3 PAST CONSTRUCTION AND DESIGN PROBLEMS

This subsection contains a discussion of problems which were reportable to the NRC according to the Code of Federal Regulations 10 CFR 50.55(e) criteria. Included are the problems, reportability determinations, and corrective actions taken.

As of July 1, 1985, the Vogtle Project had notified the NRC of 78 potentially reportable problems. Three of these were associated with foundations and backfill. Each of the three potentially reportable problems was evaluated as being reportable to the NRC. A brief discussion of each is presented below.

5.3.1 DEWATERING/EROSION

On November 14, 1979, a potentially reportable item under 10 CFR 50.55(e) concerning dewatering and erosion of backfill was identified to the NRC. Specifically, heavy rains had caused erosion of the backfill under several mud slabs in the power block area. There was no damage to any existing structures, nor was there any undermining of any Seismic Category I structures. However, backfill operations in the power block area could not continue until repairs were made to the eroded areas. Had the erosion remained uncorrected, future Category I structures located at or near the areas of erosion could have encountered settlement or other structural problems. It was therefore concluded, that the erosion constituted a reportable deficiency.

This item was not originally considered as a potential reportable item by GPC QA. The NRC noted this as a violation (79-17-01 and 02) for failure to report deficiencies. As a result of this, GPC QA expanded their criteria for reportability.

Repair work was started in the latter part of January 1980, and was completed in August 1980.

The repair work included dewatering the excavation in order to continue backfill operations. Three types of dewatering systems were used: educator wellpoint systems, a vacuum wellpoint system, and trench drain systems. Of particular importance are the wellpoint systems. A wellpoint system was installed 30 ft north of the Auxiliary Building north wall, and was later extended into Containment Building, Unit 1. Two systems were installed along the top of the east slope of Containment Building, Unit 1 and along the top of the west slope of Containment Building, Unit 2. These systems satisfactorily dewatered the slopes to permit backfilling. During the dewatering process, the quality control group monitored the operation and the effluent from the dewatering system. The effluent was monitored to insure that backfill material was not removed in a sufficient quantity to cause voids in the backfill. During the period of the backfill repair operation, a Bechtel geotechnical engineer was onsite to assist GPC in the interpretation of field test data and repair procedures. A final report issued by Bechtel and GPC, dated August 15, 1980, was transmitted to the NRC August 29, 1980.

Additional information on this problem may be found in file X7BG03-M3.

5.3.2 EROSION UNDER ELECTRICAL TUNNEL FOUNDATION SLAB

A potentially reportable item under 10 CFR 50.55(e) was identified to the NRC on March 10, 1980. The deficiency consisted of erosion of a portion of Category I backfill beneath the existing Unit 2 electrical tunnel foundation slab resulting from heavy rains.

A repair procedure was developed in close coordination with Bechtel geotechnical and project engineering. The procedure included removal of disturbed material, guniting, and filling the eroded area with lean concrete to assure the integrity of the foundation system. Repairs were completed per procedure and a final report was submitted to the NRC on April 30, 1980.

It was concluded that the erosion was a reportable deficiency under 10 CFR 50.55(e) and it was reported as such in the April 30 letter transmitting the final report to the NRC.

Additional information concerning this problem may be found in file X7BG03-M6.

5.3.3 NSCW TOWER CROSSOVER PIPING

On March 23, 1984, a potentially reportable item under 10 CFR 50.55(e) was identified to the NRC. During a review of safety-related buried piping, two NSCW transfer pump discharge pipes were found to be routed into an area of Category I backfill that could potentially be affected by liquefaction of the upper sand stratum of in-situ soil.

The ensuing evaluation determined that this event was reportable under the requirements of both 10 CFR 50.55(e) and 10 CFR 21. This conclusion was reported to the NRC June 4, 1984, along with a summary of the evaluations.

Corrective measures included rerouting of the two pipes into acceptable backfill areas; a review of the location/routing of safety-related structures, buried piping, and buried electrical duct banks; and a review of design control measures with a subsequent revision to require that Category I structures, buried piping, and electrical duct banks be located in the portion of the backfill which is not susceptible to the effects of liquefaction of adjacent in-situ soil.

Additional information concerning this problem may be found in file X7BG03-M61.

6.0 PROGRAM VERIFICATION

This section describes the activities undertaken to ascertain whether the design and construction aspects of the Seismic Category I foundations and backfill comply with the Final Safety Analysis Report (FSAR) commitments and whether compliance is verifiable with existing project documentation.

This section is divided into two parts. Section 6.1 describes activities related to design program verification; 6.2 addresses construction program verification.

Resulting findings have been classified into the following levels of importance to plant safety:

- I - Violation of licensing commitments, project procedures, or engineering requirements with indication of safety concern;
- II - Violation of licensing commitments or engineering requirements with no safety concerns;
- III - Violation of project procedures with no safety concerns;

6.1 DESIGN PROGRAM VERIFICATION

The following sections describe the design program verification, resultant findings, and corrective actions. This verification was performed by the Readiness Review civil design team. The four members of the team have a cumulative professional experience of 85 years in design engineering. Approximately 400 manhours were expended during the actual verification.

The design program verification was directed toward the programmatic aspects of design. The programmatic verification is a systematic review of design documents to determine whether the design control process has functioned effectively and whether licensing commitments were adequately implemented in design documents.

Design program verification took place in two phases. Phase I consisted of verifying licensing commitments in the design and was divided into two parts. In part 1, commitments identified within the scope of this module were reviewed for proper implementation in design basis documents (i.e., criteria), and in part 2, selected commitments were further reviewed for implementation in the detail design documents (i.e., calculations, specifications, and drawings).

Phase II consisted of a review of design documents for compliance to applicable procedures. Industry standards for quality, e.g., ANSI N45.2 and N45.2.11, were used as reference documents in the review of the design documents.

Section 6.1.1 provides a summary of the verification results, section 6.1.2 provides a description of the verification scope and plan, and section 6.1.3 provides a description of the verification results.

6.1.1 SUMMARY

The design verification included a review of the following design documents.

Document Type	Number Reviewed	Total[a]
Design Documents		
Criteria	2	2
Calculations	9	70
Drawings	5	44
Specifications	4	9
Studies and Reports	5	16

Document Type	Number Reviewed	Total[a]
Design Change Documents		
Field Change Requests (FCRs)	9	70 (approx)
Deviation Reports (DRs)	19	190 (approx)

During the verification activities, one general finding (Level II) was issued by the design group. This finding involved approximately 70 geotechnical calculations which did not comply with applicable design control procedures. The project committed to review and revise as necessary, all safety-related calculations pertaining to geotechnical work for conformance with applicable design control procedures. The review activity was completed and reverified by a joint team consisting of representatives from programmatic design verification and independent design review teams, see section 6.1.5.

6.1.2 SCOPE AND PLAN

This section describes the scope of the design verification for Module 13A and the plan implemented during the performance of the verification.

6.1.2.1 Scope of the Verification

The objective of the design program verification was to ensure, by sampling, that the design processes for Category 1 foundation materials and backfill have been adequately controlled and have resulted in proper implementation of licensing commitments in design documents. The scope of this verification included the design documents described in section 4.1. Following are the documents included in the verification.

- o Design Documents
  - Design criteria,
  - Calculations,
  - Specifications,
  - Drawings;
- o Design Change Documentation
  - Deviation Reports (DRs),
  - Field Change Request (FCRs).

a. Total numbers are for documents relative to this module.

The sample size and number of documents pertaining to this module is summarized in Table 6.1-1 at the end of this section.

6.1.2.2 Verification Plan

The verification of the licensing commitments in design documents was performed in two phases. In phase I, engineering documents were reviewed to ensure that commitments were included in the design basis documents (design criteria) or other appropriate design documents. In phase II, the detail design documents (i.e., calculations and specifications) were reviewed to verify implementation of applicable procedures to ensure that the design control process was adequately implemented.

During phases I and II, verification of commitments was performed by reviewing various engineering documents such as criteria, calculations, drawings, and specifications as applicable. The design change documents namely, FCRs, DCNs, and Deviation Reports (DRs) were reviewed for compliance with appropriate procedures and for the technical justification for the change they represented.

6.1.2.2.1 Phase I Verification

During phase I, licensing commitments were selected for review and implementation. The review consisted of two parts. In part 1, a review was made to ensure that each commitment was included in the design criteria or other appropriate design document; in part 2, a review of selected commitments was made to ensure that the design commitments were implemented in the second order design documents (namely, calculations, drawings, and specifications). Parts 1 and 2 of the phase I review were accomplished as follows:

6.1.2.2.1.1 Part 1, Commitments in Design Criteria. In part 1 of phase I, commitments identified from the FSAR or other source documents were reviewed to ensure that the commitments were included in the project criteria or other appropriate design documents. Based upon the identified commitments, an implementation matrix was developed to identify the design document in which the commitment is incorporated. The implementation matrix identifies the criteria revisions where the commitment was first implemented and the most recent revision that includes the commitment. In this manner, the commitment matrix provides a cross reference between design criteria (or other design documents) and commitments.

When commitments are not directly correlated to the design criteria, appropriate implementing design documents, such as calculations and specifications, were identified for these commitments. These documents are then listed in the implementation matrix.

These steps ensure that commitments were recognized by the design engineering group as a requirement for the detail design or construction as appropriate.

6.1.2.2.1.2 Part 2, Implementation in Detail Design. In part 2, a sample of commitments was selected for review to ascertain whether they have been correctly implemented in detail design documents. The documents reviewed included representative samples of calculations, drawings, and specifications and are listed in Table 6.1-2.

The commitments subjected to detailed review were selected on the basis of their overall relationship to the detail design and whether they provided a broad cross section of the Category I foundations and backfill design. The key commitments relative to foundation materials and backfill pertain to:

- 97 percent compaction and an adequate safety factor against liquefaction;

- Allowable bearing pressures must have an acceptable safety factor.

These were verified in the design calculations. Other data pertaining to engineering properties of the foundation materials were reviewed in the calculations to ensure that documentation supports the values provided in the FSAR.

The details are discussed in section 6.1.3.

6.1.2.2.2 Phase II, Programmatic Verification of Design Control Process

In phase II, a sample of design documents was reviewed to ensure that programmatic requirements of control design processes have been met. The emphasis was to ascertain whether the design process had been controlled. This ensures technical requirements have been adequately incorporated in the detail design, coordination among entities participating in the detail design have adequately taken place, and changes in the design have been controlled.

Selected design documents were reviewed to ensure compliance with the design control program. Checklists identifying the aspects of the design control program being verified were developed for each type of document. Design criteria, calculations, drawings, specifications, and design change documentation were reviewed.

6.1.3 RESULTS AND DISCUSSION

The results of the phase I and phase II verification are described in this section. Included in the description are the number and type of documents reviewed and a description of the finding.

6.1.3.1 Phase I (Commitment Verification) Results

In the first part of the phase I review, a total of two design criteria sections in the Design Manual were reviewed, including previous revisions. These sections from the Design Manual are DC-1000-C and DC-2146. No finding resulted from this review.

During part 2 of phase I, commitments were selected for a detailed technical verification in implementing documents. These commitments were selected based upon their technical significance and the broadness of their application.

In the phase I part 2 verification, one specification and eight calculation packages were reviewed. The calculations reviewed included those for soil properties, liquefaction, settlement, and dynamic and static safety factors. The applicable section of the specification (X2AP01) reviewed was the construction specification written by design engineering which provided requirements for field backfill and other foundations related activities. Calculations or specifications were reviewed for implementation of applicable commitments. Table 6.1-2 provides the list of calculations and specifications reviewed.

During this review, two of the selected commitments were not readily identifiable in the calculations without the help of the originator. The first relates to the liquefaction potential of Category I backfill. The backfill was committed in the FSAR to provide a minimum safety factor of 1.5 against liquefaction. It was ascertained that although the technical data in the calculation were sufficient to determine whether an adequate safety factor was provided, the results of the calculation were not summarized sufficiently so that the reviewers could readily determine the conclusions. In addition, the calculations reviewed contained the determination of static and dynamic soil properties for Category I backfill compacted to both 97 percent and 95 percent of maximum dry density in accordance with ASTM 1557. However, the relationship between the values determined for these two densities and the conservatism inherent in their use was not clearly delineated in the calculations. These inconsistencies have been included in the general Finding 13A-18 issued relative to phase II of the programmatic verification of geotechnical calculations. In response to this finding, the Project has committed to clarify calculations to support the FSAR values. The Project has provided a roadmap calculation to establish the source of the design data incorporated in the criteria and as reported in the FSAR.

6.1.3.2 Phase II Design Program Verification Results

During phase II, a programmatic review of design control processes as applied to design documents was performed. This review was performed both for design documents and design change documents associated with the foundation materials and Category I backfill. The review was performed to ascertain continuity between design documents and compliance to applicable procedures.

Documents reviewed include design criteria, calculations, drawings, specifications, and design change documents. The emphasis of the review was to verify that the design process has been controlled in accordance with licensing commitments. This was done by ascertaining that the design process has complied with applicable procedures and other documents governing design control (e.g., ANSI N45.2.11) and that appropriate design coordination has been maintained. Checklists were developed as needed for each type of document review.

6.1.3.2.1 Calculations

From approximately 70 calculations, 4 relating to the Category I backfill were reviewed specifically and are listed in Table 6.1-3. These four selected calculations did not meet the requirements of ANSI N45.2.11 or governing Project procedures. They were not detailed sufficiently to allow a technically qualified person to review the calculations without the assistance of the originator. A general review of a large number of geotechnical calculations indicated that generic programmatic deficiencies existed. One general finding (13A-18) was written concerning calculations. This finding is described in section 6.1.4.

6.1.3.2.2 Drawings

From a total of 44 geotechnical drawings, 5 drawings were selected for review and are listed in Table 6.1-4. These drawings were reviewed for conformance to project procedures and specific licensing commitments such as compaction requirements and settlement monitoring. The review indicated that drawings were issued in compliance to the project procedures and that they met the intent of ANSI N45.2.11 requirements.

There were no findings resulting from this review.

6.1.3.2.3 Specifications

Nine sections from three divisions of construction specification X2AP01 were within the scope of this module. Of these nine sections, four were included in the programmatic review and are listed in Table 6.1-5. The specification sections reviewed were written by design engineering for control of earthwork, backfill, soil drilling, soil sampling, soil testing, and other field activities. The review ascertained that the specifications met the programmatic requirements of project procedure PRM C-26. The review concerned approval, review, and incorporation of Construction Specification Change Notices (CSCNs) in design specifications. The review concluded that the geotechnical specifications for foundation materials and backfill were being handled satisfactorily according to project procedures.

No findings resulted from this review.

6.1.3.2.4 Deviation Reports

The DR review for this module began by computer sorting the DR log to list the DRs pertaining to Category I backfill and excavation. From this listing of approximately 190 DRs, 19 were selected for review. The final sample was selected using the following guidelines:

- o The sample selection was biased toward Use As-Is and Repair dispositions.
- o The sample covered representative time periods when Category I backfill and foundation excavation operations were in process.

The final review sample was reviewed for:

- o Clear identification of:
  - deviations,
  - deviation source or cause,
  - disposition;
- o Incorporation of justification and calculation;
- o DRs effect on design documents;
- o Required interface review;
- o Required approvals;
- o Evaluation by QA as a potential recurring problem.

Table 6.1-6 is a listing of the deviation reports reviewed.

The review disclosed that geotechnical related DRs were being dispositioned according to procedures in a satisfactory manner.

No finding resulted from this review.

6.1.3.2.5 Field Change Requests

After a preliminary computer sort and final manual sorting, it was determined that there were approximately 70 FCRs related to foundation materials and backfill. From this sample, nine were selected for detailed review. The final review sample was selected based on the following:

- o The sample covered representative time periods.
- o The documentation affected by the change requests was varied so that drawings, specifications, etc. would be represented by the sample.

The review sample is shown on Table 6.1-7. The FCRs were reviewed for attributes such as.

- o If BPC Project Field Engineering (PFE) dispositioned the FCR, was there BPC Home Office Engineering (HOE) concurrence?
- o Was the FCR reviewed against appropriate design criteria, calculations, or specifications?
- o Was a design change required?
- o Was interdiscipline design review required?
- o Was the justification documented?
- o Was the design/specification change issued as required?

In summary, it was determined that all FCRs related to foundation materials and backfill complied with the FCR procedure (PRM section C17), were appropriately dispositioned, and were subjected to appropriate interdiscipline review.

No findings resulted from this review.

6.1.3.2.6 Studies and Reports

In addition to the regular engineering documentation such as calculations, drawings, specifications, and the design change control documents, a number of soils/backfill related data is contained in studies and reports. The reports selected for review by the design verification team were chosen to represent a broad cross section of the subject matter covered. A listing of the reports reviewed is shown in Table 6.1-8. The sample of 5 reports was selected from a total of 16 reports produced on the project.

The review ascertained whether the reports met the requirements of PRM, part C, section 12 specifically:

- o Does the format comply with the requirements?
- o Are reviews and/or approvals indicated?
- o Have appropriate interface requirements been met?
- o Are revisions documented in a timely manner?
- o Are attachments and supporting documentation properly referenced?

The reports complied satisfactorily with the programmatic requirements of the project.

No findings resulted from this review.

6.1.3.3 Field Walkdown

The design verification team conducted a limited programmatic review (walkdown) of the earthwork activities associated with Category I backfill as a supplement to the detailed walkdown conducted by the construction verification team. The design team walkdown was directed toward a programmatic review to assess the implementation of engineering requirements delineated in construction specifications and field procedures.

The walkdown of Category I backfill placement was observed in an area of limited access adjacent to the auxiliary building (N76+75 to N77+25 by E95+00 to E96+00). Selected sandy, silty-sand backfill was being placed in 4-inch lifts and compacted manually with smooth double drum vibrating Wacker rollers and manual (Jumping Jack) tampers in accordance with CD-T-01 sections 5.2.4 and 5.4. A soils inspector was at the site directing fill placement, testing fill, and documenting the backfill activities.

Observed activities were consistent with the project specifications, X2AP01-C2.2, and were being carried out in accordance with the approved field procedures, CD-T-01.

No finding was issued as the result of the walkdown.

6.1.4 FINDING, PROJECT RESPONSES, AND TASK FORCE CONCLUSIONS

During the design program verification process described in section 4.1.2, questions were raised which either required clarification and resolution by project personnel or led to the issuance of a finding, dispositions, and corrective actions. The item determined to be a finding was documented and dispositioned using the Readiness Review Finding Form. The finding was categorized as described in section 6.0.

The design program verification process resulted in one finding, 13A-18, which was designated Level II. The finding concerns geotechnical calculations for foundation materials and backfill involving nonconformance with applicable geotechnical documentation procedures; ANSI N45.2.11 documentation requirements; and clarity among engineering design values provided in the FSAR, design reports, and design criteria relative to foundation materials and Category I backfill. A detailed description of Finding 13A-18, the project response, and the basis for the conclusions regarding Finding 13A-18 is provided in the following pages.

- Finding 13A-18 (Level II)

  ANSI N45.2.11, section 4, Design Process, states "Analysis shall be sufficiently detailed as to purpose, method, assumptions, design input, references, and units such that a person technically qualified in the subject can review and understand the analyses and verify the results without recourse to the originator..."

  <u>Description</u>: A review of a sample number of geotechnical calculations revealed various noncompliances to applicable geotechnical procedures and requirements of ANSI N45.2.11 e.g.:

  - Lack of checker and/or reviewer approvals;
  - Statement of purpose, assumptions, input sources, references, summary or conclusions not readily identifiable.
  - Computer output sheets did not properly cross reference applicable calculations.

  Input and output data and the FSAR commitments, the design reports, and the design criteria were not clearly correlated.

  Specific examples are:

  - Calculation X2CF-S-SF06: Reference to test data is not specific enough to verify input source. Calculation cover sheet has no originator, checker, or approval signatures.

- Calculation X2CF-S-S036: Calculation contains no references, output is not summarized, and computer program used inadequately cross-references the appropriate calculation.

- Calculation X2CF-S-032: Source of test data used in calculation is not referenced. Results of calculation are not summarized.

- Calculation X2CF-S-SF17: Documentation of the geotechnical design parameters is not readily ascertained in the source documents; e.g., FSAR 2.5.4.11 states liquefaction potential of Category I backfill is based on a minimum safety factor of 1.5 against liquefaction. Review of this calculation to verify this commitment required reviewer interpretation of the source data.

- Documentation of source of geotechnical design parameters not readily traceable; e.g., FSAR Table 2.5.4-9, Dynamic Property Values, and FSAR Table 2.5.4-8, Static Property Values, reflect backfill compacted to 97 percent maximum density by ASTM D 1557. Verification in the calculation was traceable to 95 percent compaction, but not to 97 percent. Justification for the use of data provided in the FSAR, was not readily identifiable.

Project Response: The two issues raised by this finding are:

- Completeness of calculations with regard to documenting the purpose, methods, assumptions, design inputs, and references (issue 1);

- Completeness of calculations supporting FSAR commitments (issue 2).

Issue 1:

Geotechnical calculations relating to foundation materials and backfill are typically prepared in accordance with BPC Hydro and Community Facilities Division (H&CF) Engineering procedures, which are essentially the same as project calculation procedures. In this particular instance, the H&CF personnel performing the calculations did not always fully delineate their methods, assumptions, design input, and references; thus, they did not comply with H&CF procedures. In order to correct this deficiency, all safety-related geotechnical calculations were reviewed and revised as necessary to establish the required documentation. Approximately 70 safety-related calculations were performed by H&CF related to Vogtle.

These calculations are related to the soils foundations required for Plant Vogtle and include the determination of an acceptable safety factor against liquefaction, appropriate safety factors for static and dynamic bearing capacity, determination of predicted tolerable structure settlements, and the development of various parameters and modules used in the design of the plant. Nearly all of these calculations were revised in response to this finding.

The nature of these revisions was of a nontechnical, documentational type. This is evidenced by reviewing the Module 13A IDR findings, all of which were resolved without affecting FSAR commitments. Had Finding 13A-18 gone undiscovered, there would have been no safety implications due to the nontechnical nature of the finding. Resolution of this finding did not and will not affect past, present, or future related construction activities; therefore, no changes to engineering design requirements were required.

The following is in response to the issues raised in the specific examples sited:

- Calculation No. X2CF-S-SF06: This is a single sheet calculation used for interpreting laboratory testing results to determine the consolidation characteristics of the clay marl bearing stratum. The calculation was revised to provide a complete reference to the source of data used, and the cover was signed off with proper approval.

- Calculation No. X2CF-S-036: This calculation is a summary of computer results. The computer output was originally attached to this calculation and later filed separately under Calculation No. X2CF-S-097. The computer code used is identified in Calculation No. X2CF-S-033 and the soil properties used were developed in Calculation No. X2CF-S-032. This calculation is one of a series of calculations (Calculation Nos. X2CF-S-032 through 036) and if reviewed as a set would have presented a clearer understanding of the process followed.

  The calculation was revised to include cross referencing to the source of data, the identification of the computer program used for analyses, and a summary of the results. The calculation had already been revised to show the quality class on the cover sheet prior to the audit.

- Calculation No. X2CF-S-032: As noted above, the output data of this calculation was used in Calculation No. X2CF-S-036. The calculation was revised to provide references to the data used and a summary of the results and their use.

- Calculation No. X2CF-S-SF-17: The minimum safety factor of 1.5 against liquefaction is accepted practice and is the FSAR commitment. The data on Sheet 22 of this calculation indicates a minimum safety factor of greater than 1.5 for backfill with a relative density of 80 percent; this is the basis for the selection of the 97 percent compaction requirement. The calculation was revised to include a summary of results and cross-referenced to appropriate geotechnical design parameters in the FSAR.

Issue 2:

The VEGP FSAR commitments are supported by BPC Geotechnical Services Group (Geotech). Because Hydro and Community Facilities Division performs calculations for many purposes other than FSAR support, they may vary parameters within acceptable ranges for conservatism or other justifiable reasons.

In order to remove any ambiguity this may have caused, a roadmap calculation (X2CF-S-112) was created to establish the source of all design data reported in the FSAR or included in the Project design criteria. Additionally, a discussion of any differences between the FSAR and values used in the calculations was addressed in the revised calculations.

The response to the specific examples cited follows:

FSAR Table 2.5.4-9

Soil unit weights (moist, saturated, and submerged) are derived in Calculation No. X2CF-S-SF17. The Poisson ratio shown is an assumed value and is reasonable for the type of materials used as Category I backfill. Damping ratios referenced in FSAR Figure 3.7.B.1-8 are a direct plot of the laboratory test data shown in the appendix to the BPC report, Dynamic Properties for Compacted Backfill. Shear modulus values shown in the table are obtained from Equation $G = 1000K2\ (\sigma'_m)$ lbs/ft where $K2 = 79$ and σ'_m is the mean effective stress. Calculations showing these values were generated and included in the project calculation files.

FSAR Table 2.5.4.8

Soil unit weights are derived in Calculation No. X2CF-S-SF17. Effective shear strength parameters and undrained modulus of elasticity, E, are calculated in Calculation Nos. X2CF-S-025 and X2CF-S-024, respectively. These calculations were performed using data for backfill compacted to 93 percent and 95 percent of ASTM D 1557. The design parameters shown in Table 2.5.4-8 are based on 93 percent and 95 percent relative compaction and are conservative for backfill at 97 percent relative compaction. The calculation was revised to describe the basis of selection for the 97 percent soil design properties and the justification for the same.

The work to be performed by Geotech was completed. The actions taken have resolved noted deficiencies regarding these calculations.

Readiness Review Finding Conclusion: The response provided is acceptable. The nonconformance and discrepancy items are documentary, nontechnical, and present no safety concern. However, the finding was designated Level II because of lack of readily identifiable cross-referencing between calculations and FSAR commitments. Furthermore, because of the extensive nature of the noncompliance to design control requirements, the Level II designation to the finding is deemed appropriate by the Readiness Review Team.

6.1.5 REVERIFICATION OF CORRECTIVE ACTION (FINDING 13A-18)

A reverification of revised calculations was conducted during the week of November 11, 1985 by a joint team consisting of members from both the Independent Design Review and the programmatic design verification teams. The reverification consisted of an overall review of all geotechnical calculations, reverification of selected commitments, and a programmatic review of design control process in the revised and upgraded geotechnical calculations.

The overall reverification of geotechnical calculations was conducted by reviewing revised calculations for completeness, and for compliance to the procedures.

6.1.5.1 Reverification of Commitments

Eighteen selected commitments were reverified to ascertain implementation of commitments in the design calculations or specifications. The sample for reverification was drawn from original samples reviewed earlier and was expanded to include some key commitments made in the FSAR.

It was found that the technical basis for various values of engineering properties for foundation materials, Category I backfill, and the design safety factor were well documented in the calculations. The calculation X2CF-S-112 dated August 14, 1985, provided a cross-reference (roadmap) to calculations and FSAR commitments clearly identified in the source data input to the FSAR.

Table 6.1-9 provides the summary commitment reverification calculation matrix.

No finding resulted from this reverification.

6.1.5.2 Programmatic Reverification of Calculations

A programmatic reverification of geotechnical calculations was conducted (November 11 through 14, 1985) to review revised and upgraded calculations pertaining to foundation materials and backfill. The reverification was aimed at ascertaining whether the corrective action committed to by the Project in response to design program verification Finding 13A-18 was completed. The reverification review was as follows:

A selected sample consisting of 25 calculations was reviewed in detail for procedural compliance. The design control process attributes reviewed included conformance to commitment/criteria, quality class, assumptions, input-output coordination, computer program identification, cross-referencing to calculations when applicable, checking review/approval, and revision control.

All calculations were found to meet the applicable attributes and complied to the geotech engineering procedures. Calculations adequately provided support to FSAR commitments and contained technical basis for the parameters and engineering properties identified in the FSAR.

Table 6.1-10 provides the list of 25 specific calculations reviewed during the reverification.

No finding resulted from this verification.

6.1.5.3 Standard Penetration Test Results

In addition to the good engineering judgements and conservatism observed in the calculations, high quality of the Category I in-place fill constructed at VEGP was recently verified by the performance of a series of onsite standard penetration tests. These tests resulted in a series of consistently high blow counts. Based upon the results of this testing, Dr. H. Bolton Seed, University of California at Berkeley, has concluded that there is no possibility of liquefaction occurring for any level of ground shaking at the Vogtle site and that liquefaction is simply not a credible mode of failure for this fill.

The reference documents relative to standard penetration test are listed in Table 6.1-8.

6.1.6 FINDING SIGNIFICANCE

The one design program verification finding (13A-18) is discussed in the previous section.

Finding 13A-18, (Level II) pertaining to geotechnical calculations was nontechnical in nature and involved the violation of design control procedures per ANSI requirements. The Project has reviewed, revised, and updated all (approximately 70) safety-related geotechnical calculations to conform to the design control procedures and to meet the intent of ANSI 45.2.11 requirements.

Based on the reverification review of the corrective actions, the design program verification team concludes that the Project has correctly and adequately implemented corrective actions as committed to earlier. The geotechnical calculations have met the programmatic design control requirements and adequately support FSAR commitments. Furthermore, there are no safety concerns.

Table 6.1-1

VERIFICATION SUMMARY

Document Type	Number Reviewed	Total[a]
Design Documents		
Criteria	2	2
Calculations	4	70
Drawings	5	44
Specifications	4	9
Studies and Reports	5	16
Design Change Documents		
Field Change Requests (FCRs)	9	70 (approx)
Deviation Reports (DRs)	19	190 (approx)

a. Total numbers are for documents relative to this module.

TABLE 6.1-2 (SHEET 1 OF 4)

COMMITMENTS VERIFICATION MATRIX

Requirement	FSAR Section	Classification Commitment	Classification Design Req't	Design Manual Section	Design Document Type	Design Document Number	Comments
Soil properties	Table 2.5.4-2	1906	X	DC-100-C	Calc.	X2CF-S-SF02	
Maximum design ground water level 165 ft MSL	2.4.12.4	769	X	DC-1000-C	Calc.	X2CF-S-036	
ASTM D2487	2.5.4.5	1889			Spec.	X2AP01-C2.12.4B and -C2.13.14B.1	
ASTM D 2488	2.5.4.5	1890			Spec.	X2AP01-C2.12.4B and -C.13.14B.1	
ASTM D 1140	2.5.4.5	1891			Spec.	X2AP01-C2.2.6H.3.6	
ASTM D 422	2.5.4.5	1892			Spec.	X2AP01-C2.2.6H.3.b and -2.13.14B.3	
ASTM D 423	2.5.4.5	1893			Spec.	X2AP01-C2.2.2B and -2.13.14B.5	
ASTM D 424	2.5.4.5	1894			Spec.	X2AP01-C2.2.2B and -2.13.14B.5	
Undrained shear strength of marl: 10 ksf	Table 2.5.4-9 2.5.4.2	1941		DC-1000-C	Calc.	X2CF-S-103	
					Spec.	X2AP01-C2.2.6	
Ultimate bearing pressure and factors of safety in table	Table 2.5.4-12	1911	X	DC-1000-C	Calc.	X2CF-S-103, Sheets 18 and 24	

TABLE 6.1-2 (SHEET 2 OF 4)

Requirement	FSAR Section	Classification: Commitment	Classification: Design Req't	Design Manual Section	Design Document: Type	Design Document: Number	Comments
Safety factor greater than or equal to 2 required for dynamic load	2.5.4.10 Table 2.5.4-12	1900			Calc.	X2CF-S-103, Sheets 18 and 24	
A minimum factor of safety of 3 against shear failure of foundation material under sustained dead load plus live load	2.5.4.11	1902	X	DC-1000-C	Calc.	X2CF-S-103, Sheets 18 and 24	
Static property values (backfill)	Table 2.5.4-8	1909	X	DC-1000-C	Calc.	X2CF-S-024 X2CF-S-025 X2CF-S-031	Finding 13A-18
All Category I structures supported on clay marl stratum or sand-silty backfill compacted to 97% maximum density measured by ASTM D1557	2.5.4.11	1901	X	DC-1000-C	Spec.	X2AP01-C2.2.7.C	
Static cone penetrometer readings used to test adequacy of compaction where access prevents use of sand cone test	2.5.4.5	1939			Spec.	X2AP01-C2.2.7C	

TABLE 6.1-2 (SHEET 3 OF 4)

Requirement	FSAR Section	Classification: Commitment	Classification: Design Req't	Design Manual Section	Design Document: Type	Design Document: Number	Comments
Backfill in areas north of turbine building compacted to an average of 95% of the maximum density determined by ASTM D1557, with not more than 10% of tests between 93 and 95% and no test less than 93%	2.5.4.5	1888		DC-1000-C DC-2146	Spec. Dwg.	X2AP01-C2.2.7C AX2D46T001 AX2D46T004	 rev. 12 rev. 11
Category I backfill should be sand and silty sand with not more than 25%, by weight, passing the US No. 200 sieve	2.5.4.5	774				X2AP01-C2.2.6H	
Backfill has an adequate safety factor against liquefaction for backfill compacted to 97% of maximum density obtained by ASTM D 1557	2.5.4.8	776		DC-1000-C	Calc.	X2CF-S-SF17	

TABLE 6.1-2 (SHEET 4 OF 4)

Requirement	FSAR Section	Classification: Commitment	Classification: Design Req't	Design Manual Section	Design Document: Type	Design Document: Number	Comments
Liquefaction potential of Category I backfills based on a minimum safety factor of 1.5 against liquefaction	2.5.4.11	1903			Calc.	X2CF-S-SF17 rev. 1, page 40	Not readily identified in calculations Finding 13A-18
Dynamic property values (backfill)	Table 2.5.4-9	1910		DC-1000-C	Calc.	X2CF-S-032 X2CF-S-SF17	Finding 13A-18
R.G. 1.132 Rev. 1 10 CFR 100 App. A	1.9.132 2.5.A	1870 1885		DC-1000-C DC-1000-C		See comments See comments	Implementation of these commitments is an aggregate of all site investigations and is summarized in the date presented in FSAR sections 2.5.1, 2.5.2, and 2.5.3. During the verification, the Readiness Review Design Team did not find any conflict with the requirements in 10 CFR 100 Appendix A or the methodology outlinec in RG 1.132 Rev. 1.

TABLE 6.1-3

SELECTED CALCULATIONS

Calculation Number	Title/Description	Reviewed For Phase I	Reviewed For Phase II	Associated Findings
X2CF-S-SF17	Liquefaction analyses Compacted soil	X	X	13A-18
X2CF-S-SF06	Atterberg limits		X	13A-18
X2CF-S-032	Dynamic soil properties	X	X	13A-18
X2CF-S-036	Liquefaction analysis 95% compacted final soil properties	X	X	13A-18
X2CF-S-103	Bearing capacity Table 2.5.4-12 of FSAR	X		None
X2CF-S-SF02	In-situ densities and water contents	X		None
X2CF-S-024	Cyclic triaxial test results	X		13A-18
X2CF-S-025	Strength parameters of compacted sand, silty sand	X		13A-18
X2CF-S-031	Index and compaction properties of backfill borrow	X		13A-18

TABLE 6.1-4

DESIGN CONTROL REVIEW - DRAWINGS

Drawing Number	Title/Description	Reviewed For Phase I	Reviewed For Phase II	Associated Findings
AX2D46T001	Excavating plan, Units 1 and 2, Power Block	X	X	None
AX2D46T004	Excavating sections, Units 1 and 2, Power Block	X	X	None
AX2D55V001	Settlement observation markers, location, and detail		X	None
AX2D55V028	Settlement observation record tables and graphs		X	None
AX2D55V063	Major structure settlement summaries		X	None

TABLE 6.1-5

DESIGN CONTROL REVIEW - SPECIFICATIONS

Specification Number	Title/Description	Reviewed For Phase I	Reviewed For Phase II	Associated Findings
X2AP01 C-2.2	Earthwork and related activities		X	None
X2AP01 C-2.4	Plastic backfill		X	None
X2AP01 C-2.13	Exploration and testing additional backfill		X	None
X2AP01 C2.15	Obtain and test marl samples		X	None

TABLE 6.1-6

DEVIATION REPORTS REVIEWED (a)(b)

DR Number:

CD-00294

CD-00352

CD-00461

CD-00578

CD-00614

CD-00730

CD-00829

CD-01046

CD-01165

CD-01748

CD-03243

CD-03948

CD-04078

CD-04189

CD-04337

CD-05160

CD-05581

CD-06289

CD-06538

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a. Reviewed programmatically.
b. There were no associated findings.

TABLE 6.1-7

FIELD CHANGE REQUESTS REVIEWED [a]

Number	Title/Description
C FCRB 3	Modify backfill placement to beam concrete for local limited access areas
C FCRB 11	Modify excavation depth
C FCRB 25	Relocate bench mark monument
C FCRB 44	Modify settlement marker installation design
C FCRB 5384	Request to leave temporary foundations block in backfill
C FCRB 5404	Request to modify sheet pile design
C FCRB 12460	Modify limits of Category I backfill
C FCRB 13556	Revise settlement monitoring
C FCRB 13706	Revise testing specifications

a. Programmatic review.

TABLE 6.1-8

DESIGN CONTROL - REPORTS AND STUDIES [(a)]

Report on Foundations Investigations, Alvin W. Vogtle Nuclear Project, BPC, July 1974.

Report of Dynamic Properties for Compacted Backfill, Alvin W. Vogtle Nuclear Project, BPC, February 1978.

Report of Coring and Laboratory Testing Marl Samples, LETCO, November 1977.

Report of Mar' nvestigation Vogtle Nuclear Power Plant, BPC, December 197

Final Report on Deviation and Repair of Erosion in Category I Backfill in Power Block, BPC and GPC, August 1980.

Standard Penetration Test Report, Law Engineering Testing Company, Letter dated July 26, 1985.

Letter from H. Bolton Seed to Walter R. Ferris dated July 3, 1985.

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a. Reviewed programmatically.

TABLE 6.1-9 (SHEET 1 OF 4)

COMMITMENT REVERIFICATION CALCULATION MATRIX

Requirement	FSAR Section	Commitment Ref. No.	Design Manual Section	Design Document Type No.	Comments
ICES-SEPOL (McAuto Version)	3.8.1.15	778 1293	DC-1000-C, Rev. 0 Appendix A	X2CF-S-106, Pg. 1 of 39 X2CF-S-110, Computer output	
Empirical relationship for undrained Young's modulus E=400 Su; Su = undrained shear strength (4000 KSF) lower bound	NRC Q 241.3 Correspondence	1480	DC-1000-C, Rev. 3 9-30-83, Fig. 13		
Backfill compacted to average 97% of maximum density determined by ASTM 1557, with no tests below 93% and no more than 10% of tests between 95% and 93%.	2.5.4.5	1887	DC-1000-C, Rev. 3 9-30-83 section 2.2B, 3.5.3	X2CF-S-117	All data pertaining to parametric evaluation reviewed.
Moisture + or - 2% optimum for sand, silty-sand material as determined by ASTM D 1557	2.5.4.5	1895	X2AP01-C2.2, Rev. 13	X2CF-S-117	See Implementation Matrix for details.

TABLE 6.1-9 (SHEET 2 OF 4)

Requirement	FSAR Section	Commitment Ref. No.	Design Manual Section	Design Document Type No.	Comments
Select sand and silty-sand backfill compacted to 97% of maximum density determined by ASTM D 1557 placed from top of marl to design elevation of various structures (Liquefaction potential)	2.5.4.8	1897	DC-1000-C, Rev. 3	X2CF-S-117	See Implementation Matrix
Safety factor greater than or equal to 3 acceptable for allowable bearing capacity for static loads	2.5.4.10	1899	DC-1000-C	X2CF-S-103, Rev. 0 Sheet 18 of 24	See Implementation Matrix
Safety factor greater than or equal to 2 required for dynamic loads	2.5.4.10	1900		X2CF-S-103, Rev. 0 Sheet 18 of 24 Tables	
A minimum safety factor of 3 against shear failure of foundation materials under sustained dead load plus live load	2.5.4.11	1902		X2CF-S-103	
Liquefaction potential of Category I backfill is based on a safety factor of 1.5 against liquefaction	2.5.4.11	1903 (776)	DC-1000-C, Rev. 3	X2CF-S-SF17, Rev. 1 page 40	See Implementation Matrix

Requirement	FSAR Section	Commitment Ref. No.	Design Manual Section	Design Document Type No.	Comments
Soil properties (density, moisture control, etc.)	2.5.4-2	1906	DC-1000-C	X2CF-S-SF02 through X2CF-S-SF16 various pages	
Static property values	2.5.4-8	1909		X2CF-S-025, Rev. 1 Sheet 1 of 2	
Dynamic property value	2.5.4-9	1910		X2CF-S-F17	
A total stress design shear strength c = o phi = 34 degrees was used for the upper sand stratum and C = 10,000 lb/ft², phi= 0 degrees for the clay-bearing stratum	2.5.5.1	1912		X2CF-S-SF07, Rev. 1 sheet 10, C = 10,000 X2CF-S-SF08, Rev. 1 Sheet 2, phi = 34	
infinite slope analyses, based on the design friction angle of 34 degrees, indicated that temporary fill slopes have a minimum safety factor against raveling of 1.01	2.5.5.2	1917	N/A	X2CF-S-062, Rev. 0 Sheet 2	
Average of 95% of ASTM D 1557 maximum density with no tests below 93% and no more than 10% of test between 93% and 95%	2.5.4.5	1935 1937	N/A	X2AP01-C2.2, Rev. 13, section 2.2.7	

TABLE 6.1-9 (SHEET 4 OF 4)

Requirement	FSAR Section	Commitment Ref. No.	Design Manual Section	Design Document Type No.	Comments
Undrained shear strength	2.5.4.2	1941	DC-1000-C	X2CF-S-SF07	See Implementation Matrix for details

TABLE 6.1-10 (SHEET 1 of 2)

DESIGN CONTROL PROGRAM REVERIFICATION
FOR PROCEDURAL COMPLIANCE

Calculation No.	Title
X2CF-S-SF04	Maximum dry density and optimum moisture content
X2CF-S-SF06	Atterberg limits
X2CF-S-SF07	Summary of unconsolidated undrained triaxial and calculation for elastic modulus
X2CF-S-SF08	Consolidated undrained triaxial test results and elastic modulus
X2CF-S-SF12	Heave due to excavations
X2CF-S-SF16	Liquefaction analyses of in-situ soil
X2CF-S-SF17	Liquefaction analyses of compacted soil
X2CF-S-SF24	Cyclic triaxial test results
X2CF-S-003	Lateral pressure on control building wall by turbine mat
X2CF-S-004	Surcharge due to equipment loads on backfill behind tendon gallery
X2CF-S-006	Elastic moduli for compacted backfill
X2CF-S-011a	Final estimates of Category 1 backfill quantities
X2CF-S-018	Settlement of diesel generator building on stockpile B backfill

TABLE 6.1-10 (SHEET 2 of 2)

Calculation No.	Title
X2CF-S-024	Static Young's modulus of compacted sand, silty sand
X2CF-S-025	Strength parameters of compacted sand, silty sand
X2CF-S-032	Dynamic soil properties
X2CF-S-036	Liquefaction analysis 95% compacted final soil properties
X2CF-S-095	Coefficient of sub-grade reaction
X2CF-S-106	Settlement analyses
X2CF-S-109	Dynamic shear and Young's modulus for backfill compaction of 97%
X2CF-S-110	Computer printout for calculation X2CF-S-106
X2CF-S-111	Reevaluation of field compaction based upon confirmatory test
X2CF-S-112	Roadmap calculation (cross reference between FSAR and calculation packages)
X2CF-S-115	Porosity of backfill compaction densities
X2CF-S-117	Computer printout for calculation X2CF-S-111

6.2 CONSTRUCTION PROGRAM VERIFICATION

The following sections describe the construction program verification, resultant findings, and corrective actions. This verification was performed by the Readiness Review construction verification team. The three members of the team have a cumulative experience of 19 years in geotechnical and soils construction. Approximately 700 manhours were expended and 1100 records were reviewed during the verification process.

The construction program verification consisted of commitment implementation and construction assessment. Commitment implementation assessed whether construction incorporated licensing commitments into the implementing documents, whereas construction assessment determined whether construction activities complied with design requirements.

6.2.1 SUMMARY EVALUATION

A total of six findings was identified during the assessment of construction activities in Module 13A. Of the six findings, two were identified during commitment implementation and four during construction assessment. The construction team assessed the findings' impact on the project and classified each with respect to the following categories:

- o Category A - Paperwork;
- o Category B - Hardware;
- o Category C - Programmatic.

The findings, their level of importance, and their categories are given in Table 6.2-1.

The two findings identified during commitment implementation (13A-1 and 13A-2) noted differences between the Final Safety Analysis Report (FSAR) and the implementing specification. Both findings require revision to the FSAR to conform to actual practice or later planning. Neither finding had any adverse affect on the work and was classified as Level II. Details of commitment implementation are found in section 6.2.2.1.

Four findings were identified during construction assessment, of which, one was Level II and three were Level III findings. There were no Level I findings. Three of the four findings (13A-3, 13A-5, 13A-6) are minor deviations from procedure requirements or record errors that are not indicative of programmatic failures or physical discrepancies. The fourth (13A-22) identified some borrow area gradation test results (secondary documents, i.e., documents that are redundant to other documents which are normally utilized for verifying acceptability of soils placement) that cannot be located in the quality assurance (QA) records vault. The data represented by these missing records is found in other documents that are retrievable from the vault. Construction has initiated a program to evaluate vault storage of records and to correct identified filing errors. Details of construction assessment are found in section 6.2.2.2.

It is the conclusion of the Readiness Review construction team, from evaluating the results of this review, that the findings were of minor consequence, had no physical impact on the backfill, and that acceptability of the backfill is verifiable with the available documentation.

6.2.2 CONSTRUCTION VERIFICATION PROCESS

6.2.2.1 Commitment Implementation

Section 3.4 contains the matrix for the commitments identified by the FSAR and generic letters that are applicable to Module 13A. After identification of the commitments, the Readiness Review construction team reviewed each construction commitment and identified the project document that currently implements each commitment. Additionally, a review was performed to identify the project document that initially implemented the commitment.

The commitment implementation matrix identified 24 construction commitments. Twenty-two of these commitments were appropriately traced to the implementing documents from the time of initial implementation to current status. The remaining two commitments were found to be deficient in their implementation. These deficiencies were identified as Readiness Review Findings 13A-1 and 13A-2.

- Readiness Review Finding 13A-1 (Level II)

  Description: Section 2.5.4.5 of the FSAR states that the test fill program concluded that the placement moisture content must be controlled between ±2 percent of the optimum moisture content. Contrary to this, specification X2AP01 C2.2 and field procedure CD-T-01 allow the placement moisture to be between +2 percent and -3 percent of optimum moisture content.

  Project Response: The FSAR statement regarding the recommendations of the test fill report is correct. In response to a field request made subsequent to issuance of the original report, the moisture range was modified. This modification was based on a review of the original test fill data and numerous additional field tests performed during the backfilling operation. FSAR Change Notice No. 239 was initiated August 20, 1985 to indicate the moisture content range actually used in the field.

Readiness Review Conclusion: The Readiness Review Team concurs with the project response and corrective action.

- Readiness Review Finding 13A-2 (Level II)

  Description: Section 2.5.4.13 of the FSAR states that survey readings for settlement are to be taken at 30-day intervals after startup. However, specification X2AP01 C10.1 requires readings to be taken at intervals of 30 days for 6 months; after 6 months, if settlement is less than .002 feet, the readings are only required on a yearly basis. These two documents are in conflict.

  Project Response: The frequency and duration of settlement monitoring subsequent to startup was under discussion with the NRC staff for approximately 18 months and was resolved subsequent to preparation of this finding. Modifications to the specification had been postponed until monitoring program agreement had been reached with the NRC staff. A specification revision was initiated September 4, 1985 and FSAR Change Notice No. 240 was initiated August 20, 1985 to correct the specification and FSAR.

  Readiness Review Conclusion: The Readiness Review construction team concurs with the project response and corrective action.

6.2.2.2 Construction Assessment

The assessment plan was developed to provide an appraisal of the documentation associated with the borrow and placement of Category I backfill. Development of the plan consisted of formulating a method for selection of documentation and a method to assess whether this documentation is retrievable and acceptable.

6.2.2.2.1 Assessment Item Selection

The items selected for assessment can be divided into four categories. These categories are borrow of backfill material, placement of backfill material, laboratory testing of backfill material, and programmatic activities. The basis for the sample selection was that only documentation dealing with Category I backfill would be considered and that the selection process would demonstrate the retrievability of data for tests performed at random locations. Secondly, since 40 of the 70 GPC and NRC audits were of backfill techniques resulting in only one finding, little could be gained from a field walkdown.

The following list identifies the activities selected for assessment and the attributes assessed.

- Borrow Activities
  - Retrievability of borrow area documentation,
  - Proper gradation test and test frequency as required by the specification (the requirements for testing of Category I borrow material are given in Table 6.2-2);
- Placement Activities
  - Retrievability of field density test records,
  - Distribution and frequency of field density tests,
  - Field density test compaction results,
  - Accurate information in Daily Inspection Reports,
  - Foundation Inspection Reports;
- Laboratory Activities
  - Retrievability of lab reports,
  - Acceptability of lab reports,
  - Acceptable calculations;
- Programmatic Activities
  - Personnel certification,
  - Equipment calibration,
  - Deviation control.

6.2.2.2.2 Borrow Activities

There were basically five time periods during construction when Category I backfill material was being excavated and stockpiled. Target months were chosen in each of these time periods. A target month is a month during which borrow documentation was sampled. The next month was also assessed if there were less than 15 days of borrow in the target month. Due to the length of the borrow period extending between November 1980 and March 1983 and the large quantity of borrow material excavated during this period, an additional target month of April 1982 was chosen for assessment. The six target months selected were:

- June 1978;
- January 1979;

- November 1980;
- April 1982;
- March 1983;
- November 1984.

The assessment was conducted utilizing instructions and checklists formulated by the construction team (Figure 6.2-1). The results of the borrow assessment are summarized below:

- Gradation tests for the target months June 1978, November 1980, and April 1982 could not be located in the project files. This item is documented by RR Finding 13A-22. The gradation tests were located for all other target months.

- All borrow area gradation tests reviewed met the requirement of 25 percent or less passing a U.S. No. 200 sieve.

- The requirement of one test per day of borrow excavation was not met for six days in the November 1980 target period. This deviation was documented in RR Finding 13A-22; The required test frequency was met for all other target months assessed.

Readiness Review Finding 13A-22 was issued to address the deviations noted above:

- Readiness Review Finding 13A-22 (Level II)

  Description: Borrow area gradation tests for several of the periods assessed cannot be found in the project files. These include June 1, 1978 to June 30, 1978; November 1, 1980 to December 31, 1980; and April 6, 1982 to May 3, 1982. Also, no gradation tests were taken on October 23, 1980; October 24, 1980; December 17, 1980; December 18, 1980; December 19, 1980; and December 30, 1980; although Category I borrow was excavated on these dates.

  Project Response: The construction review revealed the following:

  The 1978 gradation test sheets were located in the construction vault and misfiled. Borrow pit gradation tests for the period August 1980 through January 1983 could not be located; therefore Deviation Report CD-8078 was written August 9, 1985 to address the retrievability of these documents and was dispositioned Use-As-Is.

Deviation Report CD-8079 was written August 9, 1985 to address the six days in 1980 when no gradation tests were taken during Category I borrow excavation and was dispositioned hardware not affected. The basis for this disposition is that gradation tests performed in conjunction with field density tests (as opposed to borrow pit gradation tests) provide the primary documentation for the quality of Category I backfill material placed in the power block. All of these records reviewed within the scope of the Category I backfill placement assessment were located. The material quality and test frequency were found to be acceptable in all such records reviewed.

Readiness Review Conclusion: The Readiness Review Team agrees with the project response. Additionally, it is noted that construction has initiated an evaluation program of vault storage to identify and correct filing errors.

6.2.2.2.3 Placement Activities

Two methods for selecting assessment samples were formulated for the placement activities. The first method was to choose a target elevation. A target elevation is a 1 ft horizontal slice through the power block excavation at a selected elevation for which documentation is to be assessed. Elevation (el) 140 was chosen since it is below all Category I foundations except those founded on the marl stratum.

The second method was to select a target coordinate. A target coordinate is a plant coordinate for which documentation associated with discrete fill layers encompassing the coordinate will be assessed. A target coordinate of N79+61, E100+18 was chosen. This coordinate is the center of the diesel generator building, the highest Category I foundation. The assessment began at el 205 and continued downward at 20 ft intervals ending at el 135, thereby assessing the backfill program through the life of the project.

The placement assessment utilized instructions and checklists formulated by the construction team (Figures 6.2-2, -3, and -4).

The results of the placement assessment are summarized below:

o Retrievability of Field Density Test Reports

Summary of Compacted Fill Reports were reviewed to obtain all the field density test numbers for the target elevation and target coordinate. Approximately 600 documents with up to 24 tests on each document were reviewed. All field density test reports for the target elevation and target coordination were retrieved.

- Distribution and Frequency of Field Density Tests

  The location of each sand cone density test at el 140 was plotted on a drawing of the power block. The density test plot revealed that the tests were well distributed over the power block.

  For tests prior to June 1979, the limits of the fill area covered by each test was not required to be documented. However, the backfill placed during this period constituted a large-volume operation where only heavy equipment was used and the number of tests versus the volume of fill meets the specification requirements.

  For backfill placed after June 1979, the limits of the fill area represented by each test was plotted along with the location of the tests. This resulted in confirming that tests were conducted at a frequency that met the requirements of the specification.

  No findings were identified in this part of the assessment.

- Field Density Test Compaction Results

  The field density test results for the tests identified from the summary reports were reviewed for compaction results. All the tests were found to meet the requirements of the FSAR, project specifications, and project procedures.

  No findings were identified with respect to percent compaction.

- Daily Inspection Reports

  The Daily Inspection Reports for the identified tests were reviewed. The information required in the reports was assessed for completeness and compliance with specifications and procedures.

  This review confirmed that the backfill was placed according to specifications and procedures. However, two deviations were identified during this part of the assessment. These deviations were documented on Readiness Review Finding 13A-3 and 13A-6 and are described as follows.

o Readiness Review Finding 13A-3 (Level III)

<u>Description</u>: Specification X2AP01 and procedure CD-T-01 require a moisture correlation curve between pan dry and ASTM D2216 be used to control field moisture. This requirement was added August 8, 1979.

- Two different curves are identified in the files as curve no. 8.

- The moisture correlation curves used to place Category I backfill on June 2, 1980; September 20, 1980; September 23, 1980; October 2, 1980; March 26, 1981; March 27, 1981; March 20, 1981; April 1, 1981; and April 6, 1981 were not the proper revisions of the moisture curve.

<u>Project Response</u>:

- The two curves identified as curve no. 8 differed from each other by 0.5 percent and both were derived using valid data points. All reports utilizing curve no. 8 were reviewed and all moistures were found to be acceptable regardless of the curve used.

  All curves used to date have been reviewed and no other duplications were found. This item is therefore considered isolated.

- For the dates listed using improper revisions of the curve, a comparison was made between the correct curve and the curve used; a maximum of 0.1 percent difference was found. All moisture data was compared to the correct curve and no moistures were found to be out of the required range. Based on this comparison, the deficiency is considered insignificant. A review of all 75 curves used to-date detected no other problems with the moisture curves used.

<u>Readiness Review Conclusion</u>: The Readiness Review construction team concurs with the project response.

o Readiness Review Finding 13A-6 (Level III)

<u>Description</u>: Of the 123 tests identified in the target areas, 31 were found not to have representative piezometer readings taken prior to placement of backfill material.

<u>Project Response</u>: Three of the 31 sand cone tests run in April 1980 were located north of the auxiliary building. A review of piezometer readings taken from other reports indicates that the water level was at such

a point that specification requirements were not violated.

The remaining 28 tests were performed between May 19, 1980 and April 1, 1981 in areas south of a line coincident with the auxiliary building north wall. There were no piezometers in the area at the time since backfill sufficient to allow proper installation had not been placed above the marl.

To maintain an acceptable water table level, a trench drain system was designed and installed prior to backfilling. These trench drains were connected to the perimeter dewatering system.

Upon placement of sufficient backfill, two piezometers were installed and readings began on April 6, 1981. Those piezometers read dry until April 21, 1981.

Therefore, it is concluded that the backfill material was placed at the required distance above the water table.

Readiness Review Conclusion: The Readiness Review construction team concurs with the project response.

- Foundation Inspection Reports

The construction team reviewed all of the Bechtel Foundation Inspection Reports for the powerblock in the Vogtle project files. These reports document inspection and acceptance of the marl foundation. Each report was checked for approval of the area and proper signoffs. The boundaries of each area were plotted on a drawing of the powerblock and labeled with the inspection date.

The Foundation Inspection Reports are presently stored in the construction document review vault under the file name Marl Foundation Report. Copies of four reports not found in the document review file were identified in the Civil Project File. The dates of these reports are July 6, 1977 (2); June 28, 1977; and June 2, 1980. Copies of these four reports have been placed in the document review file.

All foundation inspection reports showed approval of the subject areas and all had proper signoffs. The plot of inspected areas corresponded very closely with the Marl Foundation Inspection Plan drawn by Bechtel. Three reports not found in the Vogtle project files were indicated on the Bechtel plot. Copies of these three reports, dated September 10, 1980; March 23, 1981; and March 25, 1981 have been obtained from Bechtel in order to complete the Vogtle project file.

The plot of the inspected areas revealed a few small areas where the inspection apparently was not documented. However, the overall area was substantially covered. The fact that 100 percent coverage was not obtained was acknowledged in a letter dated June 19, 1981 from B. L. Lex, Bechtel, to D. E. Dutton, GPC, transmitting the Marl Foundation Inspection Plan and the Summary of the Marl Inspection Program. The letter states that the foundation inspection program was carried out properly and achieved its purpose in assuring that the marl foundation was uniform and sound. The construction team agrees with this conclusion.

No findings were identified in this part of the assessment.

6.2.2.2.4 Laboratory Activities

A field density test which represents each procedure revision in effect during the time frame of the assessment was traced through the following laboratory reports. These reports were reviewed for completeness and computation accuracy.

- o Field density worksheet (ASTM D1556);
- o Wash 200 and sieve analysis;
- o Proctor sheet;
- o Daily moisture correlation curve update;
- o Moisture correlation curve.

The review revealed that the laboratory reports were retrievable, complete, and that calculations were performed correctly.

No deviations were identified in this part of the assessment.

6.2.2.2.5 Programmatic Activities

6.2.2.2.5.1 <u>Personnel Certification</u>. Personnel certifications of GPC inspectors were assessed to determine whether the inspection activities were performed by qualified personnel. The construction team reviewed individual certification packages for evidence that personnel were certified to the proper level.

The assessment was governed by instruction and checklists prepared by the construction team (Figure 6.2-6).

The construction team reviewed the certifications of 10 QC inspectors involved with soil activities and found all to be certified.

No deviations were identified in this part of the assessment.

6.2.2.2.5.2 Equipment Calibration. Equipment used in backfill testing was assessed.

The assessment involved three pieces of test equipment (scale, proctor hammer, and proctor mold). The assessment was governed by instructions and a checklist prepared by the construction team (Figure 6.2-7).

The construction team found that prior to December 14, 1982, the equipment control numbers were not identified on Soils Daily Inspection Reports; however, the three pieces of equipment assessed were calibrated, according to procedures C-CI-14 and M&TE-1-019, during this period. A review of the calibration records revealed that the equipment had been properly calibrated.

6.2.2.2.5.3 Deviation Control. An assessment of GPC Nonconformances or Deviation Reports (DR) was performed to ascertain whether resolutions of DRs were in compliance with GPC procedure GD-T-01. The assessment involved 100 DRs that were reviewed by the construction team for the following attributes:

- Appropriate disposition approval signatures;
- Deviation Report completeness;
- Proper closure and completion.

The 100 DRs reviewed were generated on Category I backfill only. The assessment was governed by instructions and a checklist prepared by the construction team (Figure 6.2-8). Of the 100 DRs evaluated, two minor findings associated with disposition classification were identified. The error did not affect the acceptability of the dispositions.

These deficiencies were identified on Readiness Review Finding 13A-5.

- Readiness Review Finding 13A-5 (Level III)

  Description: Two Deviation Reports were dispositioned rework; however, repair work was done. The repair consisted of lean fill concrete placement in lieu of Category I backfill.

Project Response: The two Deviation Reports were reviewed for impact on the Category I backfill. Since lean fill concrete is an acceptable repair method, provided engineering approval is obtained, the deficiency was determined to be procedural in nature.

To correct the deficiency, the original DRs were taken from the vault and redispositioned as Repair and received the necessary approval signatures.

Additional DRs were reviewed and no other discrepancies were identified. Therefore, no action is necessary to prevent future occurrences.

Readiness Review Conclusion: The Readiness Review construction team concurs with the project response.

TABLE 6.2-1

CONSTRUCTION FINDINGS

Level of Importance[a]	RRF Number	Category[b]	Description
II	13A-1	A	The FSAR stated that the test fill program concluded that moisture content should be ±2% of optimum moisture. Specification allows +2 to -3% of optimum moisture content.
II	13A-2	A	Settlement reading intervals in specification X2AP01 contradict those given in the FSAR.
III	13A-3	A	A. Two (2) moisture curves were found with same identification number. B. Wrong revision of moisture curve was used to place backfill.
III	13A-5	A	Deviation reports were not properly dispositioned and approved.
III	13A-6	B	Piezometer readings were not taken as specified.
II	13A-22	A	Gradati[illegible] for borrow areas cannot be located in the [illegible] assurance records vault.

a. Level I - Violation of licensing commitments, project procedures, or engineering requirements with indication of safety concern.
Level II - Violation of licensing commitments or engineering requirements with no safety concerns.
Level III - Violation of project procedures with no safety concerns.

b. Category A - Paperwork concern;
Category B - Hardware concern;
Category C - Program concern.

TABLE 6.2-2

MATERIAL ASSESSMENT

Category I Borrow Testing Requirements

Specification	Effective Date	ASTM D422	ASTM D1140	Minimum Daily Testing Requirement
X2AB01, Rev. 2	06-23-78	1000 yd^3 of potential borrow	Not required	Not required
X2AP01 C2.2 Rev.0	02-20-79	1000 yd^3 of potential borrow	Not required	Not required
Rev. 1	09-19-79	5000 yd^3 of Category I backfill material	Not required	1
Rev. 8	02-25-83	25,000 yd^3 of Category I backfill material	5,000 yd^3 of Category I backfill material	1
Rev. 13	11-09-84	25,000 yd^3 of Category I backfill material	5,000 yd^3 of Category I backfill material	1

General Instructions

Material

A. Material Classification Data Checklist

1. Review the daily inspection reports for the target month. Record the dates Seismic Category 1 backfill material was excavated from borrow area, the borrow area designation, and the volume excavated. If less than 15 days of excavation occurred during target month, the excavation during the following month will be assessed in addition to the target month.

2. Review the report on backfill material investigations to assess if the area being used as a borrow area was approved. If the area was not approved, write a Readiness Review Finding.

3. Review the wash 200 and sieve analysis test reports for the dates of excavation to assess if the proper number of gradation tests were performed. The requirements are given in specification X2AP01 or specification X2AB01. If any of the minimum requirements were not met, write a Readiness Review Finding.

4. Review the results of the gradation tests to assess if the requirements of X2AP01 C2.2 were met. The requirement is for 25 percent or less passing a U.S. No. 200 sieve. If gradation test results fail to meet this requirement, write a Readiness Review Finding.

0042m/2/287-5

Figure 6.2-1 Material Classification Data Checklist
(Sheet 1 of 2)

Assessment Number ______________ Target Number ______________

I. MATERIAL CLASSIFICATION DATA CHECKLIST

DATE	BORROW AREA DESIGNATION	BECHTEL APPROVED (YES/NO)	EXCAVATED VOLUME (CY)	GRADATION TEST RUN	RESULTS ACCEPTABLE (YES/NO)

Remarks: ______________________________

____

____

Section completed by ______________________ Date __________

0043m/1/287-5

Figure 6.2-1 Material Classification Data Checklist
(Sheet 2 of 2)

Placement of Backfill

Backfill Assessment Data Checklist

A. Field Density Tests (Sand Cone)

1. Review the summary of compacted fill reports and identify all field density tests at the target elevation or target coordinate respectively. Record the test number in column 1, the date the test was run in column 2, the elevation of the test in column 3, and the plant coordinates of the test in column 5 of the Backfill Assessment Data Checklist.

2. Review the Field Density Test Reports (Sand Cone) for the tests identified in step 1 above. Record the percent compaction in column 4 of the Backfill Assessment Checklist.

   a. If the sand cone test percent compaction is 97 percent or greater, write yes above the percent compaction.

   b. If the sand cone test percent compaction is below 97 percent but is 95 percent or greater, check to see that the test was averaged and that the average was 97 percent or greater.

      1) If the test average was 97 percent or greater write yes above the percent compaction.

      2) If the test average was below 97 percent, check to see that a fill failure or Deviation Report was written. Write the fill failure or Deviation Report number above the percent compaction.

      3) If the test was not averaged or the average was below 97 percent and no fill failure or DR was written, write a Readiness Review Finding, and write no above the percent compaction.

   c. If the sand cone percent compaction is below 95 percent but not less than 93 percent, check to see that not more than 10 percent of the test results were below 95 percent and that the test average was 97 percent or above.

Figure 6.2-2 Backfill Assessment Data Checklist
(Sheet 1 of 4)

1) If less than 10 percent of the tests were below 95 percent and the test average was 97 percent or above write yes above the percent compaction.

2) If more than 10 percent of the test was below 95 percent or the test average was less than 97 percent check for a fill failure or Deviation Report. Write the fill failure or Deviation Report number above the percent compaction.

3) If no fill failure or Deviation Report was written, write a Readiness Review Finding and write no above the percent compaction.

d. If the percent compaction is below 93 percent check to see that a fill failure or Deviation Report was written. Write the fill failure or Deviation Report number above the percent compaction.

1) If no fill failure or Deviation Report was written, write a Readiness Review Finding and write no above the percent compaction.

B. Daily Inspection Report

Review the Daily Inspection Report for the referenced sand cone test. If one Daily Inspection Report represents several target sand cone tests, reference other test number(s) in the remarks section.

1. Record the plant coordinates of the area(s) represented by the Daily Inspection Report in column 6 of the Backfill Assessment Checklist.

2. Review the piezometer reading given in the Daily Inspection Report. A reading of 4 ft or more below grade of fill is required for compaction by heavy equipment, or 2 ft or more below grade of fill for hand compaction. If these minimums were not met write a Readiness Review Finding.

NOTE: Prior to November 14, 1979 piezometer readings were not required by procedure to be on the Daily Inspection Report. If fill was placed prior to November 14, 1979, place N/A in the space provided on the Backfill Assessment Data Checklist. The finding of no piezometer readings prior to November 14, 1979 was evaluated by GPC 50.55(e)M03.

0042m/5/287-5

Figure 6.2-2 Backfill Assessment Data Checklist

(Sheet 2 of 4)

3. In column 8 record the number of the moisture correlation curve in effect on the date the fill was placed. (This information will be obtained from the moisture correlation curve file and not the Daily Inspection Report.)

4. Record the number of the moisture correlation curve used to place the backfill in column 9. If the correct curve was not used, write a Readiness Review Finding.

NOTE: Prior to August 8, 1979, no moisture correlation curve was required. For fill placed prior to August 8, 1979, place N/A in the space provided on the backfill assessment data checklist for items 3 and 4.

5. Record the daily optimum moisture content on the backfill Assessment Data Checklist in column 10.

6. Assess if the fill was placed with a moisture content between +2 percent and -3 percent of the daily optimum moisture content. If the moisture content was not within the required limits, write a Readiness Review Finding.

NOTE: The moisture content of fill placed prior to June 13, 1979 was evaluated in response to NRC Inspection 79-11. For fill placed prior to June 13, 1979, place N/A in the spaces provided on the backfill Assessment Data Checklist for items 5 and 6.

7. If the area was compacted using hand compactors, note this in the remarks column.

C. Gradation Tests

1. Review the gradation test in accordance with ASTM D1140 which represents the respective sand cone. Record the percent passing the U.S. No. 200 sieve in column 12. If no gradation test was run for this test, place N/A in the space provided. If more than 25 percent passed the U.S. No. 200 sieve, write a Readiness Review Finding.

2. Review the gradation test in accordance with ASTM D422 (without hydrometer) which represents the respective sand cone and record the percent passing the U.S. No. 200 sieve in column 13. If no representative gradation test was run for the test, put N/A in the space provided. If more than 25 percent passed the U.S. No. 200 sieve, write a Readiness Review Finding.

Figure 6.2-2 Backfill Assessment Data Checklist (Sheet 3 of 4)

BACKFILL ASSESSMENT DATA CHECKLIST

Field Density Test - Sand Cone					Daily Inspection Report							Grad. Tests		Remarks
Test No.	Date	Elev.	% Comp.	Test Coord.	Area Coordinates		Piez. Elev.	Moist. Curve Correct	Used	Daily Opt. Moist.	Moist. Accept	ASTM D1140	ASTM D422	
--	--	Ft.	%	Ft.	Ft.	Ft.	Y / N	#	#	%	Y / N	%	%	
1	2	3	4	5	6		7	8	9	10	11	12	13	
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								
				N + E +	N + E +	N + E +								

Completed By: ________________ Date: ________ SHEET ___ OF ___

0050m

Figure 6.2-2 Backfill Assessment Data Checklist (Sheet 4 of 4)

Field Density Test Plot Instructions

A. Plot the boundaries of the areas covered in the Daily Inspection Reports for the target elevation. The coordinates of these boundaries are to be taken from the Daily Inspection Report section of the backfill Assessment Data Checklist.

B. Plot the sand cone density test locations on the same drawing. Label each test location with the test number, and test elevation. This data is to be taken from the Backfill Assessment Data Checklist.

C. Review the plot to determine if an adequate test frequency for sand cones was obtained as required by specification X2AP01 C2.2. If minimum test frequencies were not attained, write a Readiness Review Finding.

0042m/8/287-5

Figure 6.2-3 Field Density Test Plot Instructions

Marl Reports Assessment Instructions

As the power block excavation reached its final elevation, the top of the marl was exposed, inspected by a Bechtel geologist, and covered with earth. A report testifying that the surface of the marl met acceptance criteria and that the marl surface had been covered within 24 hours of exposure was issued by Bechtel for each area inspected.

The boundaries of the areas covered by each Bechtel Marl Report will be plotted on a drawing of the power block. The dates of the Marl Reports will be shown along with the boundaries.

This plot will assure that complete coverage of the excavation was obtained and that this document is retrievable.

A. Marl Report Assessment Checklist

1. Review that Bechtel Marl Reports, record the report number, date, and coordinates of the area inspected. Note whether the area was approved or not. Record any other relevant notes in the remarks column. Record the marl report storage location.

2. Plot the boundaries of the areas covered in the individual Marl Reports on a drawing of the power block area and record the corresponding report number and date for each.

3. Review the plot to determine if complete coverage of the excavation was obtained. If an area shows up on the plot that is not covered by a Marl Report with an approved designation, write a Readiness Review Finding.

Figure 6.2-4 Marl Reports Assessment Checklist

(Sheet 1 of 2)

Marl Reports

Assessment Checklist

INSPECTION REPORT NUMBER	DATE	AREA COORDINATES N ___ E ___	N ___ E ___	AREA APPROVED (YES/NO)	REMARKS

Marl Report Storage Location: ______________________

Section Completed by: ______________________ Date ________

0043m/2/287-5

Figure 6.2-4 Marl Reports Assessment Checklist

(Sheet 2 of 2)

Sand Cone Number:

Fie'd Density Work Sheet (ASTM D1556)

1. Insure coordinates and elevation match

2. Sand jar, proctor, and scales calibrated ___ Yes ___ No
   Sand jar number:
   Proctor number:
   Scale number:

3. Verified calculation properly performed ___ Yes ___ No

4. Compaction results acceptable ___ Yes ___ No

Wash 200 (ASTM D1140) and Sieve Analysis (ASTM D423)

1. Scale used was calibrated ___ Yes ___ No
   Wash 200 scale number
   Graduation scale number

2. Gradation test results of each sieve size acceptable ___ Yes ___ No

3. Test performed per ASTM requirements ___ Yes ___ No

LABORATORY ACTIVITIES ASSESSMENT CHECKLIST

Proctor Sheet (ASTM D-1557)

1. Proctor scale, hammer and mold calibrated ___ Yes ___ No

2. Verify calculations properly performed ___ Yes ___ No

3. Verify maximum dry density and optimum moisture corresponds with moisture density curve ___ Yes ___ No

4. Inspector name performing test:

   Level II inspector accepting data:

5. Classification of sample

   a. Does sample contain more than seven sand cone numbers ___ Yes ___ No

   b. Dry density of each test is within 1.5 lbs of selected sample ___ Yes ___ No

   c. Dry density of each same are within 3.0 lbs. ___ Yes ___ No

Figure 6.2-5 1 of 2

Figure 6.2-5 Sand Cone Work Sheet (Sheet 1 of 2)

Daily Moisture Correlation Curve Update (ASTM D2216)

1. Calculations performed properly

Pan-dry % moisture ___ Yes ___ No

Oven-dry % moisture ___ Yes ___ No

Summary of Compacted Fill Test (Bi-weekly Progress Report)

1. Does information supplied on report correspond to the information from test number ___ Yes ___ No

0042m/12/287-5

Figure 6.2-5 Sand Cone Work Sheet (Sheet 2 of 2)

TRAINING AND CERTIFICATION CHECKLIST INSTRUCTIONS

Record five names appearing on field backfill documentation and five names appearing on laboratory documentation. Check the certification of the person in the area the work was done. If the person was not properly certified, write a Readiness Review Finding.

0042m/13/287-5

Figure 6.2-6 Training and Certification Checklist

(Sheet 1 of 2)

TRAINING AND CERTIFICATION CHECKLIST

Pick five names from the backfill documentation in each area below and verify the certification of that person:

	NAME	CERTS. OK
1. Field Placement	______	______
	______	______
	______	______
	______	______
	______	______
2. Laboratory Testing	______	______
	______	______
	______	______
	______	______
	______	______

Remarks: ______________________________

____

____

0042m/14/287-5

Figure 6.2-6 Training and Certification Checklist
(Sheet 2 of 2)

CALIBRATION CHECKLIST INSTRUCTIONS

List three items of measure and test equipment used in backfill operations on the checklist. Check calibration of the items on the checklists. If calibration does not meet the requirements of CD-T-03 or GD-A-04, write a Readiness Review Finding.

0042m/15/287-5

Figure 6.2-7 Calibration Checklist (Sheet 1 of 2)

CALIBRATION (M&TE) CHECKLIST

Check the calibration for three pieces of backfill measure and test equipment at random.

ITEM	NUMBER	CALIBRATION ACCEPTABLE

Storage Location ______________________________

Remarks: ______________________________

____

0042m/16/287-5

Figure 6.2-7 Calibration Checklist (Sheet 2 of 2)

DEVIATION REPORTS CHECKLIST INSTRUCTIONS

Utilizing the dates backfill operations began and ended for the target elevation, select 100 Deviation Reports in blocks of 25 that are evenly spaced over the time span. Check the DRs for completeness. Check dispositions for correct Bechtel or GPC signoff per GD-T-01. Make sure justification is provided if one is required. If DR is still open, locate the original. If any of these criteria cannot be met, write a Readiness Review Finding.

0042m/17/287-5

Figure 6.2-8 Deviation Reports Checklist (Sheet 1 of 2)

DEVIATION REPORTS/NONCONFORMANCE CONTROL CHECKLIST

	DR NUMBER	REVIEW OKAY
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

REMARKS:: ______________________________

0042m/18/287-5

Figure 6.2-8 Deviation Reports Checklist (Sheet 2 of 2)

J.O. No. 1522401

Vogtle Electric Generating Plant

November 20, 1985

Independent Design Review

Module Report

(Module No. 13A)

Foundations

Prepared For

Georgia Power Company

Readiness Review Program

Approved By: Module Team Leader Wayne E. Kilker

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Boston, Massachusetts 02107

0399-1522401-B4T

INDEPENDENT DESIGN REVIEW REPORT

TABLE OF CONTENTS

SUMMARY

This Independent Design Review (IDR) of foundations at the Vogtle Electric Generating Plant (VEGP) was conducted by Stone & Webster Engineering Corporation as part of the Vogtle Project Readiness Review Program.

The review identified a total of 11 findings. Nine of the findings were considered violations of project procedures with no safety concerns. One finding was a violation of licensing commitments with no safety concern and one finding was later considered a non-finding based on further information supplied to the IDR Team.

Based on the review performed, the limited number of findings and the corrective action taken in response to the IDR findings, the team considers the foundation design to be technically sound and in compliance with project licer . commitments, specifications and procedures.

7.0 INDEPENDENT DESIGN REVIEW

7.1 INTRODUCTION

This report describes the Independent Design Review (IDR) of foundations at the Vogtle Electric Generating Plant (VEGP). This IDR was conducted by Stone & Webster Engineering Corporation (SWEC) as part of the Vogtle Project Readiness Review Program (RRP). The IDR described in this review covers the design activities of Module No. 13A "Foundations."

The review was conducted at both Bechtel Power Corporation's (BPC) offices in Norwalk, California, and at the Plant Vogtle site during June, 1985. This report describes only the technical review performed by SWEC personnel under the overall administrative and management control of the Readiness Review Task Force Manager. The review team was composed of two SWEC engineers and one SWEC geologist experienced in the design of nuclear power plant foundations and backfill, none of whom have had any previous association with the Vogtle Project. The collective experience of this review team represents 26 man years of experience in the detailed design of nuclear power plant structures.

This report has been organized into six basic sections as follows:

7.1 Introduction

7.2 Scope - Provides an outline of the scope of the IDR review for this module.

7.3 Review Methodology - Provides the methodology utilized in the review, the samples chosen, and the basis for sample selection.

7.4 Review Summary - Provides a summary of the review and its results at the time that the review itself was conducted. It does not address or consider the resolution of review findings. These are included in Sections 7.5 and 7.6.

7.5 Review Findings - Includes the findings from the review, the project response, and the IDR assessment of that response.

7.6 Conclusions - Presents the overall evaluation and conclusions of the IDR team with respect to the work reviewed under the scope of this module.

7.2 SCOPE

This review was performed to assess the technical adequacy of the geotechnical engineering and geologic studies performed for the Vogtle Plant. The focus of this review was limited to the technical content of the civil/structural design documents (specifications, design criteria, calculations, drawings, deviation reports, etc.) to determine if the project licensing commitments were correctly understood and implemented in a technically adequate manner. The project activities reviewed included:

1. Geotechnical design calculations on bearing capacity, settlement, liquefaction, and permeability.

2. Engineering specifications and drawings relating to earthwork and settlement monitoring.

3. Deviation report dispositions.

4. Geologic commitments and studies.

A separate programmatic verification of the design process was performed by other members of the readiness review team to ensure that the project licensing commitments were correctly carried through the various levels of governing design documents and procedures. The results of this programmatic verification effort can be found in Section 6.1 of this module.

For the purpose of this review, the technical correctness and completeness of input information from other disciplines was assumed. The correctness of inputs from other disciplines will be verified by similar independent design reviews of other modules in which the methodology used by other disciplines is sampled to assess the technical correctness of that discipline's design output.

7.3 REVIEW METHODOLOGY

A Review Plan (Appendix 7A) covering foundations was prepared and submitted June 11, 1985. The plan was to provide the reviewers (Appendix 7B) with the scope, method, and key attributes of the review. Alternate or independent verification calculations did not constitute part of the review activities.

7.3.1 General

The methods of evaluating the adequacy of the project's implementation of technical commitments in the area of geotechnical engineering consisted of review of documents (Appendix 7C) and interviews with project personnel (Appendix 7D) to clarify questions of interpretation of analytical methods and results. The evaluation consisted of the following tasks:

- Review of SAR
- Review of Design Criteria
- Review of Specifications and Drawings for licensing commitments and adequacy of their implementation
- Review of Engineering Reports
- Review of Calculations for licensing, design, and specification commitments
- Review of Deviation Report Dispositions for licensing and design commitment compliance
- Site Walkdown

7.3.2 Sample Selection

FSAR Sections 2.4.13, 2.5.4, 2.5.5, and portions of 3.7 were reviewed to identify the technical requirements and licensing commitments relating to the following areas of subsurface materials and foundations:

- Properties of subsurface materials
- Site ground water/permeability
- Liquefaction
- Bearing capacity
- Settlement
- Lateral earth pressure
- Slopes

Design calculations and applicable sections of the Design Criteria pertaining to these areas were reviewed. Bearing capacity calculations for the NSCW towers, refueling water tank, and turbine building were selected for review. Also, settlement calculations were reviewed for the containment, control building, and turbine building. The bearing capacity and settlement calculations were selected to include distinct founding conditions varying from a shallow embedded mat (refueling water tank) on backfill to a highly loaded, deeply embedded, marl-founded mat (containment).

Geotechnical calculations on liquefaction and permeability were reviewed on a site-wide basis, not by specific structure. The IDR team had originally proposed to assess the Radwaste Solidification Building (RSB) caisson foundation design. However, since this structure is more than 100 ft from the nearest Category I structure and there could be no adverse impact on a Category I structure by a RSB foundation failure, this review was not conducted.

Specifications addressing the entire range of geotechnical activities were reviewed. These included earthwork and related site activities, piezometers and dewatering, in situ testing of Category I backfill and obtaining and recording foundation settlement data.

7.3.3 Implementation

The review, conducted at the Vogtle site and BPC's Norwalk, California office, was in accordance with the module review plan (Appendix 7A) provided prior to the start of the review. Approximately 800 man-hours of review time were expended on this module.

After becoming familiar with the FSAR and Design Criteria, a review of 22 geotechnical calculations was conducted at BPC's Norwalk, California office. Engineering reports prepared by BPC and used as design documents were also reviewed.

Specifications and Deviation Reports (DRs) were reviewed at the Vogtle site. DRs were selected from a computerized log covering geotechnical items. Approximately 190 DRs had been written against the geotechnical requirements within the power block area. A sample of 44 DRs issued between the years 1978 and 1985 were selected for review and covered the range of such items as erosion control, backfill compaction, slope configuration, plastic backfill, caissons and sheet piles.

7.4 REVIEW SUMMARY

7.4.1 General

This section presents a summary of the IDR status following the review itself but prior to the resolution of the review findings. Individual findings are resolved in Section 7.5 and the overall IDR evaluation is provided in Section 7.6.

7.4.2 Engineering Reports

Engineering reports which were used as design documents or as references to FSAR Section 2.5.4 were reviewed. Several inconsistencies were found to exist between the engineering reports and the FSAR:

- The values of Young's modulus, E, and shear modulus, G, presented in FSAR Table 2.5.4-7 and Bechtel's Report on Foundation Investigations, 1974, were found to differ. (Refer to Finding No. 9.)

- The shear modulus, G, was computed for the compacted backfill based on the equation:

  $$G = 1000\ k_2\ (\sigma'_m)^{\frac{1}{2}},\ \text{psf}$$

  For backfill compacted to 97 percent of ASTM D1557, the Bechtel Report on Dynamic Properties for Compacted Backfill, 1978, recommends a value of k_2=82. FSAR TAble 2.5.4-9 states that a value of k_2=79 was used in this equation deriving G. (Refer to Finding No. 9.)

- FSAR Tables 2.5.4-10 and 2.5.4-11 and Bechtel's Report on Test Fill Program Phase II, 1978, are inconsistent. The column headings titled "Percent of Tests" on the FSAR tables are confusing. (Refer to Finding No. 9.)

- The permeability values presented in the FSAR are supplemented by Bechtel's Ground Water Supplement Report, 1985. The reported permeability values for the upper sand, Utley limestone and marl are based on a combination of field and laboratory tests. The permeability values for the Utley limestone presented in Table 3-3 of the Ground Water Supplement were developed in Calculation X2CF-S-107. Permeability values for the upper sands presented in Table 3-1 were developed in an independent testing laboratory report and are correlated to grain size.

  Boring logs and field test data records constitute the back-up information for the remaining upper sand permeability results shown in Table 3-1 and for the Blue Bluff marl permeability results shown in Table 3-2. However, no calculations are available transforming this field test data into the individual permeability values shown in Tables 3-1 and 3-2 or the representative permeability values utilized in the analysis of an accidental spill (FSAR Section 2.4.13). (Refer to Finding No. 8)

7.4.3 Design Criteria

The portions of the Design Criteria (Civil Structural) DC-1000-C pertaining to geotechnical engineering and foundations were reviewed to assess whether the commitments were correctly implemented into the project criteria. The following observations were made:

- The G/Gmax and damping values vs percent strain plots for compacted backfill are presented in Figures 7 and 8 of the Bechtel Report on Dynamic Properties for Compacted Backfill, 1978, and Figures F3 and 11 of the Design Criteria DC-1000-C, respectively. The G/Gmax values vs percent strain appear to be quite large at higher strain levels compared to that referenced in accepted industry literature (Seed and Idriss, EERC 70-10, Soil Moduli and Damping Factors for Dynamic Response Analysis, 1970) for strain levels greater than 10^{-2} percent.

  In performing the cyclic triaxial tests that provided the basis for this plot, the samples were subjected to compressional deviator stresses but not to extensional deviator stresses. The 1972 Shannon and Wilson - AJA report on Soil Behavior Under Earthquake Loading Conditions recommends complete cyclic loading. Also, the definition of damping ratio as given in Figure 19 of the appendix to the Bechtel Report on Dynamic Properties for Compacted Backfill differs from that referenced in the Shannon and Wilson - AJA report.

  The use of higher values of G/Gmax and the omission of the extensional portion of the cyclic triaxial tests should be justified. An explanation for the use of the alternate method of determining the damping ratio should be included. (Refer to Finding No. 1.)

- Settlement predictions presented in FSAR Fig. 2.5.4-8 and Design Criteria, Rev. 3., Fig. 13, are not consistent. During the IDR, it was explained that a revision to Fig. 13 was underway to resolve the inconsistency.

- Several inconsistencies exist for soil property values reported in the Design Criteria and the FSAR. (Refer to Section 7.4.4 of this report for a tabulation of these differences.)

7.4.4 Calculations

Calculations covering the topics listed in Section 7.3.2 were selected and reviewed for consistency with the project licensing commitments, design criteria, and specifications. The review also evaluated the technical adequacy of the calculations. The following observations were made:

- Settlement calculations used to determine the static, dynamic and differential settlements of the containment, control building and turbine building were reviewed (Calc. X2CF-S-037, X2CF-S-087, X2CF-S-101, X2CF-S-105, and X2CF-S-106). In addition, a civil/structural calculation on the prediction of differential settlement at various piping penetrations was reviewed. The methods used to predict settlement were satisfactory and in accordance with normal practice.

Calculation X2CF-S-106 was developed in response to observed settlements of the major power block structures exceeding the originally predicted values. The original settlement predictions considered the consolidation of the marl as the major component of settlement. Calculation X2CF-S-106 accounts for the elastic settlement of the marl and lower sand. The results are presented in FSAR Fig. 2.5.4-8. However, within this calculation there were no settlement predictions for six smaller Category I structures in the power block area.

Calculation No. X2CF-S-87 predicts the settlement of four of the six smaller Category I structures referenced above but does not take into account the effects of settlement in the marl or lower sand. Also, the method of deriving E for the backfill was different in calculation S-87 than in calculation S-106.

In FSAR Table 2.5.4-12 a gross static load of 8.1 ksf is given for the fuel building while in Calc. X2CF-S-106 a value of 6.3 ksf was used to determine static settlement. The use of different loads is not explained. (Refer to Finding No. 4.)

- Calculation X2CF-S-103 develops bearing capacity factors of safety and the results appear in FSAR Table 2.5.4-12. The bearing capacity analyses of the cooling towers, refueling water tank and turbine building were reviewed in detail. The method used to obtain allowable bearing capacity is satisfactory and in accordance with normal practice. However, the calculation does not directly determine the factors of safety or net static and dynamic loads which appear in the FSAR. Also, the turbine building dynamic factor of safety appearing in the FSAR is not computed in Calculation X2CF-S-103. (Refer to Finding No. 6.)

- The liquefaction analysis of the backfill was reviewed as presented in Calculations X2CF-S-SF17, X2CF-S-033, X2CF-S-036, and X2CF-S-097. The analysis presented in Calculation X2CF-S-SF17 used the SHAKE computer program with an artificial earthquake history input scaled to a ground surface acceleration of 0.2g (SSE). The resulting shear stress determination was based on laboratory tests of the compacted backfill (FSAR Fig. 2.5.4-7). An N_c value, the number of significant cycles associated with the site SSE, equal to 30 was originally selected referencing a 1971 report by Seed and Idriss, <u>Simplified Procedure for Evaluating Soil Liquefaction</u>. The FSAR stated the SSE was conservatively assumed to correspond to a intensity VII-VIII seismic event. On that basis, a much lower value of N_c would have been appropriate (Ref. Seed and Idriss). The original Bechtel <u>Report on Foundation Investigations</u>, 1974, had reported a value of N_c equal to 30 corresponding to earthquake magnitude 7.5. In 1975, Seed and Idriss issued an updated report in which N_c equal to 23 was determined to be suitable for a magnitude 7.5 earthquake. Calculations X2CF-S-SF17 and X2CF-S-036 used N_c values of 30 and 23, respectively. The use of different values should be justified. (Refer to Finding No. 7.)

- The liquefaction analysis performed in Calculation X2CF-S-SF17 considered only the free field case which is adequate for structures which have a small net static load. There are, however, a few structures with larger net positive static loads on the order of 2 and 3 ksf. A verification of an adequate factor of safety against liquefaction beneath structures with a significant positive net static load was not performed. (Refer to Finding No. 5.)

- FSAR commitments were compared with calculations and in a number of instances the FSAR commitments were found to be inconsistent with subsurface material property values used in both geotechnical calculations and/or the design criteria. Following is a table summarizing these inconsistencies:

Attribute	FSAR Commmitment	Design Criteria	Calc.
Young's Modulus, E Backfill - Static	1500ksf @ 97% ASTM D1557	1430-5140 ksf	1500 ksf @ 94% ASTM D1557 (Calc. No. X2CF-S-024)
- Dynamic	Not Provided	4300-15,400 ksf	No calc.
Marl	4000-10,000 ksf	10,000 ksf	4000 ksf (Calc. No. X2CF-S-101) 10,000 ksf (Calc. No. X2CF-S-106)
Lower Sand	Varies (see Fig. 2.5.4-12)	11,290 ksf	No calc.
Shear Modulus, G Backfill	2300-6200 ksf	1530-5510 ksf	1250-4650 ksf (Calc. No. X2CF-S-SF17)
Poisson's ratio, backfill	0.4	0.4	0.47 - 0.48 (Calc. No. X2CF-S-032)
At-rest earth pressure coefficient - backfill	0.7	0.7	0.4 (Calc. No. X2CF-S-SF17)

(Refer to Finding No. 2 and Finding No. 3)

7.4.5 Specifications

The specifications and drawings listed in Appendix 7C were reviewed for consistency of technical requirements with project licensing commitments and design criteria.

- Specification X2AP01, Civil Structural Construction Specification for the Georgia Power Company, Alvin W. Vogtle Plant, Units 1 and 2, Division C2.2, Site and Site-related Work, Rev. 13, was reviewed and found to be consistent with the Design Criteria and FSAR Section 2.5.4. Field Change Requests (FCRs) and Construction Specification Change Notices (CSCNs) written against this division of the specification were also reviewed. These documents covered temporary slope restrictions, field personnel duties, backfill moisture control, founding requirements for structures, determination of water levels during fill placement, and the use of lean concrete or crushed stone in lieu of compacted backfill at specific locations. Approximately 75 percent of the FCRs related to the use of lean concrete in place of compacted soil backfill for specific cases. Overall, there was proper use and implementation of FCRs and CSCNs.

- Division C10.1 of Specification X2AP01, Heave and Settlement Monitoring, was reviewed and found to be consistent with FSAR Section 2.5.4. The specification requires that settlement graphs have loads and unusual environmental conditions noted on the graphs. These values were not present on the drawings referenced in Rev. 3 of the specification. However, Drawings AX2D55V050 to AX2D55V063, Rev. 0, issued in 1985 but not yet incorporated into this specification do present a summary of structural loads vs time.

7.4.6 Deviation Reports

Approximately 190 Deviation Reports have been written against geotechnical requirements within the power block area. A sample of 44 DRs issued between 1978 and 1985 were selected for review that covered such items as erosion control, backfill compaction, slope configuration, plastic backfill, caissons and sheet piles.

Thirty-nine of the 44 DRs were found to be satisfactorily dispositioned. Following is a summary of the five remaining DRs:

- CD-353 dealt with fill being placed at 18 in. lift thickness while the specification allowed a 6 in. maximum. The DR indicated no QC inspector was present during the placement of this fill. This area was reworked, however, no elevation of the fill area in question is given. The plan location, on the other hand, is documented. (Refer to Finding No. 10.)

- CD-530 describes sloughing of backfill at the Unit 1 containment tendon gallery. The area was repaired by reworking and placement of lean concrete fill. The plan location is given but no elevation is noted. (Refer to Finding No. 10.)

- CD-2674 describes a deviation in the method of calculating average backfill density within a given area. The resolution addressed the issue by citing the small number of lower precentage tests compared to the total number (less than 2 percent) and the even distribution of these tests over time. However, it does not address the spatial distribution of the lower percentage tests. (Refer to Finding No. 10.)

- CD-3756 describes an excavation slope which exceeded the steepness limitation. It was dispositioned to use "as is" since construction was "in the process of backfilling the slopes to the top of slope". This statement could mean the slope was being flattened or the area in front of the slope was being backfilled. The resolution is not clearly worded. (Refer to Finding No. 10.)

- CD-4186 concerns an insufficient number of density tests in the Category I backfill west of the auxiliary building. It was dispositioned to use "as is" based on the result of four tests. The exact area in question is not defined nor is the number of tests required. Also, the elevation of the fill area in question is not given. (Refer to Finding No. 10.)

7.4.7 Site Walkdown

During the site walkdown various personnel were contacted and observations of ongoing geotechnical activities were made as follows:

- Soil samples from previous subsurface investigations were no longer available. However, a series of borings penetrating the compacted backfill had recently been completed (May-June 1985). The jar samples from boring SPT-108 were reviewed and inspected by the IDR team. The blow counts, N, were found to be very high, ranging from greater than 40 in the upper 10 ft, to greater than 80 below 15 ft and greater than 100 between 30 ft and 90 ft.

- At the time of the site walkdown (June 1985), observation well number 900 was being drilled and tested in the marl layer. A section of cored marl was inspected. It consisted of stiff gray clay with occasional limestone lenses. A packer test was observed underway in this boring at a depth of 20 ft into the marl. At pressures up to 50 psi, there was no measurable flow in a 5 ft zone isolated by the packers.

- Ongoing placement of Category I backfill was observed northeast of the Unit 1 NSCW towers and a large area north of the Unit 2 diesel generator building. Soil was placed in 4 in. or 6 in. lifts as required by the specification and the loose fill was wetted down and scarified. A Wacker W74 dual drum, hand-operated roller was used in confined areas. An Ingersoll-Rand SP60 roller was used for the larger areas and was operated at speeds of approximately 1-2 mph. The backfill placement observed was judged acceptable based on the FSAR Table 2.5.4-10 comment.

- The general procedures and requirements for surveying and reporting settlement observation marker data were described by GPC. The GPC procedure SU-T-01, Rev. 3, which establishes the basic methods and personnel responsibilities and a "desk top" procedure on the First Order Class II geodetic surveying employed for settlement monitoring were reviewed. The latter procedure is based on NOAA manual NOS NGS-3. Survey measurements were observed being made at markers 120 and 171 in the Control Building at approximately elevation 180 ft. A Wild micrometered level, read to 0.001 ft, was being used. The settlement monitoring points in floor slabs are recessed brass discs with cover plates. Wall monitoring points are Nelson studs. However, there were no marker identifications stencilled nearby as required by Specification X2AP01, Div. C10.1 and also noted on FSAR Fig. 2.5.4-11. (Refer to Finding No. 11).

  A copy of the 1984 Bechtel Report on Settlement Review was supplied to the IDR team. This report described the improvements in survey accuracy since 1977 and presented a discussion on the settlement prediction changes since the PSAR stage of the project. The report also indicated that the deep-seated benchmarks are located well outside the construction area and the shallow control monuments are checked against these benchmarks every 60 days. Overall, the survey methods observed by the IDR team were found to be satisfactory.

7.5 REVIEW FINDINGS

Upon completeion, the findings have been classified into levels of importance to the potential impact on plant safety. The following levels have been used:

I. Violation of licensing commitments, project procedures, or engineering requirements with indication of safety significance.

II. Violation of licensing commitments or engineering requirements with no safety concerns.

III. Violation of project procedure with no safety concerns.

IV. Non-finding based on additional information/clarification supplied by the project.

Immediately following each of the findings is the response provided by the project to the issue raised and the IDR team assessment of the response.

Finding 1 - Determination of the Shear Modulus and Damping Ratio for Compacted Backfill by Laboratory Testing (RRF 13A-8)

The G/G(max) and Damping value versus strain plots for compacted backfill are presented in Figures 7 and 8 of the Bechtel Report on Dynamic Properties for Compacted Backfill, 1978 and Figures F3 and 11 of the Design Criteria DC-1000-C, respectively.

a. The G/G(max) value appears to be quite large compared to that referenced in accepted industry literature (Seed and Idriss, EERC 70-10, Soil Moduli and Damping Factors for Dynamic Response Analysis, 1970) for strain levels greater than 10^{-2} percent. In performing the cyclic triaxial tests that provided the basis for this plot, the samples were subjected to compressional deviator but not to extensional deviator stresses. The 1972 Shannon and Wilson-AJA report on Soil Behavior Under Earthquake Loading Conditions (pg. 72) recommends the complete cyclic loading. The use of the higher values of G/G(max) and the omission of the extensional portion of the cyclic triaxial tests should be justified.

b. The definition of damping ratio as given in Fig. 19 of the Appendix to the Bechtel Report on Dynamic Properties for Compacted Backfill differs from that referenced in the Shannon and Wilson-AJA (pg. 76) report. An explanation for the use of the alternate method of determining the damping ratio should be included.

Project Response

a. Reference 1 describes the basis for selection of the dynamic properties used in VEGP design. The results of dynamic tests of Category I backfill at 97 percent relative compaction were evaluated to establish the strain-dependent soil properties for VEGP. Data obtained from dynamic tests on backfill at 93 and 95 percent relative compactions were also utilized in interpreting the 97 percent data. The adopted shear modulus reduction curve represents a good average reduction when all data from the 95 and the 97 percent relative compaction tests are combined.

   The report by Geotechnical Engineers, Inc., included as an appendix in Reference 1 provides the details on the laboratory testing program. As stated in Section 5.3.3 therein, the loading for triaxial test (which is used for strain levels greater than 10^{-2} percent), not containing tensional components may have resulted in somewhat higher modulus values. The method of loading selected was compression loading only, to avoid test inaccuracies that arise under extension loading. These inaccuracies relate to the following:

   - A disproportionately large part of the deformations tends to concentrate in looser and softer zones of the specimens. Thus the overall behavior is not a good representation of the average behavior of the soil at its average density. When loaded in compression, an averaging of soil properties takes place to a greater degree than in extension.

- Under repeated extensional loading, the initial non- uniformities in the specimens are accentuated leading to an unrealistic degree of modulus degradation. In an extreme case, the extensional loading can lead to "necking" of the specimens.

The 1970 Seed and Idriss Report (Reference 2) summarized the available test data on shear moduli and damping factors and provided guidelines for selection of dynamic properties. A comparison of the project modulus reduction curve with the range presented in Seed and Idriss Report is provided in Figure 1. Identified therein is the maximum effective strain ($2x10^{-2}$ percent) under SSE conditions in the compacted backfill soil column, corresponding to layer 15, FSAR Figure 241.12-1. It can be seen that for the range of strains up to $2x10^{-2}$ percent, the project curve falls within the band suggested by Seed and Idriss. In addition, the effects of minor fluctuations in the modulus reduction curve on the seismic analysis are insignificant.

b. Specific Damping Capacity is defined as the ratio of the energy absorbed in one cycle of vibration to the potential energy at maximum displacement during that cycle, or, with reference to Figure 2a:

$$\text{Damping} = \frac{\Delta E}{E} \qquad (1)$$

For an isotropic cyclic test, this definition becomes (See Shannon and Wilson Report and Figure 2b):

$$\text{Damping} = \frac{\text{Area of Loop}}{4\pi \text{ Area of Triangle OAB}} \qquad (2)$$

For an anisotropic cyclic test, this definition becomes (See Figure 19 of Appendix to Reference 3 and Figure 2c):

$$\text{Damping} = \frac{\text{Area of Loop}}{\pi \text{ Area of Triangle OCD}} \qquad (3)$$

but Area OCD = 4 Area OAB, then equation 3 becomes,

$$\text{Damping} = \frac{\text{Area of Loop}}{4\pi \text{ Area of Triangle OAB}}$$

which is equal to equation (2)

Performing the cyclic triaxial test using compression loading only might have resulted, if any, in lowering the material damping values, which is conservative. In addition, in the strain range greater than 10^{-2}%, for which the triaxial test was utilized, the project damping curve falls below the Seed and Idriss curve (Figure 10 of Reference 2) and is within the band recommended by them.

REFERENCES:

1. Bechtel Incorporated, "Report on Dynamic Properties for Compacted Backfill", prepared for Southern Company Services, Inc., and Georgia Power Company, February, 1978.

2. Seed, H., Bolton and I. M. Idriss, "Soil Moduli and Damping Factors for Dynamic Response Analysis", Report No. EERC 70-10, December 1970. University of California, Berkeley.

3. Shannon and Wilson, Agbabian Jacobsen and Associates, "Soil Behavior Under Earthquake Loading Conditions", Report to Union Carbide Company for the U. S. Atomic Energy Commission, January 1972.

Associated Reports:

None

Root Cause of Finding:

None

Action Taken To Prevent Recurrence:

None

Future Commitments:

None

IDR Assessment

A. The project response described the maximum shear strain level for the compacted backfill associated with SSE loading conditions as $2x10^{-2}$ percent. For the range of strains of interest in plant design ($\leq 2x10^{-2}$ percent) the shear modulus reduction curve used was satisf- -tory.

The IDR te... believes that the test methodology of excluding the extensional loading portion of the cyclic triaxial test not only differs from standard practice but does not represent the anticipated field loading conditions. However, for the Vogtle plant analysis, within the range of strains of interest, the shear modulus was developed using acceptable resonant column test data. Therefore, the issue of the cyclic test methodology at higher strain levels has no significant impact on the plant design.

B. The definition of damping ratio used for these tests was clarified by demonstrating that the geometry used for an anisotropic test was similar to that used for an isotropic test. This response satisfies the IDR team concern.

Finding Level IV

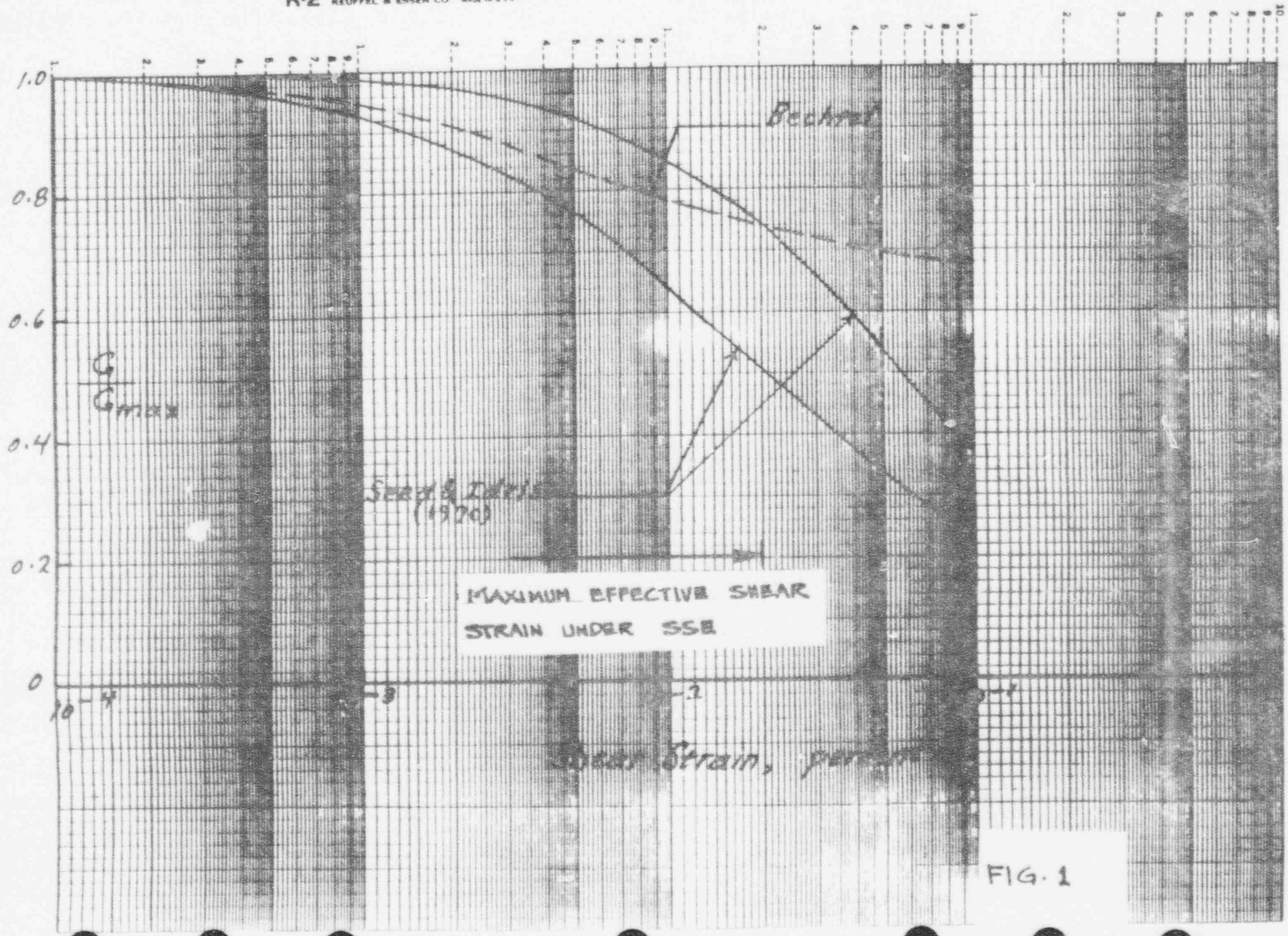
1.0
0.8
0.6
0.4
0.2
0
$\frac{G}{G_{max}}$
Bechtel
Seed & Idriss (1970)
MAXIMUM EFFECTIVE SHEAR STRAIN UNDER SSE
10^{-4}
10^{-3}
10^{-2}
10^{-1}
Shear Strain, percent

FIG. 1

CALCULATION SHEET

DATE ____

DESIGN BY ____ DATE ____ CHECKED BY ____ SHEET NO ____

PROJECT ____ JOB NO ____

SUBJECT ____ CALCULATION NO ____ FILE NO ____

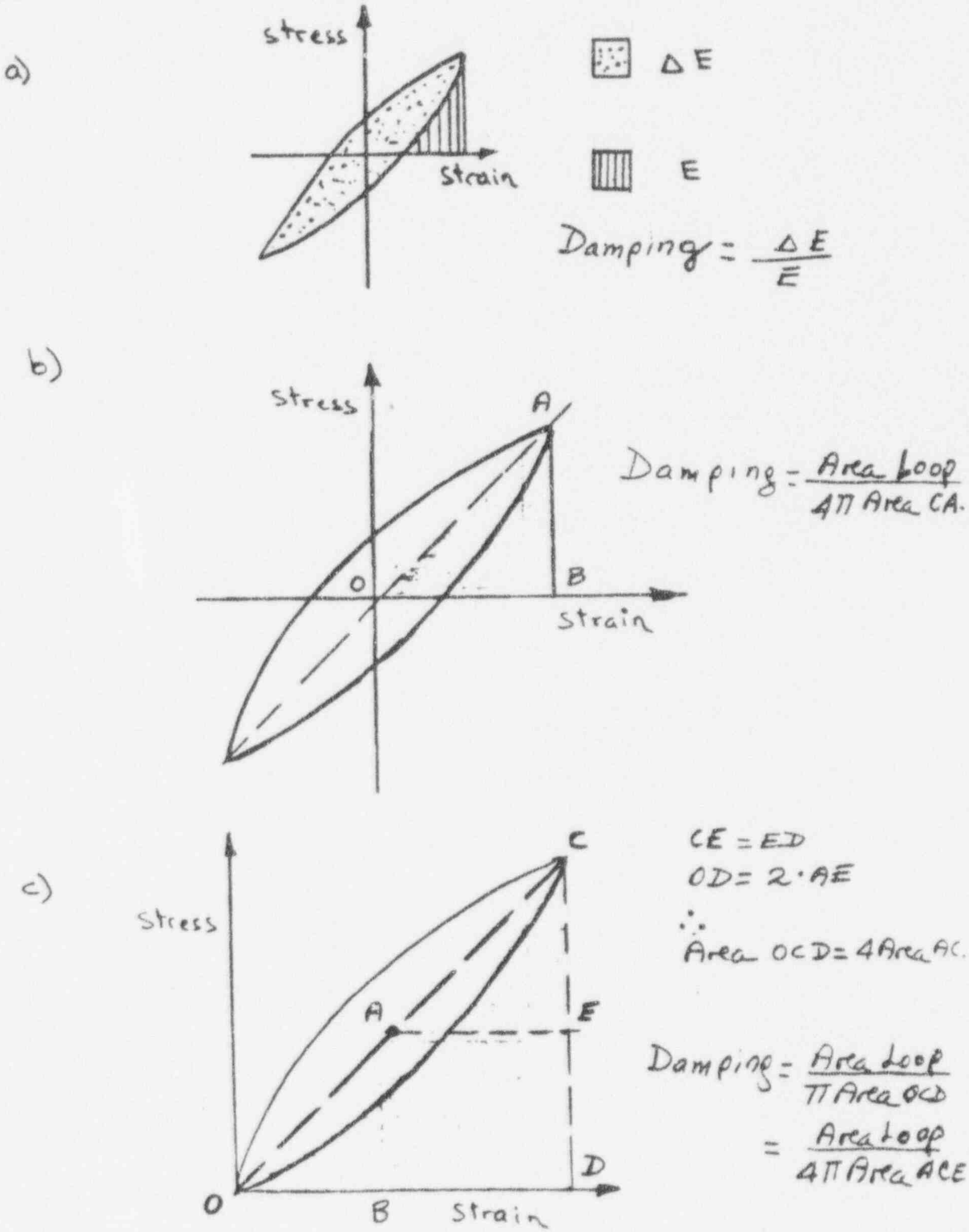

FIGURE 2

Finding 2 - Geotechnical Calculation Inconsistencies (RRF 13A-15)

Of the 22 geotechnical calculations reviewed by the Independent Design Review Team, a sufficient number of individual findings have been identified that these findings when taken collectively indicate the following:

a. An inconsistent use and presentation of values between the FSAR, the Design Criteria, Engineering Reports and Calculations.

b. Insufficient justification and documentation of inputs and assumptions.

Project Response

Reference Response to 13A-18

Associated Reports:

Reference Response to 13A-18

Root Cause of Finding:

Reference Response to 13A-18

Action Taken to Prevent Recurrence:

Reference Response to 13A-18

Future Commitments:

Reference Response to 13A-18

IDR Assessment

The response to this IDR finding has been incorporated into that for the Design Verification Finding 13A-18. As a result of these two findings, the project responded by taking action to address the concerns. Upon completion of the project's review and revision of the geotechnical calculations, the IDR sample included the 22 calculations originally reviewed plus 12 additional newly created or revised calculations. These additional calculations were selected based on their relative importance to the geotechnical design aspects of the plant.

The calculations now provide adequate justification and documentation of inputs and assumptions. In addition, the use and presentation of the various soil parameters and design values in the project documents have been clarified, documented, or revised as required. The IDR team is satisfied that the geotechnical calculations now provide a satisfactory basis for project documentation and plant foundation design.

Finding Level III

Finding 3 - Use and/or Documentation of Soil Property Values (RRF 13A-7)

The following parameters were used inconsistently without justification:

a. Moduli of Elasticity - E (Backfill): FSAR Table 2.5.4-8 lists 1500 ksf at 97 percent compaction. Design Criteria describes a range from 1430 ksf to 5140 ksf. Calculation X2CF-S-024 uses 1500 ksf at 94 percent compaction.

E (Dynamic Backfill): The Design Criteria lists a range of 4300-15400 ksf. There is no calculated derivation of these values.

E (Marl): FSAR Table 2.5.4-2 lists a range of 4,000-10,000 ksf. Design criteria has 10,000 ksf. Calculations X2CF-S-101 and X2CF-S-106 use values of 4,000 ksf and 10,000 ksf, respectively.

E (Lower Sand): There are no calculations deriving the value of 11,290 ksf presented in the Design Criteria or the variation with depth shown in FSAR Fig. 2.5.4-12.

b. Shear Modulus - G (Backfill): FSAR Table 2.5.4-9 lists a range of 2300-6200 ksf. The Design Criteria has a range of 1530-5510 ksf. Calculation X2CF-S-SF17 uses 1250-4650 ksf.

c. Poisson's Ratio (Backfill) - The values of 0.47-0.48 computed in Calculation X2CF-S-032 are reported as 0.4 in the Design Criteria and FSAR Table 2.5.4-8.

d. At-Rest Earth Pressure Coefficient (Backfill) - The Design Criteria states a value equal to 0.7. Calculation X2CF-S-SF17 uses a value of 0.4.

Project Response

A. Modulus of Elasticity

E (Backfill):

E values were obtained from the Bechtel Power Corporation Report entitled, Report on Dynamic Properties for Compacted Backfill, February 1978, Table 2.

These values were grouped to represent the modulus for different backfill depth intervals and are correctly presented in the design criteria. Calculations will be generated to indicate the source references and procedure used to obtain the modulus of elasticity, E.

When estimating settlement of structures for the FSAR, a conservative uniform soil modulus of 1500 ksf was chosen from within the range given in the design criteria. Therefore, the modulus value of 1500 ksf was presented in the FSAR discussion of settlement.

E values of soil samples compacted to averages of 93 percent and 95 percent of the maximum dry density (ASTM D1557) were independently determined in Calculation No. X2CF-S-024. The results showed an average E-value of 1500 ksf. At 97 percent compaction, this E-value would be much higher which is consistent with the conservative assumptions made for settlement. Calculation No. X2CF-S-024 will be revised to clarify the source of the test results.

E (Dynamic - Backfill):

The dynamic moduli E-values shown in the design criteria were obtained using the low strain shear moduli, G, given in the Report on Dynamic Properties for Compacted Backfill, February 1978, and using the relationship between E and G. A set of calculations will be generated to show how the dynamic E-values were obtained.

E (Marl):

During the PSAR stage, the modulus of elasticity E for the marl was very conservatively taken as 4000 ksf. Subsequently, the marl shear wave velocity and Menard pressure meter data were used to arrive at a value of the modulus of elasticity.

This value of 10,000 ksf, specified in the project design criteria, was determined to be representative of the marl and yet remained a conservative estimate. The very conservative value of 4000 ksf was, in some cases, used in geotechnical calculations, notably specific settlement determinations in Calculation No. X2CF-S-101 where it was desired to insure a more conservative estimate. For this reason, the values of 4000 and 10,000 were both given in the FSAR. Based on the above discussion, there is no requirement to revise either the design criteria or the FSAR. The FSAR gives a conservative to very conservative range. The conservative value of 10,000 ksf was chosen for the design criteria. Calculation No. X2CF-S-101 will be revised to clarify the use of E = 4000 ksf.

E (Lower Sand):

The E-values for the lower sand stratum were derived from seismic shear wave measurements. This variation is shown in FSAR Figure 2.5.4-12 and was determined specifically for a detailed settlement evaluation. Calculations that resulted in these values will be finalized and included in the project calculation file. Calculations will include the basis of the representative value of 11,290 ksf value given in the design criteria for project use.

B. Shear Modulus

Both FSAR Table 2.5.4-9 and Design Criteria provisions were developed from the following Seed and Idriss equation provided in the footnote to FSAR Table 2.5.4-9:

$$G = 1000\ K_2\ (\sigma_m\ )^{\frac{1}{2}}\ \text{(See Associated Reports)}$$

The value of 79 is an average value for K_2, based on interpretation of laboratory test data (Report on Dynamic Properties for Compacted Backfill). The values provided in the FSAR table correspond to depths of 10, 25, 55, 70, and 90 ft, whereas the values provided in the design criteria correspond to depth ranges of 0-10, 10-20, 20-40, and 40-90 ft corresponding to depths of 5, 15, 30, and 65. The FSAR and the design criteria are therefore consistent.

Calculation No. X2CF-S-SF17 used the Seed and Idriss equation to obtain a shear modulus using a K_2 value of 64. In this calculation, K_2 was assumed using the Seed and Idriss original curves because experimental data on compacted backfill material had not been developed at that time. (Reference Response No. 13A-14 for a detailed discussion of this calculation).

C. Poisson's Ratio

In Calculation No. X2CF-S-032, a compression wave velocity was assumed while the shear wave velocity was measured. As a result, the Poisson's ratio was estimated to be 0.46 to 0.47. A value of 0.4 was chosen for design. In settlement calculations involving only elastic properties of soil, a Poisson's ratio approaching a value of 0.5 will result in lesser settlement than when the Poisson's ratio approaches 0.4. Since a Poisson's ratio of 0.4 results in more conservative estimates of settlements, this value is used in the design criteria as well as in the FSAR. A note will be added in Calculation No. X2CF-S-032 to clarify this point.

D. At-Rest Earth Pressures

The value of K_o of 0.4 used in the liquefaction analyses was based on the equation: $K_o = 1-\sin\phi$ where $\phi = 34°$ and is correct for that analysis. This will be clarified in Calculation No. X2CF-S-SF17.

Associated Reports:

Report on Dynamic Properties for Compacted Backfill, February 1978.

Root Cause of Finding:

Calculations did not strictly comply with procedures in that assumptions and cross references were not clearly provided.

Action Taken To Prevent Recurrence:

Reference response to Finding Nos. 13A-15 and 13A-18.

Future Commitments:

A. Generate calculations to show development of modulus of elasticity, E, by October 1, 1985.

   Modify Calculation No. X2CF-S-024 to clarify source of test results by October 1, 1985.

   Modify Calculation No. X2CF-S-101 to clarify use of modulus of elasticity by October 1, 1985.

B. Revise Calculation No. X2CF-S-SF17 to clarify assumptions by October 1, 1985.

C. Revise Calculation No. X2CF-S-032 by October 1, 1985.

D. Revise Calculation No. X2CF-S-SF17 by October 1, 1985.

IDR Assessment

A. The project response addresses the failure to fully document or clarify the various modulus of elasticity, E, values presented in project documents or used in calculations. The IDR team has reviewed the newly issued and/or revised calculations. Based on this review, the documentation of the deviation and use of E for the various site soils is satisfactory. No further action is required.

B. The project response satisfactorily explains different ranges of shear modulus, G, given in the FSAR and Design Criteria. The revised calculation was reviewed and the values of shear modulus were found to be satisfactory. No further action is required.

C. The value of Poisson's ratio used in the project calculations is acceptable. The revision to the referenced calculation satisfactorily addresses the IDR finding.

D. The project response satisfactorily explains the use of a K_o in the liquefaction calculation that is distinct from that value of K_o given in the Design Criteria.

Finding Level III

Finding 4 - Static Settlements for Category I Structures
(RRF 13A-9)

a. In Calculation X2CF-S-106, the updated predicted settlements were computed for the major plant structures, but no settlements were calculated for six smaller Category I structures. In Calculation X2CF-S-87, settlements were predicted for four of the six structures but the method of deriving E (backfill) was different and the effects of compression of the marl and lower sand were ignored.

b. The load of 8.1 ksf listed in the FSAR Table 2.5.4-12 for the Fuel Building is taken to be 6.3 ksf in calculation X2CF-S-106 for static settlement. No explanation is provided for this difference.

Project Response:

A. Settlement calculations for the plant structures, including four of six of the smaller structures, were originally performed excluding the contribution due to compression of the lower sand stratum (below the marl layer) by the structures and backfill. Calculation No. X2CF-S-106 was performed to incorporate the contribution of the lower sands into the predicted settlements for structures where applicable. The applicable structures analyzed were those that were either large, heavily loaded, or deeply imbedded, so that the contribution to settlement from the lower sand stratum was significant. The six smaller structures were not included because they did not significantly contribute to the compression of the lower sand stratum, nor were they significantly affected by the compression of the lower sand stratum because they were located near grade and thus constructed subsequent to compression of the lower sands by the backfill and other structures. Therefore, the original settlement calculations for the four smaller structures remain valid. Calculations were not performed for the two additional structures as it was felt that their settlements would be similar to the other four small structures for which calculations had been completed (Calculation No. X2CF-S-87). As addressed in Finding Nos. 13A-15 and 13A-18, these calculations will be revised to clarify these assumptions and conclusions.

B. The load of 8.1 ksf given in the FSAR for the Fuel Handling Building (FHB) is correct. The load of 6.3 ksf used in Calculation No. X2CF-S-106 is a preliminary estimate that was superceded by the 8.1 ksf value. This value was transmitted by the project to geotech along with values for all of the other structures. Calculation No. X2CF-S-106 will be revised to incorporate the correct value for the FHB. The correct values for the other structures were used in the calculation. The predicted settlement for the FHB will be increased. However, the total settlement to date is well within the value currently predicted and is stabilizing.

Associated Reports:

None

Root Cause of Finding:

The failure to incorporate the correct value in Calculation No. X2CF-S-106 was an oversight by the Responsible Engineer.

Action Taken To Prevent Recurrence:

Refer to Response for Finding Nos. 13A-15 and 13A-18.

Future Commitments:

Revise Calculation No. X2CF-S-106 by October 1, 1985, to incorporate the correct value and clarify its purpose and assumptions. Revise Calculation No. X2CF-S-87 to clarify its purpose, assumptions, and limitations relative to Calculation No. X2CF-S-106 by October 1, 1985.

IDR Assessment

A. The explanation for not performing additional calculations provided in the response adequately addresses the IDR observation. That is, the compression effect on the lower sands exerted by the smaller, near grade founded structures will not be significant. In addition, the revised calculation was reviewed and found to incorporate the clarifying assumptions and conclusions. Therefore, the project response satisfactorily addresses the IDR concern and no further action is required.

B. The revision to the settlement calculation incorporating the Fuel Handling Building (FHB) foundation load reported in the FSAR adequately addresses the finding. The revised calculation indicates that increasing the FHB load from 6.3 ksf to 8.1 ksf increased the predicted settlement from approximately 3 1/2 in. to slightly greater than 4 in.

Finding Level II

Finding 5 - Calculation of Factors of Safety Against Liquefaction (RRF 13A-10)

The liquefaction analysis performed in Calculation X2CF-S-S17 considered the free field case only. This approach was adequate for most of the structures that have either a small net positive static load or a net negative static load. There are, however, a few structures with net positive static loads on the order of 2-3 ksf. A verification of the factor of safety against liquefaction was not performed considering these net loads.

Project Response:

The factor of safety against liquefaction under "free field" conditions is normally expressed as the ratio between the stress ratio (dynamic shear stress to initial effective vertical stress) required to cause initial liquefaction, and the stress ratio induced by the given ground motion, i.e.,

$$\text{Factor of Safety against liquefaction} = \frac{\tau/\sigma_o' \text{ for initial liquefaction}}{\tau/\sigma_o' \text{ induced}}$$

When structures are present, three additional factors may need to be considered:

a. effect of initial static shear stresses, or K_α effect

b. effect of additional vertical stresses, or K_p effect

c. increase of the cyclic shear stresses on and above those corresponding to the free field condition (soil-structure interaction effect)

These three factors will be discussed below:

a. K_α effect

When a simple shear test sample of sand is subjected to an initial horizontal shear stress before the application of cyclic stresses, its resistance to liquefaction increases. If the ratio between the initial static shear stress and the initial effective vertical stress is called α, then by definition $\alpha = 0$ for the free field conditions. Typically, values of α range between 0.0 (free field) and $\alpha = 0.30$ for conditions under loaded areas and embankments.

Test results on many sands at a wide range of densities are available showing the increases in cyclic stress ratio required to cause initial liquefaction in tests conducted with different initial α. Thus, for example:

α	Cyclic Stress Ratio required to cause liquefaction, τ/σ_o'	$\frac{\tau/\sigma_o' \text{ for } \alpha = \alpha^*}{\tau/\sigma_o' \text{ for } \alpha = 0}$
0 (free field)	0.18	1.0
0.1	0.22	1.3
0.3	0.36	2.0

Clearly then, the application of initial shear stresses to the state of stress corresponding to the free field condition has beneficial effects on the soil resistance to liquefaction.

* Reference Associated Reports

b. K_p effect

Current practice in evaluating liquefaction potential consists of comparing the site under study with others whose performance during earthquakes are known. To do this, a characteristic property at the two sites is selected for the comparison (usually the standard penetration resistance). Taking this as a basis, the cyclic stress ratio required to induce liquefaction of a sand which has the given SPT values is read off an empirical chart. The data used in the preparation of that chart come from relatively shallow (less than about 40 feet) sand deposits, for which the effective vertical stresses are less than about 2500 psf.

Laboratory studies show that the stress ratio required to cause liquefaction in a given sand decreases as the effective confining pressure increases. Thus, in order to apply the data from the empirical chart to field conditions where a surcharge is applied, care must be taken to modify the stress ratio values from the chart by a factor K such that:

$$\frac{\tau}{\sigma_o'} = K_p \left(\frac{\tau}{\sigma_o'}\right)$$

K_p in the above equation is near 1 for values of σ_o' up to about 3000 psf.

Thus in the cases addressed in the review, the vertical loads applied by the structures have no effect on the free field situation of the liquefaction resistance of the subsurface sands.

c. Soil Structures Interaction Effect

Extensive dynamic soil-structure interaction studies by finite element modeling (The Pilgrim Nuclear Power Project for example) have shown that the small increases in dynamic shear stress due to interaction effects slightly increase the cyclic stress ratio, but this slight increase is compensated by a much larger increase in stress ratio to resist liquefaction due to the K_α effect, as discussed above. The overall net result is an increased resistance to liquefaction.

SUMMARY AND CONCLUSIONS:

The liquefaction potential of foundation sands below the structures addressed in the review was evaluated considering it to be a "free-field" condition. This was considered conservative, because:

a. The K_α effect, which increases liquefaction resistance by a factor potentially as large as 2 was ignored.

b. The increase in vertical stress due to structural loads has no effect on the stress-ratio required to cause liquefaction as obtained from empirical data.

c. Based on experience, the soil-structure interaction effect will not increase the potential for liquefaction for the loadings under consideration.

We therefore conclude that the liquefaction potential was properly studied and requires no additional review.

Associated Reports:

"Evaluation of Liquefaction Potential Using Field Performance Data", by H. B. Seed, I. M. Idriss, and I. Arango, Journal of Geotechnical Engineering, ASCE, Volume 109, March, 1983.

"Earthquake-Resistance Design of Earth Dams", by H. B. Seed, in "Seismic Design of Embankments and Caverns", Terry R. Howard, Editor, (Published by ASCE in 1983).

Root Cause of Finding:

Calculation did not strictly comply with procedures in that all assumptions were not clearly presented.

Action Taken To Prevent Recurrence:

Reference response to Finding Nos. 13A-15 and 13A-18.

Future Commitments:

Revise Calculation No. X2CF-S-SF17 to justify and clearly describe assumptions by October 1, 1985.

IDR Assessment

While the IDR team believes actual calculations are the best solution to a problem, the Project Response by explanation in this case is considered adequate. As described, the free-field case is the most conservative and results in the minimum factor of safety against liquefaction. In effect, introducing net positive loads onto the profile increases resistance to liquefaction within the soils loaded by that structure.

Finding Level III

Finding 6 - Calculation of Bearing Capacity (RRF 13A-11)

FSAR Table 2.5.4-12 contains the static and dynamic bearing capacities for the Category I structures, the Turbine Building, and the Radwaste Transfer Building. Documentation of input data for certain calculations has not been provided in that:

a. Calculation X2CF-S-103 does not develop the net static and dynamic pressures which are used to compute factors of safety.

b. The Turbine Building dynamic factor of safety is not computed in Calculation X2CF-S-103, but a value is given in FSAR Table 2.5.4-12.

Project Response

A. Although Calculation No. X2CF-S-103 does not present each algebraic step for each structure, it does develop the static and dynamic bearing capacity for the structures noted by the following approach:

   1. Summarizing the calculation procedure to be used and providing a specific example.

   2. Summarizing the input parameters.

   3. Summarizing the results in tabular form.

B. The static and dynamic bearing capacities for the VEGP structures were calculated by Geotech (Calculation No. X2CF-S-103) based on input received from the Project. The capacities for the Turbine Building were excluded from Revision 0 of the calculation pending input from SCS. Upon receipt of the input from SCS, the Turbine Building dynamic factor of safety was developed and the results reported in the FSAR. Calculation No. X2CF-S-103 has not been re-issued to incorporate this addition.

Associated Reports:

None

Root Cause of Finding:

Oversight by Engineering.

Action Taken To Prevent Recurrence.

Refer to the Response to Finding Nos. 13A-15 and 13A-18.

Future Commitments:

Calculation No. X2CF-S-103 will be revised to incorporate the calculation for the Turbine Building by October 1, 1985. Calculation will be reviewed and revised as necessary to provide all required data and references by October 1, 1985.

IDR Assessment:

A. The IDR team has reviewed Calculation X2CF-S-103 and concurs that the algebraic form to develop the net static and dynamic pressures and all input data are adequately summarized or presented. No additional clarifications or modifications to the calculation are required.

B. Including the Turbine Building dynamic factor of safety in the calculation satisfactorily addresses the finding.

Finding Level III

Finding 7 - Determination and Use of N_c, the Number of Cycles of Significant Motion in Liquefaction Calculations (RRF 13A-12)

An N_c value equal to 30 was originally selected for the Vogtle site referencing a 1971 report by Seed and Idriss, Simplified Procedure for Evaluating Soil Liquefaction. In 1975, Seed and Idriss issued an updated report in which N_c equal to 23 was determined to be suitable for a Magnitude 7.5 earthquake.

In Calculations X2CF-S-SF17 and X2CF-S-36, N_c values of 30 and 23 were used, respectively. Justify or resolve the use of these different values.

Project Response

The design SSE intensity for the site is VII-VIII. The N_c value of 30 cycles for an earthquake of a magnitude 8 was conservatively used in Calculation No. X2CF-S-SF17 for backfill compacted to 97 percent to calculate the factor of safety against liquefaction. This evaluation is conservative because the cyclic stress ratios for the compacted backfill decrease with the increase in stress cycles. Therefore, both values of N_c yield acceptable factors of safety against liquefaction for backfill compacted to 97 percent.

Calculation No. X2CF-S-36 was performed at a later date to study liquefaction for backfill compacted to 93 percent and 95 percent. The design value N_c of 23 cycles was used and an acceptable factor of safety was obtained. Backfill is placed at 97 percent in the field.

Associated Reports:

None

Root Cause of Finding:

Explanatory statement not included in Calculation No. X2CFS-SF17.

Action Taken To Prevent Recurrence:

Refer to the Response to Finding Nos. 13A-15 and 13A-18.

Future Commitments:

Calculation No. X2CF-S-SF17 will be revised to include a statement regarding the conservative use of an N_c value of 30 cycles by October 1, 1985.

IDR Assessment

The IDR team accepts the project response justifying the use of an extremely conservative N_c equal to 30 during the early stages of the project. In addition, the revised value of N_c equal to 23 used in later calculations remained highly conservative. No further action is required.

Finding Level III

Finding 8 - Permeability Determinations (RRF 13A-13)

The Groundwater Supplement Report, 1985, Section 3.1 states that all test data from 1971 to the present was reviewed and analyzed to determine representative permeability values. FSAR Section 2.4.13.1 contains average permeability values based on this test data. The permeability values for the Utley Limestone presented in Table 3-3 are developed in Calculation X2CF-S-107, and the Law Engineering Testing report of July 1972 contains some permeability values, shown in Table 3-1, for the upper sands based on grain size correlations.

Boring logs and field test data records constitute the back-up information for the remaining upper sand permeability results shown in Table 3-1 and for the Blue Bluff Marl permeability results shown in Table 3-2. However, no calculations were shown in Tables 3-1 and 3-2 or the average permeability values utilized in the analysis of radiological consequences (FSAR Section 2.4.13.1).

Project Response:

Calculations were performed to transform all field test data into the permeabilities shown in Table No. 3-2. Much of this analysis was performed in the early stages of the job prior to the temporary shutdown in 1974. At that time, there were no formal calculation procedures in the Hydro and Community Facilities Division (H&CF). The H&CF personnel performing this task did not retain this calculation. The results were merely tabulated in various logs and reports. Original data, however, were retained. The calculations determining permeability will be recreated and issued.

The "average" permeability values noted in the finding were neither averages nor the result of a numerical calculation. They were a conservative selection based upon a review of the data. Recreation of the calculations will include a summary indicating the basis for the selection of the representative values.

Associated Reports:

None

Root Cause of Finding:

Calculations do not conform to present procedural requirements. Hydro and Community Facilities (H&CF) is an independent, off-project group; the procedural discrepancies cited are related only to H&CF.

Action Taken To Prevent Recurrence:

Refer to the response for Finding Nos. 13A-15 and 13A-18.

Future Commitments:

Recreate permeability calculations and issue by October 15, 1985.

IDR Assessment

The recreation of the calculations transforming the field data into representative permeability values for upper sand and marl satisfies the IDR team. The calculations have been reviewed and do adequately address the finding. That is, the algebraic manipulations are correct, fully explained and the basis for the selection of the representative values is satisfactory.

Finding Level III

Fidning 9 - Document Inconsistencies (RRF 13A-14)

Inconsistencies exist between the referenced FSAR tables and the following reports:

a. FSAR Table 2.5.4-7 and Bechtel Report on Foundation Investigation, 1974 - the computed values of E and G are based on different soil densities from those shown in the table.

b. FSAR Table 2.5.4-9 and Bechtel Report on Dynamic Properties for Compacted Backfill, 1978 - Different values of the factor K_2 are given for backfill compacted to 97 percent of ASTM D1557.

c. FSAR Tables 2.5.4-10 and 2.5.4-11 and Bechtel Report on Test Fill Program Phase II, 1978 - The "percent of tests" numbers in the referenced tables are inconclusive as presented and are inconsistent with the referenced report.

Project Response:

A. The computed values of E and G shown in FSAR Table No. 2.5.4-7 are valid and are based on Table 3 of Bechtel Power Corporation's "Report on Foundation Investigation, 1974". The values shown in Table 3 of the Bechtel report were obtained from a report presented by Weston Geophysical Engineers, Inc., dated April 13, 1972, and are applicable only for a soil unit weight of 100 lbs/cubic ft. The FSAR values of E and G have been adjusted since the actual unit weight of the upper sand, marl and lower sand strata is 115 lbs/cubic ft. The column showing density in the FSAR table will be revised to show the correct densities.

B. There is no inconsistency between the values of K_2 for backfill compacted to 97 percent of ASTM D1557 shown in FSAR Table No. 2.5.4-9 and the Bechtel "Report on Dynamic Properties for Compacted Backfill". FSAR Table No. 2.4.4-9 shows a K_2 value of 79. Bechtel's report (Table 2, Page 11) also recommends a K_2 value of 79. The basis for the selection of the K_2 value of 79 is discussed in Bechtel's report (Page 7) and is summarized below.

   The K_2 value of 79 was based on data developed for 95 percent relative compaction and was an average of the upper and lower bound K_2 value. Subsequent data for 97 percent relative compaction yielded an average K_2 value of 82 for 97 percent relative compaction. Since the difference between K_2 for 95 percent and 97 percent relative compaction is very small (less than 4 percent), the value of K_2 of 79 was recommended for consistency.

   There are two instances in the calculations where a value of K_2 different from the design value of 79 was used. In both instances, the calculations were performed prior to the determination of K_2 in the laboratory.

Calculation No. X2CF-S-006 was performed to estimate the static modulus of elasticity of compacted backfill beneath the reactor pit of the Containment Building. In this calculation, K_2 was assumed as 60 based on published data for materials similar to the Vogtle soils. The results of this calculation were conservative because the use of the higher average measured value of $K_2 = 79$ would have yielded a static modulus higher than what was obtained in Calculation No. X2CF-S-006.

Calculation No. X2CF-S-SF17 addresses the liquefaction potential of backfill compacted to 80 percent relative density or 97 percent of the maximum density determined by ASTM D 1557. This calculation was performed in 1974, when no laboratory data for the parameter K_2 were available. Thus a value of $K_2 = 64$ was assumed in the analysis and this was based on standard curves compiled by Seed and Idriss (See Associated Reports, Reference 3). The analysis was performed using the SHAKE 3 computer program to determine maximum shear stress versus depth in the backfill. The analysis yielded a safety factor of approximately 1.9 against liquefaction. In 1978, Calculation No. X2CF-S-036 was performed to determine the factor of safety against liquefaction for backfill compacted to 95 percent of the maximum dry density determined by ASTM D 1557. The parameter K_2 was taken as 79 in the analyses based on laboratory test data. Maximum shear stresses induced during an SSE event were computed using the FLUSH computer program. The analysis yielded a safety factor of approximately 1.5. Thus the results of the calculations demonstrate that the use of both the assumed and laboratory determined values of K_2 produce an acceptable factor of safety against liquefaction. Calculations will be revised to provide proper documentation of assumptions and cross-referencing.

C. The term "less than" was inadvertently omitted in the columns showing 97 percent and 93 percent compaction on Table No. 2.5.4-10 of the FSAR. This term will be included in the revised version of the table. The "percent of tests" column in Table No. 2.5.4-11 will be changed to read "number of tests showing".

<u>Associated Reports</u>:

1. Seismic Survey and In-Situ Velocity Measurements, Weston Geophysical Engineers, Inc., 1972.

2. Report on Dynamic Properties of Compacted Backfill, Bechtel 1978.

3. Soil Moduli and Damping Factors for Dynamic Response Analyses by H. B. Seed and S. M. Idriss, University of California at Berkeley, Report EERC 70-10, December 1970.

<u>Root Cause of Finding</u>:

The lack of strict compliance with procedures is attributed to limited training and procedural enforcement.

Action Taken To Prevent Recurrence:

All Geotechnical calculations will be reviewed and revised as necessary to establish the required documentation (Refer to the response to Finding Nos. 13A-15 and 13A-18). The addition, a "roadmap" calculation will be created to establish the source of all design data reported in the FSAR.

Future Commitments:

- Revise calculations to establish documentation by October 15, 1985.

- Develop and issue "roadmap" calculation to support FSAR by November 1, 1985.

- Revise FSAR tables by August 31, 1985.

IDR Assessment

A. The revision to the referenced tables adjusting the values of E and G satisfies the IDR finding. No further action is required.

B. The project response satisfactorily explains the determination and use of the factor K_2. Initially, using the assumed lower value of K_2 and subsequently using greater values of K_2 based on laboratory testing, did not significantly affect the liquefaction analysis.

   Clarifications made to the liquefaction calculations have been reviewed by the IDR team and found to adequately explain, document and cross-reference the use of different values of K_2.

C. The modifications to the referenced FSAR tables satisfactorily addresses the IDR finding. No further action is required. In general, the IDR team believes the "roadmap" calculation that cross-references the design data presented in the FSAR with the project calculations adequately serves to clarify the project data sources.

Finding Level III

Finding 10 - Deviation Reports (RRF 13A-16)

a. Deviation Reports CD-353, CD-530, and CD-4186 did not include elevations when describing the location of the non-conformances.

b. The justification for the disposition of Deviation Report CD-3756 is not clear. Either the contractor could have been establishing the proper slope or could have been simply backfilling the area which would eventually bury the slopes.

c. The justification for the disposition of Deviation Report CD-2674 addressed the overall low frequency of "95 percent" density tests compared to "97 percent" density tests. The justification would be stronger if the location (plan and elevation) of the "95 percent" test results were evaluated in order to ascertain if they were concentrated in a given area or were widely dispersed.

Project Response

A. The elevations for Deviation Report Nos. CD-353 and CD-530 were available in other field documents and were not included in the Deviation Report sketches. These Deviation Reports are being re-issued to include the elevations. The elevation data for CD-4186 was available in the original and revision is not required.

B. Deviation Report No. CD-3756 was written to address slopes constructed steeper than allowed by specification. The slopes had been protected from erosion and showed no signs of sloughing. As noted in the Deviation Report justification, the slopes were in the process of being backfilled against and no additional rework was required. Deviation Report No. CD-3756 will be re-issued to include a description of field review regarding erosion protection and stability.

C. The justification for Deviation Report No. CD-2674 demonstrated that the specifics of how the tests were averaged was irrelevant since 98.5 percent of the tests were over 97 percent and no more than 0.7 percent were below 95 percent. The specification required only an average of 97 percent with no more than 10 percent below 95 percent.

   The dispersion of the few tests below 97 percent (approximately 100 tests out of 8000) is also addressed in the Deviation Report by referring to the distribution over the duration of the backfill program. It should be noted that the tests below 97 percent are not failing tests, but rather tests to be considered in averaging to meet the specification requirements for horizontal planes of backfill. The Deviation Report covers the period from October, 1977, to September 15, 1982. During this period, the number of tests below 97 percent were: 4 in 1977, 10 in 1978, 12 in 1979, 20 in 1980, 24 in 1981, and 29 in 1982, indicating that tests below 97 percent e not confined to any one period. In addition, compaction tes are sequentially numbered as they are performed and review of the data in the Deviation Report indicates the numbers are distributed throughout the program.

Based on the above discussion, it is concluded that the existing Deviation Report adequately justifies the approval, and that further evaluation of the plan and elevation location of the tests is not required. This conclusion has recently been reinforced by the standard penetration test program verifying that the fill is dense throughout its depth. In addition, a conservative evaluation of the field density test data has been performed and indicates the average percent compaction is 100 percent.

Associated Reports:

None

Root Cause of Finding:

Items A&B: Oversight by Project Field Engineering. Item C: None

Action Taken To Prevent Recurrence:

Oversights are minor and are not related to technical justification. No further action is required.

Future Comments:

Deviation Report Nos. CD-353, CD-530, and CD-3756 have been revised to provide the required data.

IDR Assessment

A. The project response outlining the re-issue of the referenced Deviation Reports (DR) as required adequately addresses the IDR findings.

B. The clarification to the referenced DR satisfactorily addresses the IDR finding.

C. The project response discussion with respect to the extremely low percentage of density tests below 95 percent compaction and the dispersion of these few tests throughout the site backfill adequately addresses this IDR finding. No further action is required.

Finding Level III

Finding 11 Settlement Marker Numbers (RRF 13A-17)

Specification X2AP01 Section C10.1 requires that "Settlement marker numbers be stencilled on a flat surface adjacent to the marker." During the site walkdown it was noted that there were no identification numbers at the marker locations.

Project Response

Past attempts to stencil marker numbers on flat surfaces near markers have met with limited success. Typically, in areas where stenciling was attempted, it was obliterated by construction activity. Further attempts were abandoned. It is therefore proposed to fabricate plaques containing marker numbers and attach them to permanent surfaces near the markers.

It should be noted that the marker number can always be determined by referring to the Structure Forming Drawings where the number and exact location are given.

The purpose of FSAR Figure 2.5.4.11, "LOCATION OF SETTLEMENT MARKERS," was to indicate the location of settlement markers in the power block structures. No commitments as to the miscellaneous notes on the design drawing from which the figure was made were intended. Therefore no revision of the FSAR is required.

Associated Reports

None

Root Cause of Finding

Georgia Power Company (GPC) construction chose to delay stenciling until construction interferences and deleterious activities had ceased.

Action Taken to Prevent Recurrence

None

Future Commitments

Install plaques by October 15, 1985. Specification No. X2AP01 C10.1 has been revised to allow the use of plaques.

IDR Assessment

The revision to the referenced specification mandating the installation of permanent plaques and the commitment to their installation satisfies the IDR finding. No further action is required on the part of the project.

Finding Level III

7.6 CONCLUSIONS

The Independent Design Review (IDR), conducted by Stone & Webster Engineering Corporation, evaluated the technical content of the design documents relating to the geotechnical design of the Category I foundations on a sample basis. The documents reviewed included calculations, engineering reports, design criteria, specifications, drawings, and deviation reports.

The IDR initially identified a total of 11 findings. Upon the presentation of additional information to the IDR team, one of them was classified as a nonfinding. The remaining ten findings have all been classified Level II (one) or Level III (nine) since they were assessed to be documentation deficiencies with no safety concerns.

The most significant finding (13A-15/Level III) by the IDR team resulted from the collective nature of seven of the findings which related to either calculations or design criteria. Specifically, the IDR review process revealed inconsistencies in the use of such items as soil moduli and building loads, incomplete documentation of design assumptions, the absence of certain calculations as support for design values, and overall lack of attention to detail in the calculation preparation process. The IDR team considered the calculations, design criteria, and associated cross-referencing to the FSAR to be insufficient in detail, documentation and accuracy. This resulted in a commitment by the project to review and revise, as necessary, all project geotechnical calculations.

In order to evaluate the adequacy of the responses to five of the individual findings and the collective finding (13A-15), the IDR team found it necessary to review numerous revised or newly created calculations. These calculations have been found to be satisfactory by the IDR team. Since these calculations reviewed by the IDR team represent approximately one-half of the total population which was reviewed and revised in response to Finding 13A-15, the IDR team concludes that the project has correctly implemented the corrective action committed to.

In summary, all of the IDR findings have been satisfactorily resolved. The IDR team has concluded that, due to good engineering judgement incorporated into the project documents and a very conservative basis for design, these findings have not resulted in any physical impact or impact on licensing commitments.

APPENDIX 7A

INDEPENDENT DESIGN REVIEW PLAN

X7BD102-IDRP 13-1
Stone & Webster Engineering Corp.
Boston, MA
J.O. No. 15224

Independent Design Review Plan
Vogtle Electric Generating Plant
Module No. 13
Foundations

Approval:

Team Leader Wayne E. Kilker Date: June 10, 1985

IDRG Manager J.P. Allen for S.C. Hamm Date: 6/11/85

0104-1522401-B4T

1.0 Objective

This portion of the Independent Design Review (IDR) addresses the technical adequacy of the geotechnical engineering and specific geologic subjects for Plant Vogtle.

The purpose of this review plan is to define the scope, the review method and the activities necessary in order to make an assessment of the design.

2.0 Scope

The effort will consist of a review of:

1. Geology sections of licensing documents

2. Design Criteria (pertains to all Category I structures)

   Backfill and marl properties, laboratory test reports, subsurface conditions, field tests

   Calculations relating to Design Criteria

      Design groundwater level and aquifer characteristics, static and dynamic soil properties, general bearing capacity

      Lateral Earth Pressure (static and dynamic)

      Slope Criteria

      Allowable bearing pressures

3. Design Calculations

      Bearing Capacity
         cooling towers (marl founded)
         refueling water tank (backfill founded)

      Settlement (static, dynamic, differential)
         containment (marl and backfill founded)
         control building (backfill)
         auxiliary building (marl)

      Liquefaction
         compacted backfill
         diesel generator building (backfill)
         condensate storage tank (backfill)

      Permeability

      Deep Foundations
         radwaste solidification building caissons (Category II) (marl founded)

Turbine Building Foundation (Category II)
- bearing capacity
- settlement
- liquefaction

4. Specifications
   - Site investigation
     - borings
     - geophysical surveys
     - groundwater
   - Site and Site Related Work
   - Heave and Settlement Monitoring
   - Deep Foundations

5. Construction Procedures
   - settlement monitoring
   - groundwater control and monitoring
   - excavation
   - backfill placement and testing
   - deep foundation installation
   - field testing

6. Deviation Reports (DR)
   A sample of DRs covering the following areas will be selected:
   - foundation preparation
   - backfill placement
   - excavation and dewatering
   - settlement monitoring

7. Site Walkdown
   - Core samples
   - Ongoing backfill operations
   - Ongoing observation well installation
   - Settlement markers and benchmarks

The review will be conducted to ascertain whether the Plant Vogtle licensing commitments have been incorporated into the engineering and design of Category I plant foundations. The review will include licensing commitments, design criteria, codes and standards, drawings, specifications, technical reports and calculations.

3.0 Review Method

The Independent Design Review (IDR) for this module will evaluate project design criteria, calculations, drawings, specifications, and design change documentation. This review will encompass the documents listed in Attachment 1. Independent verification calculations will not be prepared during this review.

The reviewers will use the FSAR as a basis to understand the project licensing commitments. A representative sample of calculations will be selected for detailed review. The design criteria will be evaluated to ascertain whether the commitments have been correctly translated into the document through codes, standards and calculations.

Design calculations will be evaluated for agreement with the design criteria, the proper use of codes/standards and allowable design stresses and limits.

The design specifications and construction procedures will be reviewed to ascertain whether the information from design calculations has been correctly incorporated. Applicable specifications and a representative number of construction procedures will be reviewed.

The review of Category II foundations for the turbine building and radwaste solidification building will be done to ensure that the design precludes conditions that may jeopardize adjacent Category I structures. The review will include liquefaction, bearing capacity, settlement and lateral stability of these foundations.

A sample of Deviation Reports (DR) covering founding conditions, backfill, dewatering, settlement monitoring, and deep foundations will be selected for review. The reviewer will evaluate the engineering basis of the dispositions.

There will be an overview of field construction and testing procedures, field and laboratory test reports, and soil/rock samples obtained during subsurface investigations and maintained by GPC.

The site walkdown will include observations of settlement monitoring markers, existing site soil and groundwater conditions and ongoing backfilling or other foundation related activities.

4.0 Schedule

Activity	Location	Date
Review Plan Preparation	SWEC Boston, MA	5/23 to 6/7
Design Review Plan Approval	SWEC Boston, MA	6/14
Site Walkdown and Review of Specifications, Procedures and Test Results	Plant Vogtle	6/17 to 6/21
Review of Project Engineering Calculations and Engineering Reports	Bechtel Office Norwalk, CA	6/24 to 6/28
Review of Turbine Building Foundation Design Calculations	Southern Company Services Birmingham, ALA	7/1 to 7/2
Reviewer Reports	SWEC Boston, MA	7/8

Activity	Location	Date
Findings of Review Submitted	SWEC Boston, MA	7/12
Draft Module Report for SWEC Review	SWEC Boston, MA	8/7
Module Report for Review Board	SWEC Boston, MA	8/7

DOCUMENTS

A. Readiness Review Task Force Module No. 13 - Licensing Commitment Matrix

B. PSAR (Chapter 2.5) and FSAR (Chapters 1.9, 2.4, 2.5, 3.7)

C. Design Criteria
General Design Criteria DC-1000-C
Grading and Earthwork DC-2146

D. Geotechnical Reports

1. Bechtel Power Corporation. Report of Foundation Investigations, Alvin W. Vogtle Nuclear Project. July 1974.

2. Bechtel Power Corporation. Report of Backfill Material Investgations, Alvin W. Vogtle Nuclear Project. January 1978

3. Bechtel Power Corporation. Report of Backfill Material Investigations, Alvin W. Vogtle Nuclear Project. Addendum No. 1, October 1978

4. Bechtel Power Corporation. Report of Backfill Material Investigations, Alvin W. Vogtle Nuclear Project. Addendum No. 2, November 1979

5. Bechtel Power Corporation. Report of Dynamic Properties for Compacted Backfill, Alvin W. Vogtle Nuclear Project. February 1978

6. Bechtel Power Corporation. Test Fill Program, Phase II, Alvin W. Vogtle Nuclear Project. October 1978

7. Bechtel Power Corporation and Georgia Power Company. Final Report on Dewatering and Repair of Erosion in Category 1 Backfill in Power Block Area. August 15, 1980

8. Bechtel Power Corporation. Report of Marl Investigation. Vogtle Nuclear Power Plant, December 1974

E. Geotechnical Design Calculations

Design Criteria Calculation relating to:
- design groundwater level and aquifer characteristics
- static and dynamic soil properties
- general bearing capacity
- settlement

Bearing Capacity
- cooling tower
- refueling water tank

Settlement (static, dynamic, differential)
- containment
- control building

Liquefaction
- compacted backfill
- diesel generator building
- condensate storage tank

Deep Foundations
- radwaste solidification building caissons

Turbine Building Foundation Design

F. Civil Drawings (relating to earthwork, foundations, dewatering, etc.)

G. Civil-Structural Construction Specification; Spec. No. X2AP01

Site and Site Related Work, Division C2
Heave and Settlement, Division C10
Piles, Division C12

H. Field Procedures (relating to Spec. No. X2AP01)

Reviewer's Assignments

Reviewer	Area of Review
W. Kilker J. McCoy	Geotechnical Engineering
R. Skryness	Geology

APPENDIX 7B

REVIEW TEAM MEMBERS

MODULE 13A

IDR REVIEW TEAM

W.E. Kilker (Team Leader)
J.W. McCoy
R.S. Skryness

APPENDIX 7C

DOCUMENTS REVIEWED

1. General Design Criteria (Civil Structural) DC-1000-C, Rev. 3, Alvin W. Vogtle Nuclear Plant Units 1 and 2. September 30, 1983.

2. Vogtle Electric Generating Station Units 1 and 2, PSAR Sections 2.5.1 and FSAR Sections 2.4.12, 2.4.13, 2.5.1, 2.5.4, 2.5.5, and Appendix 2B.

3. Bechtel Power Corporation. Report of Foundation Investigations, Alvin W. Vogtle Nuclear Project. July 1974.

4. Bechtel Power Corporation. Report of Backfill Material Investigations, Alvin W. Vogtle Nuclear Project. January 1978.

5. Bechtel Power Corporation. Report of Dynamic Properties for Compacted Backfill, Alvin W. Vogtle Nuclear Project. February 1978.

6. Bechtel Power Corporation. Test Fill Program, Phase II, Alvin W. Vogtle Nuclear Project. October 1978.

7. Bechtel Power Corporation and Georgia Power Company. Final Report on Dewatering and Repair of Erosion in Category I Backfill in Power Block Area. August 15, 1980.

8. Bechtel Power Corporation, Ground Water Supplement, Vogtle Electric Generating Station. March 1985.

9. Bechtel Power Corporation. Settlement Review, Plant Vogtle. September 1984.

10. Specification No. X2AP01, Civil Structural Construction Specification for the Georgia Power Company, Alvin W. Vogtle Plant, Units 1 and 2, Burke County, Georgia.

    a. Section No. C2.2, Rev. 13, "Earthwork and Related Site Activities."

    b. Section No. C2.18, Rev. 9, "Piezometers and Dewatering Wellpoints."

    c. Section No. C2.19, Rev. 0. "Standard Penetration of Category I Backfill."

    d. Section No. C10.1, Rev. 7, "Obtaining and Recording Foundation Settlement Data."

11. Calc. No. X2CF-S-SF04, Rev. 0, "Max. Compacted Dry Density and Optimum Moisture Control."

12. Calc. No. X2CF-S-SF07, Rev. 0, "Summary of Unconsolidated Undrained Triaxial Test Results and Calculations of Elastic Modulus."

13. Calc. No. X2CF-S-SF08, Rev. 0, "Consolidated Undrained Triaxial Test Results and Elastic Modulus."

14. Calc. No. X2CF-S-SF09, Rev. 0, "Void Ratio and Compression Index."

15. Calc. No. X2CF-S-SF11, Rev. 0, "Stresses and Settlements Under Various Structures."

16. Calc. No. X2CF-S-SF17, Rev. 0, "Liquefaction Analysis - Induced Shear Stress by Earthquake and Liquefaction Potential in Compacted Fill."

17. Calc. No. X2CF-S-007, Rev. 0, "Lateral Pressure on Auxiliary Building North Wall."

18. Calc. No. X2CF-S-017, Rev. 0, "Static Modulus of Elasticity of Marl from Soils Data."

19. Calc. No. X2CF-S-024, Rev. 0, "Static Young's Modulus cf Compacted Sand, Silty Sand."

20. Calc. No. X2CF-S-025, Rev. 0, "Strength Parameters of Compacted Sand, Silty Sand."

21. Calc. No. X2CF-S-032, Rev. 1, "Dynamic Soil Properties."

22. Calc. No. X2CF-S-033, Rev. 0, "FLUSH Model for Liquefaction Study."

23. Calc. No. X2CF-S-036, Rev. 0, "Liquefaction Analysis 95% Compaction - Final Soil Properties."

24. Calc. No. X2CF-S-037, Rev. 0, "Earthquake Induced Settlement."

25. Calc. No. X2CF-S-087, Rev. 0, "Settlement of Condensate Storage Tanks, Auxiliary Feedwater Pumphouse/RWST, RMWST, and Pipe Tunnels."

26. Calc. No. X2CF-S-097, Rev. 0, "Computer Printouts for Geotech Calcs (Soils)."

27. Calc. No. X2CF-S-101, Rev. 0, "Differential Settlement (Containment and Fuel Building)."

28. Calc. No. X2CF-S-103, Rev. 0, "Backup Calcs for Revised Table 2.5.4-12 of FSAR (Bearing Capacity Analysis)."

29. Calc. No. X2CF-S-105, Rev. 0, "Review of Measured Settlement."

30. Calc. No. X2CF-S-106, Rev. 0, "Settlement Analysis."

31. Calc. No. X2CF-S-107, Rev. 0, "Analysis of Dewatering Data."

32. Calc. No. pending, "Settlement Review," Civil/Structural Calculation.

33. Drawing AX2D55V001, Rev. 10, "Settlement Observation Markers, Location and Detail."

34. Drawings AX2D55V002 through AX2D55V063, Settlement Records and Graphs.

35. Deviation Reports:

CD-49	CD-1413	CD-4320
CD-228	CD-1476	CD-4339
CD-257	CD-1913	CD-4847
CD-331	CD-2320	CD-4913
CD-348	CD-2336	CD-5476
CD-353	CD-2552	CD-5514
CD-459	CD-2674	CD-5636
CD-530	CD-2741	CD-5793
CD-604	CD-2847	CD-5940
CD-639	CD-2965	CD-6241
CD-780	CD-3125	CD-6255
CD-947	CD-3756	CD-6484
CD-1102	CD-3968	CD-6788
CD-1230	CD-3998	CD-7519
CD-1301	CD-4186	

36. Seed, H. B. and Idriss I. M., A Simplified Procedure for Evaluation of Soil Liquefaction Potential. Journal of Soil Mechanics and Foundation Division, ASCE, Vol. 97, No. SM9, 1971.

37. Seed, H. B., Arango, I. and Chan, C. K., Evaluation of Soil Liquefaction Effects During Earthquakes. Report No. EERC 75-28, College of Engineering, University of California, Berkeley, 1975.

38. Seed, H. B. and Idriss, I. M. Soil Moduli and Damping Factors for Dynamic Response Analyses. Report No. EERC 70-10, University of California, Berkeley, December 1970.

39. Shannon & Wilson, Inc. and Agbabian - Jacobsen Associates, Soil Behavior Under Earthquake Loading Conditions, Interim Report No. 1 for the USAEC.

40. Procedure SU-T-01, Rev 3, Plant Vogtle, Survey Control, Field Procedure Manual.

APPENDIX 7D

PERSONNEL CONTACTED

The following persons were contacted during the site walkdown at the Vogtle Plant during the week of June 17 through 21, 1985:

J. Carlton	Surveying Supervisor
W. Davis	Construction Engineer
B. Fairley	QC Senior Inspector (Soils Lab)
R. Powell	Document Control Supervisor
G. White	Document Control Data Processing
L. West	Geotechnical Engineer (Bechtel)
T. Crosby	Geologist (Bechtel)
L. Robison	Civil Engineer (Bechtel)

The following persons were contacted during the review at Bechtel Corporation's Office in Norwalk, California, during the week of June 24 through 28, 1985:

M. Malcom	Assistant Project Engineering Manager
F. Wend	Manager Geotechnical Services
M. Perovich	Civil Structural Engineer
Z. Yazdani	Geotechnical Engineer
D. Ho	Geotechnical Engineer
H. Rao	Geotechnical Engineer
M. Wolfe	Geologist

8.0 PROGRAM ASSESSMENT/CONCLUSIONS

8.1 SUMMARY OF OPEN CORRECTIVE ACTION

8.1.1 SECTION 6.1 ENGINEERING

Corrective actions committed to by Project Engineering have been completed as of November 14, 1985.

There are no open items.

8.1.2 SECTION 6.2 CONSTRUCTION

- Finding 13A-1

  Action: FSAR change notice number 239 initiated on August 20, 1985, needs to be incorporated into the FSAR.

  Responsible Organization: Project Licensing

  Completion Date: December 16, 1985

- Finding 13A-2

  Action: FSAR change notice number 240 initiated on August 20, 1985, needs to be incorporated into FSAR.

  Responsible Organization: Project Licensing

  Completion Date: December 16, 1985

8.2 QA STATEMENT

The process for the development of this module was monitored by the Readiness Review Quality Assurance (QA) staff for general adequacy.

The primary focus of the monitoring effort was the identification, documentation, analysis, and resolution of Readiness Review Findings. The finding reports issued by the Readiness Review Team and their responses were reviewed, both individually and collectively, for root causes and generic issues; i.e., trends. Based upon review of the responses and commitments to individual finding reports and generic concerns, the resolutions were determined to be adequate. All findings were initially distributed to project QA for review for reportability [10 CFR 21, 10 CFR 50.55(e)] in accordance with existing QA procedures. In addition, findings were screened by Readiness Review to determine whether any required additional evaluation by the project for reportability. None were identified.

Other monitoring activities consisted of reviewing personnel qualification and training records for the team members, reviewing the verification plan, and reviewing completed checklists to assure adequate identification of findings. Additionally, an independent reverification was performed on a sampling basis under Readiness Review QA overview to determine the adequacy of the Commitment/Implementation Matrixes and the Design/Construction verification efforts.

Based upon these monitoring efforts, this module and the Readiness Review Team conclusions are judged to be acceptable.

John H. Draggs
John H. Draggs
Readiness Review Team
Quality Assurance Representative

George C. Bell
George C. Bell
Readiness Review Team
Quality Assurance Representative

TECHNICAL CONSULTANT'S CERTIFICATION

On the basis of review of this Module 13A Report of Foundations and Backfill, and appropriate project documents such as construction specifications, engineering reports, design criteria and selected drawings, I certify that to the best of my belief and knowledge the information and conclusions contained herein are factually and technically correct. Under the program described in Section 4 of this report and on the basis of corrective action described in Sections 6 and 7, the commitments of the Vogtle Electric Generating Plant Final Safety Analysis Report are being implemented. The analysis, design and construction programs that relate to foundation materials and backfill have produced a final product that meets design requirements and licensing commitments.

William O. Martin

William O. Martin, PE

Foundation Materials and Backfill - Module 13A

Readiness Review Board Acceptance

The Readiness Review Board has been apprised of the scope and content of Module 13A, Foundation Materials and Backfill.

The Board has reviewed the program verification as well as corrective actions, both proposed and implemented, by the Vogtle Project. Based upon this review and based upon the collective experience and professional judgment of the members, the Readiness Review Board is of the opinion that the corrective actions are acceptable, and that the Foundation Materials and Backfill Program at Plant Vogtle is sound and complies with commitments set forth in the FSAR and acceptable practices.

APPROVED: Doug Dutton DATE: Nov. 20, 1985

Doug Dutton
Chairman, Readiness Review Board
Vogtle Electric Generating Plant

Georgia Power Company
Project Management
Post Office Box 282
Waynesboro, Georgia 30830
Telephone 404 724-8114
404 554-9961

Southern Company Services, Inc.
Post Office Box 2625
Birmingham, Alabama 35202
Telephone 205 870-6011

Vogtle Project

Date: November 19, 1985

Re: Plant Vogtle - Units 1 & 2
Readiness Review Module 13A
File: X7BD102
Log: SS-5402

From: O. Batum

To: W. C. Ramsey

Engineering has reviewed Module 13A, Foundations and Backfill, for general accuracy and completeness. To the best of our knowledge and belief, the module is a complete and accurate representation of the Foundations and Backfill, and the engineering process and commitments related thereto.

Ozen Batum
Ozen Batum
General Manager, Project
Engineering - Vogtle

xc: Project File

Georgia Power Company
Project Management
Route 2, Box 299A
Waynesboro, Georgia 30830
Telephone 404 724-8114
404 554-9961

Vogtle Project

DATE: August 21, 1985

RE: Plant Vogtle - Units 1 & 2
Readiness Review Module 13A

FROM: M. H. Googe

TO: W. C. Ramsey

Nuclear Construction has reviewed Module 13A excluding the referenced appendices. To the best of our knowledge and belief, the module is a complete and accurate representation of the Foundation Preparation and Backfill Installation Program and commitments related thereto.

M. H. Googe
Project Construction Manager II
Vogtle Nuclear Construction Department

0204B

8.6 RESUMES

The resumes which follow present a brief professional listing of those people instrumental to the development of Module 13A.

JOSEPH V. DAWSEY, Senior Design Engineer, Team Member

Mr. Dawsey began his employment with Georgia Power Company in 1982.

His 13 years of engineering experience have involved structural seismic design, analysis, and evaluations; material handling system design; feasibility and developmental studies for offshore facilities; and various hydro, fossil and nuclear generating plant assignments.

Mr. Dawsey has over 7 years of nuclear experience.

Education:

Mississippi State University
B.S., Civil Engineering

P.E., State of Louisiana

RAMON F. DINSDALE, Senior Field Engineer, Team Member

Mr. Dinsdale has been employed by Bechtel Power Corporation since 1969.

Eight of his 16 years of generating plant construction experience were in the nuclear field. He has held the positions of field engineer, area engineer, lead civil engineer and scheduler. Mr. Dinsdale has extensive computer assisted engineering experience.

Education:

Utah State University
B.S., Civil Engineering
M.S., Civil Engineering

W. RODGER DUNCAN, Construction Engineer, Team Member

Mr. Duncan began his employment with Georgia Power Company in 1979.

Mr. Duncan has held positions in civil and mechanical engineering departments in the fields of soils, steel and concrete structures, and HVAC.

Education:

Georgia Institute of Technology
Bachelor of Civil Engineering

JOEL GALT, Senior Design Engineer, Team Member

Mr. Galt has worked for Georgia Power Company since 1979. He has had nuclear experience since 1980 when he was assigned to the Edwin I. Hatch Nuclear Plant, Unit 2 Modification Outage Support Team. He has performed duties ranging from concrete design to geotechnical investigations.

Education:

Georgia Institute of Technology
Bachelor of Civil Engineering
M.S., Civil Engineering

P.E., State of Georgia

BILL LUNDEEN, Engineering Geologist, Team Member

Mr. Lundeen began his career with Bechtel Power Corporation in 1978.

Mr. Lundeen has 31 years experience in field and office studies in engineering geology and mining geology with the last 20 years specializing in major engineering structures such as fossil fuel and nuclear power plants, dams, and reservoirs.

Education:

University of California, Los Angeles
B.A., Geology

ROBERT W. McMANUS, Assistant Project Construction Manager, Construction Discipline Manager

Mr. McManus has been with Georgia Power Company for over 11 years, 5 of them on direct assignment at the Vogtle Electric Generating Plant. He was most recently responsible for the quality acceptance of Civil, Electrical, and Mechanical portions of VEGP. Responsibilities other than management of personnel included reviewing Field Change Notices to design drawings for acceptance, contact with Engineering Quality Assurance on acceptability of the site quality program, construction contact for the Nuclear Regulatory Commission for their quality audits, and performing departmental audits of site construction activities for design compliance.

Education:

Southern Technical Institute
B.S., Civil Engineering Technology

JOE E. SEAGRAVES, Quality Control Section Supervisor, Team Leader

Mr. Seagraves began employment with Georgia Power Company as a co-op student in 1969. Since receiving his degree, he has held the positions of civil and mechanical shift engineer, instrumentation section supervisor, and mechanical surveillance section supervisor.

All of Mr. Seagraves' 12 years of experience with Georgia Power Company has been nuclear related.

Education:

Tennessee Technological University
B.S., Civil Engineering

M. R. THAKAR, Project Engineer, Team Leader

Mr. Thakar has been employed by Bechtel Power Corporation since 1965.

He has over 15 years of nuclear power construction experience and has held supervisory and engineering management positions at San Ononfre Nuclear Generating Station, Vogtle Electric Generating Plant, Palo Verde Nuclear Generating Station, and the South Texas Nuclear Project.

Other engineering experience involves fossil fuel electric generating plants and various industrial construction projects.

Education:

Sardar Vallabhbhai University (Gujarat State, India)
B.S., Civil Engineering

University of Iowa
M.S., Civil Engineering

Pepperdine University, Los Angeles, California
Master of Business Administration

P.E., State of California
P.E., State of Georgia

WILLIAM M. WRIGHT, Mechanical Project Engineer, Design Discipline Manager

Mr. Wright has over 12 years of nuclear power plant experience in mechanical design. He was most recently responsible for managing a group of engineers and pipe designers involved in BOP system design and pipe/pipe support design activities for the Vogtle Electric Generating Plant. He was also involved in several design control evaluations conducted on the Vogtle project which involved technical audit/INPO type reviews of Bechtel, Georgia Power, and Westinghouse organizations. Mr. Wright was also an engineering group leader for BOP system design activities on plant Vogtle; a design engineer for developing in-service inspection plans (per ASME XI) on the Farley Nuclear Power Plant; and a design engineer on the Barton Nuclear Power Plant where he developed P&IDs, developed system calculations, developed hazards analyses for NSSS and safety-related systems, and participated in writing the Barton PSAR.

Education:

University of Alabama
B.S., Mechanical Engineering
M.S., Mechanical Engineering

P.E., State of Alabama